

## How fairness concerns shape strategic pricing for national and store brands under ecommerce platform leadership

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### ABSTRACT

Driven by the robust growth of ecommerce and the ongoing upgrading of consumer demand structures, the development and strategic layout of private store brands by ecommerce platforms have emerged as a key development trend in the global retail industry. This industrial shift not only grants platforms stronger channel bargaining power and wider profit margins, but also fundamentally reconstructs the traditional channel power structure that was long dominated by national brand manufacturers. Against this backdrop, this study takes a two-tier supply chain consisting of a national brand manufacturer and an ecommerce platform as the research object. Under the channel power structure where the ecommerce platform serves as the leader in the Stackelberg game, we build game models integrating the fairness preference behaviors of supply chain members, to systematically explore the heterogeneous effects of brand advantage, store brand quality perception, and fairness concerns on the pricing strategies and revenue performance of all supply chain participants. The empirical results indicate that in the fairness neutrality scenario, the ecommerce platform's leadership can significantly boost the revenue of all supply chain members. However, the fairness concerns of the national brand manufacturer are not always conducive to its own benefits, and may even impair the ecommerce platform's revenue. When the commission rate exceeds a specific critical threshold, overemphasis on fairness may even trigger a drop in the manufacturer's own revenue. For the ecommerce platform, the revenue contribution of its fairness concern behaviors is heavily dependent on the level of the commission rate, and only exerts a positive promotion effect in the high commission rate scenario. In addition, under the ecommerce platform's leadership, the increase of the commission rate has a positive driving effect on the retail prices of both national brand and store brand products, while the promotion effect of brand advantage on product quality is restricted by specific parameter thresholds. This study enriches the comparative research on store brand supply chain management under different channel power structures, extends the behavioral operation theory of supply chain members with fairness preference, and offers a new analytical perspective for investigating the core operational decision-making mechanisms of ecommerce supply chains.

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## 1. Introduction

With the iterative upgrading of information technology over the past few years, the global e-commerce industry has maintained a sustained and rapid growth momentum. From a global perspective, the e-commerce market has shown a continuous expansion trend, with consumers' shopping behaviors gradually shifting from offline physical channels to online platforms, and both the user scale of ecommerce platforms and the total transaction volume have maintained a year-on-year growth trend. According to the 55th Statistical Report on China's Internet Development released by the China Internet Network Information Center (CNNIC) in 2024, the number of online shopping users in China had reached 974 million, representing a year-on-year increase of 59.47 million, and accounting for 87.9% of the country's total Internet users<sup>1</sup>. Meanwhile, the proportion of online shopping consumption in residents' total consumption expenditure has been rising steadily. Data from the National Bureau of Statistics of China shows that in 2022, China's total online retail sales reached 13.79 trillion yuan, nearly 10 times the scale in 2012<sup>2</sup>. The ecommerce industry has thus achieved remarkable progress and has become an important driving force of economic growth. Over the past decade, the number of ecommerce platforms has grown exponentially, with new platforms

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continuously emerging in an attempt to secure a foothold in this limited market space. In addition to long-established comprehensive e-commerce giants, social ecommerce platforms such as Douyin and Xiaohongshu have attracted large numbers of consumers to participate in online shopping through innovative formats such as product-recommendation “seeding” and live-streaming commerce<sup>3</sup>, thereby further increasing the complexity of industry competition. As the e-commerce market gradually approaches saturation, consumer demand has tended to stabilize. New entrants wishing to break through in these mature product categories must therefore seek differentiated paths. Moreover, consumers have raised their expectations regarding product quality and other attributes, which compels ecommerce platforms to continuously invest resources in product innovation to meet increasingly diverse consumer needs; otherwise, they are highly likely to be eliminated in the context of fierce market competition.

As an emerging retailing format, store brands not only provide consumers with a broader range of choices but also expand firms’ market space, thereby attracting increasing attention from platform enterprises. With the development of online retailing and the rising power of platforms, some online platforms are no longer content to function solely as large virtual marketplaces and have begun to develop their own store brands to enter end markets directly. Well-known ecommerce platforms have actively expanded their store-brand portfolios, such as Jingzao, Jingxuan, Jiabai, and Baxian under JD.com, and Amazon Basics under Amazon. Ecommerce market is growing really fast and brands stores too. There are newer and tougher times in the competition arena. As for power structure, product quality, supply chain, etc., it’s evident. And especially in the midst of them, it is the fairness concerned over supply chain players that has the greatest clout to make the ecommerce environment blossom.

From the perspective of power structure, the introduction of store brands has significantly transformed the original balance of power in ecommerce markets. In traditional ecommerce settings, incumbent brand manufacturers, by virtue of multiple advantages, typically enjoy strong bargaining power in their cooperation with platforms and hold a dominant position in product quality control and pricing decisions. For example, in the high-end cosmetics segment, national brands such as Esté e Lauder and Lancôme rely on their unique formula R&D capabilities, strict production processes, and deeply embedded brand images. Even in the face of intensive promotion of store-brand cosmetics by ecommerce platforms, these brands can still capitalize on consumers’ strong willingness to pay a brand premium and act as price leaders in their respective niche markets. By contrast, ecommerce platforms that develop store brands can cooperate directly with upstream suppliers, reduce intermediary stages, and, drawing on their extensive big-data resources, gain insights into consumer needs and rapidly adjust the design, features, and prices of their store-brand products. In doing so, they acquire greater bargaining power in negotiations. This model further strengthens platforms’ authority within the supply chain, while exposing national brand manufacturers to intensified competitive pressure. As a result, platforms are no longer merely channels for product distribution but also become product creators and one of the rule-setters in the marketplace. At the same time, the rise of store brands exerts a pronounced crowding-out effect on national brands, particularly small and medium-sized ones. The fact that both ecommerce platforms and national brand manufacturers may potentially assume the role of market leader renders competition in e-commerce markets increasingly complex and multifaceted.

In the power game of e-commerce supply chains, fairness considerations have also emerged as a critical variable influencing pricing decisions. With the evolution of market structures, the ecommerce platform assumes the dual roles of a referee by formulating sales rules and a player by selling store brand products directly to consumers. This dual role not only triggers channel conflicts but also ignites deep-seated crises regarding fairness perception in profit distribution. When national brand manufacturers held supply chain dominance, their pricing decisions often prioritized their own returns while neglecting the platform’s fairness appeals. However, as store brands emerge and expand, the market landscape has shifted significantly. Leveraging robust traffic advantages and data resources to precisely target market demand, and utilizing its rule-making power to guide merchant strategies, the platform directs more attention and resources toward its store brands. This comprehensive elevation allows the platform to secure a leadership position, posing a direct challenge to the market share of national brands. Within this competitive landscape, national brand manufacturers and ecommerce platforms strive for individual financial optimization while emphasizing the equitable allocation of surplus value. Disproportionate sharing may compromise collaborative ties and threaten the structural integrity and evolution of the supply chain as a whole.

Based on the above, we look at the pricing decision problem of the platform dominated ecommerce supply chain which has store-brands (hereinafter referred to as “SB”) and fairness. We build a two-tier supply chain game-theoretic model made up of a national brand (hereinafter referred to as “NB”) manufacturer and an ecommerce platform. We research and examine 3 different fairness situations that have the optimal pricing strategy. The non-fair case, the manufacturer is fair case and the platform is fair case. This paper will choose a brand advantage, as well as different commission rates, and consumers’ preference for stores as objects, conducting a multi-scenario deep comparison of the driving and sensitivity to choosing prices, so as to discover more about the decision-making involved in the choices people make in different behavioral modes.

The primary academic contributions of this work are detailed below:

(1) We innovatively integrate store brand introduction and fairness concerns into a unified analytical framework. By systematically deriving and comparing equilibrium strategies under three heterogeneous scenarios, including the fairness-

neutral case, the manufacturer-fairness-concerned case, and the platform-fairness-concerned case, it characterizes the gaming dynamics arising from the platform's dual role. This provides a theoretical reference for understanding how irrational behaviors reshape pricing mechanisms in store brand supply chains characterized by asymmetric power structures.

(2) Through numerical simulation and sensitivity analysis, this paper thoroughly dissects the interactive effects of three core variables, namely brand competitive advantage, platform commission rate, and consumer preference, on optimal decisions. The research clarifies strategic differences under distinct fairness concern configurations, offering managerial implications for mitigating channel conflicts between NB manufacturers and platforms and achieving Pareto improvements for the supply chain in complex co-opetition environments.

The rest of this paper will be organized as follows. Section 2 provides a comprehensive survey of the existing literature and delineates the contributions of this research. Section 3 introduces the formulation of the game theoretic framework and derives the equilibrium solutions. Section 4 performs a multi dimensional comparison of different behavioral scenarios and conducts sensitivity analysis using numerical examples. Finally, Section 5 summarizes the research findings and offers managerial implications as well as potential directions for future research.

## 2. Literature review

Our study examines price determination strategies within a platform SB distribution network that incorporates behavioral fairness considerations under ecommerce platforms leadership. Reflecting the specific attributes of this research, we organize and review the related literature along three main streams: (1) research on the adoption of store brands; (2) research on consumer fairness concerns; (3) research on pricing decisions in supply chains.

### 2.1 Research on the adoption of store brands

Studies on the implications of introducing SB generally encompass two dimensions: (i) the drivers of store-brand introduction and (ii) the consequences following their introduction. Regarding the drivers, some scholars adopt the retailer's perspective and argue that SB can improve the overall profitability of retail platforms; therefore, profit considerations constitute the most powerful motivation for introducing SB (Wang et al., 2008). Research on the consequences of store-brand introduction has been conducted primarily from the perspectives of retailers, manufacturers, and consumers. From the retailer's perspective, Liu and Fu (2019) analyze how retailers' introduction of SB affects ordering strategies under information asymmetry. Li (2017) investigates the influence of store brand adoption on supply chain decisions, with particular attention to how different power structures shape member decision-making. Li et al. (2022) examine retailers' optimal market-encroachment strategies when they offer both high-quality and low-quality SB offerings. The results demonstrate that the implementation of premium SB facilitates higher channel earnings and improves consumer welfare. From the manufacturer's perspective, Cai and Nie (2019) study how an ecommerce platform's store-brand strategy affects manufacturers' choice of sales formats and find that the commission fee represents a critical factor in determining the favored sales strategy of the producer subsequent to the launch of a platform SB. Chakraborty et al. (2022) explore the competitive dynamics of product quality involving NB and SB within various power frameworks. They conclude that the quality of the SB could potentially surpass that of the NB, despite the SB maintaining a lower price point. Zhong and Nie (2023), focusing on suppliers' adoption of SB, examine its effects on product-line extension strategies. Their results indicate that suppliers have opportunities to introduce SB when they possess substantial production cost advantages, and that such introduction may be detrimental to manufacturers' product-line extension. From the consumer's perspective, Assarzadegan et al. (2024) find that increased advertising investment by the NB manufacturer and superior product quality foster long term consumer loyalty toward NB. And their results indicate that launching high quality SB serves as an economically advantageous strategy for ecommerce platforms.

Existing literature suggests that the advent of SB in the market can have negative impacts on producers, specifically by reducing the market share belonging to established NB and narrowing the profit margins of manufacturers (Scott & Zettelmeyer, 2004; Meza & colleagues, 2010). Consequently, numerous academic works have analyzed the competitive dynamics involving SB and products belonging to NB manufacturers. For example, Liao et al. (2020) investigate the ideal quality decisions made by retailers and the related relative values within six different frameworks combining various price leadership structures and procurement alternatives. Their findings indicate that launching a SB with high quality can exacerbate the rivalry between NB manufacturers and retailers acting as SB providers, which eventually advantages the retailers. Fang et al. (2013) explore, within a reselling model, the strategic choice of a retailer regarding the adoption of a SB as well as its optimal pricing. Their conclusions imply that the marginal cost related to quality serves as a vital factor for the motivation of a retailer to establish a SB. Furthermore, to address the subsequent competitive tension, the NB manufacturer might also adopt a SB concurrently with the retailer. Ru et al. (2015) contest the perspective that SB offerings inevitably damage the welfare of NB manufacturers. Amaldoss and Shin (2015) examine the consequences of a multi-tier SB strategy on supply chain earnings. They observe that even though the widespread adoption of SB leads to lower product diversity, it fails to negatively impact the well being of consumers or the holistic profitability of the channel. Additionally, they demonstrate that SB are capable of diminishing the profits of manufacturers and can make a two part tariff contract inadequate for achieving channel coordination.

In summary, a substantial body of research has examined SB, with primary emphases on the antecedent drivers of store-brand introduction, the introduction decision itself, and the ensuing pricing decisions and market impacts. However, research specifically addressing SB in e-commerce supply chains remains relatively limited. Although some studies have investigated ecommerce platforms' decisions to introduce SB, most treat the introduction decision as exogenous and do not focus on SB introduction within the framework of agency selling.

### *2.2 Research on consumer fairness concerns*

Fairness concern refers to the tendency of players in a game to attend not only to their own absolute payoffs but also to compare their payoffs with those of other participants, thereby assessing whether the allocation of benefits is fair. A number of studies, using ultimatum bargaining experiments and dictator game experiments, have verified the presence of fairness preferences in laboratory settings and argue that such fairness motives can lead to systematic deviations from standard game-theoretic predictions (Forsythe et al., 1994; Harrison and McCabe, 1996; Oosterbeek et al., 2004). Pizzi and Scarpi (2020) show that consumers' concerns about distributive fairness influence their perceived product value and trust in retailers, which in turn affect purchase intentions and word-of-mouth communication. Hride et al. (2022) examine the connections among the perceived equity of prices, consumer devotion, fulfillment, and confidence. Hamzah and Pontes (2024) suggest that the perception of price fairness serves as a mediating variable for the impact of consumer perceived value on their intent to purchase. Diao et al. (2023) investigate the time variant pricing strategies of companies under consumer fairness considerations. Their results indicate that within a two period supply network, behaviors driven by fairness considerations can result in win win outcomes for both NB manufacturers and retailers. Furthermore, companies might avoid utilizing structured pricing frameworks as a means to alleviate the possible negative consequences of fairness concerns. Regarding the management of sales channels, Yi et al. (2018) find that when consumer fairness concerns are strong, it is more advantageous for manufacturers to sell through retailers, conversely, when fairness concerns are weak, manufacturers are better off selling directly to consumers via offline company-owned stores. Regarding channel choice, Pu et al. (2019) analyze how fairness concerns along vertical and horizontal dimensions affect manufacturers' channel-format selection. Their results suggest that when vertical fairness concerns are low, manufacturers should choose an online direct-selling channel, whereas when such concerns are high, an online agency selling format is preferred. Yu et al. (2022) show that the behavioral fairness considerations of consumers can adversely impact the financial earnings of retailers and result in reduced market prices for NB as well as SB. Furthermore, given specific circumstances, such fairness considerations can successfully discourage retailers from launching SB.

### *2.3 Research on pricing decisions in supply chains*

Pricing-decision models have undergone a long process of development. Prior to the late 1970s, academic research on pricing models was relatively scarce. This situation began to change after Monroe and Della Bitta (1978) highlighted the importance of integrated pricing-decision models, which subsequently stimulated the development of a large number of pricing models (Monroe & Della Bitta, 1978). Li et al. (2020) establish a two stage analytical framework to scrutinize how an ecommerce platform optimizes markdown pricing and digital coupon selection in the presence of strategic purchasing behavior. Their study accounts for three distinct electronic redemption mechanisms, specifically immediate, continuous, and hybrid approaches. Zhu et al. (2022) examine the effects of conspicuous consumption on firms' pricing and quality decisions as well as profitability. Wang et al. (2024) provide a systematic analysis of how reference price effects influence manufacturers' pricing, channel demand, and revenues. Allender et al. (2021) explore the linkage between price discrimination strategies and issues of price obfuscation and fairness. Gallego and Berbeglia (2024) propose a non-personalized heuristic pricing approach applicable across multiple models. Gong et al. (2022) analyze the time variant management of stock and pricing strategies within the framework of an aggregate baseline commitment agreement. Hafizoğlu et al. (2016) study product pricing in settings where both contract customers and spot buyers coexist. Rahmani and Yavari (2019) examine how demand disruptions affect decision-making within an environmentally oriented two channel supply network. Their findings demonstrate that shocks to market demand can motivate the enhancement of environmental quality attributes in products. Furthermore, when such consumption shifts result in an enlarged market scale, the corresponding equilibrium prices exhibit an upward trajectory. Wu et al. (2023) analyze the impacts of stochastic demand on product pricing and green decisions, noting that demand uncertainty does not necessarily exert a negative effect on either product price or greenness. Peng et al. (2023) incorporate the joint effects of corporate social responsibility and manufacturers' risk preferences, while scrutinizing pricing plus green innovation directions. They evaluate a green supply chain subject to market volatility, featuring diverse CSR involvement.

Overall, although a substantial body of research has examined pricing decisions for store-brand products, most of it is situated in traditional supply chain contexts. Moreover, existing studies typically consider the effects of either fairness concerns or power structure as a single factor shaping store-brand pricing strategies. Research on SB pricing in e-commerce supply chains remains relatively limited, with prior work focusing primarily on boundary conditions for SB adoption and the choice of sales mode. Accordingly, studies that jointly examine how power structure and fairness concerns interact to influence platform store-brand pricing strategies are still scarce.

## **3. Model**

This paper establishes a two-tier supply chain model, one that consists of a NB producer and an ecommerce platform

(hereinafter referred to as “e-platform”). It meticulously looks into the most appropriate pricing strategies that supply chain members can make under three different scenarios. Furthermore, by comparing the strategic differences across these scenarios, this study deeply dissects the impacts of critical factors, such as brand advantage, commission rates, and consumer preference for SB, on pricing decisions. Below, we detail the baseline model and key assumptions.

3.1 Problem Description and Basic Assumptions

We consider an ecommerce supply chain framework comprising a NB manufacturer and an e-platform that maintains a SB. Following the structure in Figure 1, the NB manufacturer is responsible for manufacturing recognized brand offerings and distributing these items to buyers through an agency sales arrangement while remitting a specific percentage of sales as commission to the e-platform. Within this setting, occupying the position of market leader, the e-platform utilizes the platform data strengths to acquire accurate understanding regarding consumer preferences for holistic product quality, such as performance and safety. As a result, the platform dictates the product quality level for the market, particularly in terms of standards and monitoring mechanisms, which has a fundamental impact on the whole industry.

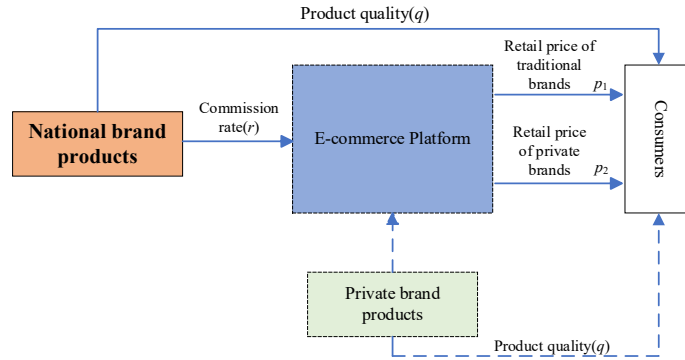


Fig.1. Supply chain architecture under e-platform leadership

Within this framework, the NB manufacturer initially establishes the quality standards for the market. Following this stage, the e-platform and the NB manufacturer finalize the pricing for their individual offerings at the same time. Buyers then evaluate their options according to considerations including the subjective quality assessment of the SB as well as the overall quality level of the products. Table 1 summarizes the specific notations and variables utilized in this section.

Table 1 Symbols and Explanations of the Model Under the Leadership of e-platform

Symbol	Meaning
$a$	Potential market volume of the product
$N$	E-platform leadership
$N-\square$	The superscript $N-\square$ denotes the scenario of e-platform leadership $\square$ fairness concern. $\square = \{1, 2\}$ , where 1 represents NB and 2 represents SB
$i$	The subscript $i = \{1, 2\}$ , where 1 represents NB and 2 represents SB
Parameters	
$\theta$	Brand advantage of well-known brand products
$t$	Quality perception coefficient
$r$	Commission rate
$\tau_i$	Fairness concern coefficient of member $i$
Decision Variables	
$p_1$	Retail price of NB products
$p_2$	Retail price of SB products
$q$	Quality level
Other Symbols	
$d_i$	Market demand of $i$
$\pi_i^N$	Profit of $i$ in the $N$ scenario
$U_i^{N-\square}$	Utility of $i$ in the $N-\square$ scenario
*	Optimal solution

Based on the above description, the model adopts the following basic assumptions:

(1) This study defines the strategic relationship as a Stackelberg game under complete information where the e-platform serves as the leader.

(2) The e-platform is expected to operate as a marketplace which corresponds to an agency sales arrangement. Within this framework the NB manufacturer distributes products via the e-platform and allocates a specific percentage of its total earnings to the platform according to a commission rate  $r$  ( $0 < r < 1$ ). We treat  $r$  as an exogenous parameter, consistent with operational practice (Zhang & Liang, 2012; Bian et al., 2025).

(3) The platform has the capacity to manufacture its own SB offering, namely an SB product. This item resides in the identical classification as the NB. The platform serves customers within a marketplace where the total potential market volume is  $a$ . Furthermore, the unit manufacturing expenses for both the NB and SB offerings are considered equivalent (Wang et al., 2024).

(4) Because the NB manufacturer is more capable in product design and production, the NB typically enjoys stronger brand loyalty than the SB. Prior research also suggests that even when SB quality is comparable to that of well-known brands, consumers still tend to prefer NB. Accordingly,  $\theta$  is defined as the brand advantage of NB relative to SB (Zhang & Hou, 2022).

(5) Given that NB manufacturers specialize in product design and production, NB typically enjoy higher brand loyalty compared to SB. Furthermore, scholarly evidence suggests that although SB quality may align with that of NB offerings, buyers often maintain a persistent favoritism for NB products. As a result, this research stipulates that  $\theta$  denotes the brand advantage of NB relative to SB.

(6) Let  $t_1$  denote consumers' perceived sensitivity to product quality. For analytical convenience, we normalize  $t_1 = 1$  and set  $t_2 = t$  with  $0 < t < 1$  (Chen et al., 2011).

(7) The expenditures linked to quality enhancement for the NB manufacturer as well as the e-platform SB are defined by the function  $c_q = \frac{q^2}{2}$ .

(8) We employ  $\tau_1$  to represent the degree of fairness concerns for the NB manufacturer while  $\tau_2$  identifies the platform fairness concern intensity. Elevated values of  $\tau$  signify a more robust orientation toward distributive equity on the part of the producer or the e-platform.

### 3.2 Model Development and Solution under E-Platform Leadership

#### 3.2.1 E-platform leadership: Fairness neutrality

This section examines price determination within an ecommerce supply network under a specific environment where all participants exhibit fairness neutral behavior. Within this framework, occupying the role of market leader, the e-platform drives the decision process whereas the NB manufacturer performs as the follower. Initially, the e-platform establishes the level of product quality  $q$ . Following this stage, both the e-platform and the NB manufacturer finalize the pricing for their specific offerings,  $p_2$  and  $p_1$ , independently. Based on the previously stated framework, consumer requirements regarding the NB manufacturer and the e-platform products are formulated as follows:

$$d_1 = a + \theta - p_1 + q \quad (1)$$

$$d_2 = a - p_2 + tq \quad (2)$$

Consequently, the profit expressions for the NB manufacturer as well as the e-platform are formulated as follows:

$$\pi_1 = (1-r)d_1p_1 - \frac{q^2}{2} \quad (3)$$

$$\pi_2 = rd_1p_1 + d_2p_2 - \frac{q^2}{2} \quad (4)$$

Following this, we derive the equilibrium results through backward induction. During the subsequent phase of the game, both

the NB manufacturer and the e-platform establish their individual retail prices to ensure the optimization of their respective profits. By evaluating the first order conditions represented by  $\partial\pi_1/p_1 = 0$  and  $\partial\pi_2/p_2 = 0$ , yields  $p_1^N = \frac{a+\theta+q}{2}$  and  $p_2^N = \frac{a+q}{2}$ . In the initial stage the NB manufacturer specifies the product quality level to reach the maximum profit possible.

By incorporating  $p_1^N$  and  $p_2^N$  into profit function  $\pi_2$  and solving  $\partial\pi_2/q = 0$  yields the optimal quality level. Holding the above second-stage conditions unchanged, we can obtain the equilibrium outcome.

**Lemma 1.** In the environment where the e-platform occupies the role of market leader the equilibrium solutions are presented below:

$$q^{N*} = \frac{(a+\theta)r+at}{2-r-t^2} \tag{5}$$

$$p_1^{N*} = \frac{(a+\theta)t^2-at-2a-2\theta}{2(t^2+r-2)} \tag{6}$$

$$p_2^{N*} = \frac{[(1-t)a-t\theta]r-2a}{2(t^2+r-2)} \tag{7}$$

By inserting the derived optimal values into Eqs. (3) and (4), we yield the equilibrium profits for the NB manufacturer and the e-platform as follows:

$$\pi_1^{N*} = \frac{K_1a^2+2\theta K_2a+\theta^2 K_3}{4(t^2+r-2)^2} \tag{8}$$

$$[(t^2-2t+3)a^2+2\theta(t^2-t+2)a+\theta^2(t^2+2)]r^2 + [(t^4-2t^3-3t^2+12t)a^2+2\theta(t+2)(t^3-3t^2+2t+2)a] \tag{9}$$

$$\pi_2^{N*} = \frac{+\theta^2(t^2-2)^2]r+2a^2(t^2+2)}{4(t^2+r-2)^2}$$

where,

$$K_1 = (1-r)t^4 - 2(1-r)t^3 - [3(1-r)+2]t^2 + [8(1-r)-4]t - (2r^2+4r-4) ;$$

$$K_2 = (1-r)t^4 - (1-r)t^3 - 4(1-r)t^2 + [4(1-r)-2]t - (2r^2+4r-4) ; K_3 = (1-r)t^4 - 4(1-r)t^2 - (2r^2+4r-4).$$

Based on Lemma 1, we obtain the following proposition:

**Proposition 1.**

- (1)  $\frac{\partial q^{N*}}{\partial \theta} > 0$ ,  $\frac{\partial p_1^{N*}}{\partial \theta} > 0$ ,  $\frac{\partial p_2^{N*}}{\partial \theta} > 0$ ;
- (2) When  $0 < r < r^*$ ,  $\frac{\partial \pi_1^{N*}}{\partial \theta} > 0$ ; when  $r^* < r < 1$ ,  $\frac{\partial \pi_1^{N*}}{\partial \theta} < 0$ ;
- (3)  $\frac{\partial \pi_2^{N*}}{\partial \theta} > 0$ .

Proposition 1(1) indicates that even though product quality specifications are decided by the e-platform, the competitive edge held by the NB manufacturer continues to be of paramount importance. The platform anticipates that the NB manufacturer will sustain high product quality, thereby utilizing the brand’s existing prestige to generate traffic and strengthen the platform’s total competitiveness. An increase in brand advantage implies higher consumer favor; consequently, to foster better cooperation and maximize its own interests, the platform encourages the NB manufacturer to sustain or even elevate product quality. For instance, as an e-platform, JD.com expects well-established NB like Apple to continuously provide high-quality electronics to bolster the platform’s quality image in the 3C digital category. As the NB’s advantage grows, consumers become more inclined to purchase NB products, leading to increased traffic for the platform. This heightened consumer goodwill toward the platform further stimulates market demand for its SB.

Proposition 1(2) reveals that the extent to which brand advantage influences the NB manufacturer’s earnings is contingent upon the commission rate and consumers’ perceived quality of the SB. Specifically, within a low commission rate interval  $0 < r < r_{22}$ , the NB manufacturer yields higher profits as its brand advantage intensifies. This is because the platform and the

NB manufacturer avoid cooperative conflicts triggered by excessive commission rates, making both parties more inclined toward stable, long-term collaboration. Recognizing the value brought by the NB's advantage (in terms of traffic and platform image), the platform is willing to allocate reasonable resources, such as premium display slots and marketing recommendations. Leveraging these resources, the NB manufacturer can further enhance product exposure and sales conversion rates, thereby driving revenue growth. In contrast, within the high commission rate interval ( $r_{22} < r < 1$ ), an inverse relationship is observed where the NB manufacturer's profitability declines as its brand advantage strengthens. This phenomenon arises because an elevated commission rate imposes a heavier cost burden on the manufacturer. Since raising retail prices to offset this cost would trigger significant customer attrition, the manufacturer is trapped in an unfavorable pricing position. Consequently, to preserve market competitiveness, price hikes are constrained, leading to severe erosion of profit margins.

Proposition 1(3) reveals that when acting as the market leader, the e-platform derives greater financial returns as the NB's advantage intensifies. This is because the growth in NB advantage attracts a large volume of consumers to the platform, thereby increasing overall platform traffic and the number of potential customers, which in turn enhances sales opportunities and total revenue.

**Proposition 2.**

$$(1) \frac{\partial q^{N^*}}{\partial r} > 0;$$

$$(2) \frac{\partial p_1^{N^*}}{\partial r} > 0, \text{ when } 0 < r < r_2, \frac{\partial \pi_1^{N^*}}{\partial r} < 0; \text{ when } r_3 < r < 0.5, \frac{\partial \pi_1^{N^*}}{\partial r} < 0;$$

$$(3) \frac{\partial p_2^{N^*}}{\partial r} > 0, \frac{\partial \pi_2^{N^*}}{\partial r} > 0.$$

As revealed in Proposition 2, with the e-platform acting as the leader, a higher commission rate drives an improvement in product quality and simultaneously pushes up the retail prices for both the national and SB. However, the trajectory of the NB manufacturer's revenue is non-monotonic: it declines when the commission rate is at either the lower ( $0 < r < r_2$ ) or higher ( $r_3 < r < 0.5$ ) spectrum but rebounds during the intermediate interval ( $r_2 < r < r_3$ ). In contrast, the platform's earnings show a strict monotonic increase as the commission rate rises.

The underlying rationale is that when the e-platform assumes a dominant market position and levies a higher commission rate, it channels a fraction of the surplus earnings into upgrading product quality. Consequently, quality standards rise in tandem with the commission rate. This simultaneous escalation in commission fees and quality inputs inevitably drives up operational costs. To preserve their profit margins, both the NB manufacturer and the platform are compelled to transfer this financial burden to consumers, resulting in elevated retail prices. Although consumers generally favor premium goods, meaning quality enhancements can stimulate demand despite price hikes, the correlation between the NB manufacturer's earnings and the commission rate follows a non-linear pattern. Specifically, within the low commission bracket ( $0 < r < r_2$ ), the adverse effects of cost inflation and demand suppression overshadow other benefits, causing the NB manufacturer's income to shrink as the rate climbs. Likewise, in the high commission bracket ( $r_3 < r < 0.5$ ), prohibitive pricing severely stifles demand growth despite quality improvements; the loss in sales volume negates any gains from higher unit prices, triggering a further decline in revenue. Conversely, within the intermediate interval ( $r_2 < r < r_3$ ), the demand-stimulating effect of quality becomes dominant, and the revenue benefits from price increases surpass the rising costs, thereby boosting the NB manufacturer's total income. In contrast, the e-platform's revenue exhibits a strict monotonic increase with the commission rate, as commissions represent a core income stream. Irrespective of fluctuations in demand or the retail prices of NB and SB, the platform captures higher revenue from every transaction.

**Proposition 3.**

$$(1) \frac{\partial q^{N^*}}{\partial t} > 0;$$

$$(2) \frac{\partial p_1^{N^*}}{\partial t} > 0, \text{ when } 0 < t < t_1, \frac{\partial \pi_1^{N^*}}{\partial t} < 0; \text{ when } t_1 < t < 1, \frac{\partial \pi_1^{N^*}}{\partial t} > 0;$$

$$(3) \frac{\partial p_2^{N^*}}{\partial t} > 0, \frac{\partial \pi_2^{N^*}}{\partial t} > 0.$$

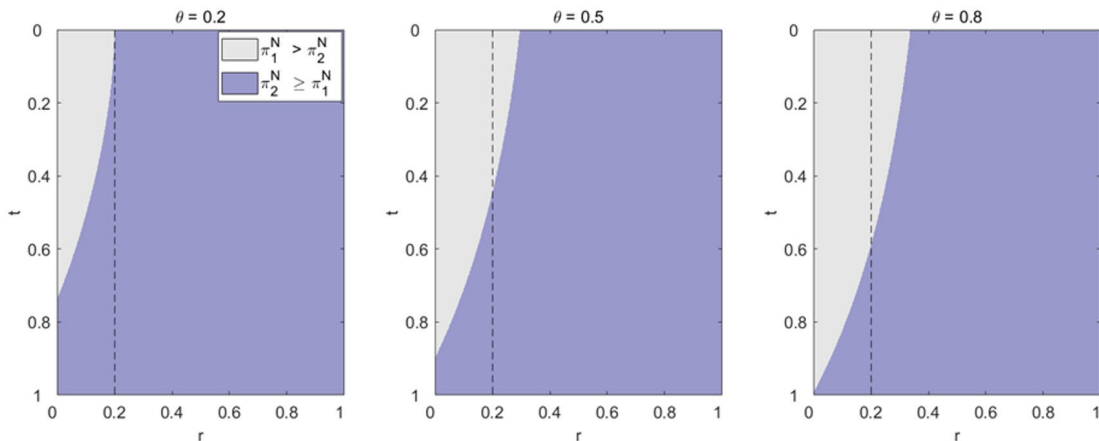
Proposition 3 reveals that, within e-platform-led framework, a higher quality perception coefficient drives improvements in product quality, while simultaneously pushing up retail prices and market demand. Regarding profitability, the NB manufacturer experiences a reversal in fortune: its revenue initially declines when the quality perception coefficient is in a lower range ( $0 < t < t_1$ ), but rebounds and exhibits a positive growth trend once the coefficient exceeds a certain threshold ( $t_1 < t < 1$ ). In contrast, the e-platform enjoys a strict monotonic increase in revenue as the coefficient rises. The underlying mechanism is that as consumers become more sensitive to the quality of SB, the platform is incentivized to ramp up quality investments. Although this upgrades product standards, it inevitably inflates costs. Consequently, both the NB manufacturer and the platform are compelled to transfer this financial burden to consumers through higher retail pricing.

With the enhancement of consumer recognition regarding the SB, its sales performance naturally climbs. This shift raises the bar for quality across the board, leading consumers to project attributes of reliability and expertise onto the NB manufacturer due to its incumbent status. This phenomenon, effectively a cognitive spillover, catalyzes a surge in demand for the NB. However, within the lower threshold of the quality perception coefficient ( $0 < t < t_1$ ), this demand expansion is insufficient to counterbalance the heavy expenditures required for quality improvement. Consequently, the escalating costs outstrip the financial benefits derived from higher prices and volume, resulting in a downward trajectory for the NB manufacturer's revenue. In contrast, when the quality perception coefficient reaches a high level ( $t_1 < t < 1$ ), the spillover effect on consumer perception becomes substantial, leading to a significant surge in market demand. Moreover, consumer price tolerance increases at this stage, allowing sellers to raise prices appropriately. The combined effect of increased sales volume and higher prices then drives up the NB manufacturer's total revenue. From the perspective of the e-platform, a rise in the quality perception coefficient will lift the market demand for both national and SB, which in turn enlarges the overall transaction scale on the platform. The platform's revenue growth is achieved through two channels: the commission income obtained from the growing transaction volume of NB, and the increased revenue brought by the expanded sales scale of its proprietary SB.

**Corollary 1.**

- (1)  $p_1^N > p_2^N$  ;
- (2) When  $\theta < \frac{3}{4}$ ,  $\pi_1^N < \pi_2^N$  always holds; when  $\theta > \frac{3}{4}$  and  $\frac{2}{5} < r < 1$ ,  $\pi_1^N < \pi_2^N$  ; when  $\theta > \frac{3}{4}$  and  $0 < r < \frac{2}{5}$ ,  $\pi_1^N > \pi_2^N$ .

Corollary 1 demonstrates that when the e-platform serves as the market leader, the SB has a more favorable pricing edge over the NB, while the e-platform's revenue does not consistently outperform that of the NB manufacturer. By virtue of its market leading position, the e-platform holds stronger pricing authority, which allows it to boost market competitiveness through optimizing the retail pricing of its SB products. In the platform-dominated market structure, the revenue comparison between the two stakeholders is presented in Figure 2. When the brand advantage value is below 0.75, it means the NB has relatively constrained market influence. Under this circumstance, the e-platform's decisions on product quality levels can impose a more significant effect on consumers' purchase decisions. By rolling out SB products that match consumer demand preferences, the platform draws in a large consumer group, and thus gains considerable sales revenue from its SB business. On the other hand, when the brand advantage of the NB is above 0.75, the NB retains strong market influence and consumer stickiness. Consumers' trust and recognition allow the NB to occupy a dominant position in market competition. Even though the e-platform makes the upfront quality-related decisions, consumers still show a stronger preference for NB products. Nevertheless, under a high commission rate setting, the larger the sales scale of the NB manufacturer on the platform, the more commission revenue the e-platform can obtain. This part of revenue can effectively make up for the revenue gap of SB product sales.



**Fig. 2.** Impacts of  $r$  and  $t$  on the profits of both parties under e-platform leadership

### 3.2.2. E-platform leadership: Fairness concerns of the NB manufacturer (N-1)

In the scenario where the NB manufacturer holds fairness concern preferences while the e-platform maintains fairness neutrality, the NB manufacturer pays greater attention to the fairness of profit distribution within the supply chain, and takes the maximization of its fairness-concern utility as the core decision goal. Under this model setting, the NB manufacturer's optimization objective is characterized by the following fairness-adjusted utility function:

$$\begin{aligned} U_1^{N-1} &= \pi_1 - \tau_1(\pi_2 - \pi_1) \\ &= [(1-r)d_1p_1 - \frac{q^2}{2}] - \tau_1\{[rd_1p_1 + d_2p_2 - \frac{q^2}{2}] - [(1-r)d_1p_1 - \frac{q^2}{2}]\} \end{aligned} \quad (10)$$

The e-platform's utility function remains its profit function:

$$U_2^{N-1} = rd_1p_1 + d_2p_2 - \frac{q^2}{2} \quad (11)$$

In the e-platform-led Stackelberg game scenario (N-1), the e-platform serves as the first mover and determines the product quality level  $q$ , followed by separate decision-making on product retail prices  $p_1$  and  $p_2$  by the NB manufacturer and the e-platform respectively. The market demand and revenue functions applied in this scenario are fully consistent with those specified in case N-1. Following the standard backward induction method, we first derive the equilibrium retail prices for NB and SB products: the NB manufacturer and the e-platform solve for their respective optimal prices by jointly calculating the first-order conditions  $\partial U_1^{N-1} / p_1 = 0$  and  $\partial U_2^{N-1} / p_2 = 0$ . Solving the above equations yields the equilibrium price solutions  $p_1^{N-1} = \frac{a + \theta + q}{2}$  and  $p_2^{N-1} = \frac{a + qt}{2}$ . We then substitute the equilibrium prices  $p_1^{N-1}$  and  $p_2^{N-1}$  into the e-platform's objective function  $U_2^{N-1}$  and solve the first-order condition  $\partial U_2^{N-1} / q = 0$  to derive the optimal product quality level.

**Lemma 2.** In the e-platform-led game setting, the equilibrium outcomes with the NB manufacturer's fairness concerns are presented below:

$$q^{N-1*} = -\frac{ar + at + \theta r}{t^2 + r - 2} \quad (12)$$

$$p_1^{N-1*} = \frac{(a + \theta)t^2 - at - 2a - 2\theta}{2t^2 + 2r - 4} \quad (13)$$

$$p_2^{N-1*} = \frac{(a + \theta)t^2 - at - 2a - 2\theta}{2t^2 + 2r - 4} \quad (14)$$

Substituting the optimal solutions derived above into Eqs. (10) and (11) yields the profit expressions of the NB manufacturer and the e-platform as shown below:

$$\begin{aligned} U_1^{N-1*} &= -\frac{(2r\tau_1 + r - \tau_1 - 1)(at^2 + t^2\theta - ta - 2a - 2\theta)^2}{4(t^2 + r - 2)^2} \\ &\quad - \frac{(((a + \theta)t - a)r + 2a)^2 \tau_1}{4(t^2 + r - 2)^2} - \frac{((a + \theta)r + ta)^2}{2(t^2 + r - 2)^2} \end{aligned} \quad (15)$$

$$U_2^{N-1*} = \frac{((t^2 - 2t - 1)a^2 + 2\theta(t + 1)(t - 2)a + \theta^2(t^2 - 2))r - 2a^2}{4t^2 + 4r - 8} \quad (16)$$

Building on the results of Lemma 2, we derive the following proposition:

**Proposition 4.** Impacts of brand advantage, commission rate, and quality perception coefficient on decision variables:

$$(1) \frac{\partial q^{N-1}}{\partial \theta} > 0, \quad \frac{\partial p_1^{N-1}}{\partial \theta} > 0, \quad \frac{\partial p_2^{N-1}}{\partial \theta} > 0; \quad (2) \frac{\partial q^{N-1}}{\partial r} > 0, \quad \frac{\partial p_1^{N-1}}{\partial r} > 0, \quad \frac{\partial p_2^{N-1}}{\partial r} > 0;$$

$$(3) \frac{\partial q^{N-1}}{\partial t} > 0, \quad \frac{\partial p_1^{N-1}}{\partial t} > 0, \quad \frac{\partial p_2^{N-1}}{\partial t} > 0.$$

Proposition 4 illustrates that when the e-platform acts as the Stackelberg market leader and the NB manufacturer holds fairness concern preferences, product quality, the retail price of NB products, and the retail price of SB products all show an upward trend with the increase of exogenous variables, including the NB’s brand advantage, commission rate, and the SB’s quality perception coefficient. In the market regime led by the e-platform, the introduction of the NB manufacturer’s fairness concerns helps to cultivate a positive and proactive market environment characterized by a virtuous cycle. From the perspective of product quality, as the NB’s brand advantage expands, the e-platform will set stricter quality requirements to fully leverage the competitive strengths of the NB manufacturer. Under a high commission rate scenario, the e-platform also has more capital to invest in the quality improvement of SB products. Furthermore, as consumers’ perception of SB quality rises, the platform actively improves its offerings, which in turn prompts the NB manufacturer to follow suit. This overall enhancement in product quality subsequently attracts a larger consumer base. Regarding the pricing level, the NB can appropriately raise prices based on its brand advantage. As the commission rate increases, consumers are also more willing to accept price hikes due to the corresponding improvements in quality. The heightened recognition and trust that consumers place in high-quality products further strengthen brand advantage, which once again drives a positive increase in both product quality and price. This iterative process creates a virtuous cycle that promotes the healthy development of the market.

**Proposition 5.** Impacts of brand advantage, commission rate, and quality perception coefficient on revenues:

$$(1) \frac{\partial U_1^{N-1}}{\partial \theta} > 0, \quad \frac{\partial U_2^{N-1}}{\partial \theta} > 0;$$

$$(2) \frac{\partial U_1^{N-1}}{\partial r} < 0, \quad \frac{\partial U_2^{N-1}}{\partial r} > 0;$$

$$(3) \text{ When } t_0 < t < 1, \frac{\partial U_1^{N-1}}{\partial t} < 0, \quad \frac{\partial U_2^{N-1}}{\partial t} > 0; \text{ when } r > r_0, \frac{\partial U_1^{N-1}}{\partial \tau_1} < 0.$$

Proposition 5 illustrates that under the e-platform-led market structure, the brand advantage of NB products exerts a significant positive driving effect on the earnings of both the NB manufacturer and the e-platform. An increase in the commission rate will suppress the revenue performance of the NB manufacturer, while simultaneously boosting the revenue level of the e-platform. In addition, the rise of consumers’ quality perception coefficient for SB products will lift the e-platform’s overall revenue, whereas its impact on the NB manufacturer’s revenue presents an inverted U-shaped trend of initial growth followed by a subsequent decline. The underlying mechanism of the above findings is elaborated as follows: the improvement of brand advantage will expand the market share of NB products. The growing market demand for NB will attract more NB manufacturers to settle on the e-platform. The platform can obtain higher user traffic by virtue of the strong brand endorsement from more well-known NB, which in turn indirectly drives the growth of its sales scale and total revenue. Therefore, brand advantage plays a positive role in promoting the sound development of the whole market. A higher commission rate directly increases the marginal operation cost of the NB manufacturer. However, a moderate rise in the commission rate will not lead to the churn of NB manufacturers settled on the platform, thus contributing to the growth of the e-platform’s revenue. The increase of the SB’s quality perception coefficient reflects the enhanced market competitiveness of SB products. When the SB’s perception coefficient surpasses a specific critical threshold, consumers who originally purchased NB products will switch to SB items, which will curb the revenue growth of the NB manufacturer. Furthermore, we find that when the e-platform acts as the market leader, the NB manufacturer’s fairness concern behaviors will also generate negative impacts on the manufacturer’s own operational performance.

**Corollary 2.**  $p_1^{N-1} > p_2^{N-1}$

Corollary 2 illustrates that when the e-platform acts as the leader in the Stackelberg game market structure and the NB manufacturer holds fairness concern preferences, the retail price of NB products is notably higher than that of SB products. The underlying reason for this phenomenon can be partially attributed to the inherent brand advantages and high-quality product attributes of the NB manufacturer, which not only help attract target consumers but also provide solid support for its retail pricing decisions. In addition, the NB manufacturer’s fairness concern behaviors help preserve the operational stability of the whole supply chain and improve end-consumer satisfaction, thus further enhancing its market competitiveness. Although the e-platform’s dominant position in the market exerts considerable competitive pressure on the NB manufacturer, the manufacturer can still effectively mitigate such pressure by virtue of its fairness concern strategies and inherent brand advantages.

### 3.2.3. E-platform leadership: Fairness concerns of the e-platform (N-2)

**Lemma 3.** In the e-platform-led decision-making framework, the equilibrium outcomes considering the e-platform's fairness concerns are presented below::

$$q^{N-2*} = \frac{((-2a-2\theta)r + (-t+1)a + \theta)\tau_2 + (-a-\theta)r - at}{(t^2 + 2r-1)\tau_2 + t^2 + r - 2} \quad (17)$$

$$p_1^{N-2*} = \frac{(\tau_2 + 1)(a + \theta)t^2 - a(\tau_2 + 1)t - 2a - 2\theta}{(2\tau_2 + 2)t^2 + (4r - 2)\tau_2 + 2r - 4} \quad (18)$$

$$p_2^{N-2*} = \frac{-2\left(r - \frac{1}{2}\right)\left((a + \theta)t - a\right)\tau_2 + \left((-a - \theta)t + a\right)r - 2a}{(2t^2 + 4r - 2)\tau_2 + 2t^2 + 2r - 4} \quad (19)$$

By plugging the optimal solutions obtained from the above derivation into Eq. (10) and Eq. (11), we can derive the profit functions for both the NB manufacturer and the e-platform, which are presented below:

$$U_1^{N-2*} = (1-r) \left( \frac{a}{2} + \frac{\theta}{2} - \frac{2\tau_2 ar + \tau_2 at + 2\tau_2 \theta r + ra + at - \tau_2 a + r\theta - \tau_2 \theta}{2t^2 \tau_2 + 4r\tau_2 + 2t^2 + 2r - 2\tau_2 - 4} \right)^2 - \frac{(2\tau_2 ar + \tau_2 at + 2\tau_2 \theta r + ra + at - \tau_2 a + r\theta - \tau_2 \theta)^2}{2(t^2 \tau_2 + 2r\tau_2 + t^2 + r - \tau_2 - 2)^2} \quad (20)$$

$$U_2^{N-2*} = \frac{2\left(r - \frac{1}{2}\right)\left((t-1)a + t\theta\right)^2 \tau_2^2 + \begin{pmatrix} (3Bt^2 - 6Bt - r - 1)a^2 \\ +6(Bt^2 - Bt + C)\theta a \\ +3(Bt^2 + C)\theta^2 \end{pmatrix} \tau_2}{(4t^2 + 8r - 4)\tau_2 + 4t^2 + 4r - 8} + \frac{(rt^2 - 2rt - r - 2)a^2 + 2r\theta(t+1)(t-2)a + r\theta^2(t^2 - 2)}{(4t^2 + 8r - 4)\tau_2 + 4t^2 + 4r - 8} \quad (21)$$

Building on the results of Lemma 3, we derive the following proposition:

**Proposition 6.** Impacts of NB advantage, the commission rate, and the quality perception coefficient on decision variables.

- (1) When  $0 < r < \frac{\tau_2}{2\tau_2 + 1}$ ,  $\frac{\partial q^{N-2}}{\partial \theta} < 0$ ,  $\frac{\partial p_2^{N-2}}{\partial \theta} < 0$ ; when  $\frac{\tau_2}{2\tau_2 + 1} < r < 1$ ,  $\frac{\partial q^{N-2}}{\partial \theta} > 0$ ,  $\frac{\partial p_2^{N-2}}{\partial \theta} > 0$ , and  $\frac{\partial p_1^{N-2}}{\partial \theta} > 0$  always holds;
- (2)  $\frac{\partial q^{N-2}}{\partial r} > 0$ ,  $\frac{\partial p_1^{N-2}}{\partial r} > 0$ ,  $\frac{\partial p_2^{N-2}}{\partial r} > 0$ ;
- (3)  $\frac{\partial q^{N-2}}{\partial t} > 0$ ,  $\frac{\partial p_1^{N-2}}{\partial t} > 0$ ; when  $\frac{1}{2} < t < 1$ ,  $\frac{\partial p_2^{N-2}}{\partial t} > 0$  always holds.

Proposition 6 illustrates that under the e-platform-led market structure, when the e-platform's fairness concern behaviors are incorporated into the analytical framework, the enhancement of brand advantage will lead to a reduction in product quality. Only in the scenario of an extremely high commission rate will product quality increase synchronously with brand advantage. Brand advantage exerts a significant positive driving effect on the retail price of NB products, while presenting a negative inhibitory impact on the retail pricing of SB products. In addition, both product quality and the retail prices of NB and SB products present an upward trend with the rise of the commission rate. Consumers' quality perception coefficient for SB products has a positive promoting effect on product quality, as well as the retail prices of the two types of products. The underlying mechanism of the above conclusions is elaborated as follows: when brand advantage rises, the trend of product quality (increase or decrease) is highly dependent on the level of the commission rate. Meanwhile, consumers are willing to pay a price premium for the additional value endowed by NB products. To cope with the resulting competitive pressure, SB products will adopt a price reduction strategy. An increase in the commission rate will push up the marginal operation costs of the NB manufacturer. To maintain its revenue level and market competitiveness, the manufacturer will improve product quality and raise its product prices, which further drives the SB to adjust its pricing strategy accordingly. Finally, the rise of the quality perception coefficient for SB products will motivate the e-platform to upgrade the product quality of its SB and raise the corresponding retail price.

**Proposition 7.** Impacts of NB advantage, the commission rate, and the quality perception coefficient on revenues.

- (1)  $\frac{\partial U_1^{N-2}}{\partial \theta} > 0$ , when  $0 < r < \frac{\tau_2}{2\tau_2 + 1}$ ,  $\frac{\partial U_2^{N-2}}{\partial \theta} > 0$ ;
- (2)  $\frac{\partial U_1^{N-2}}{\partial r} < 0$ ,  $\frac{\partial U_2^{N-2}}{\partial r} > 0$ ;
- (3) When  $0 < r < \frac{1}{2}$ ,  $\frac{\partial U_1^{N-2}}{\partial t} > 0$ ; when  $\frac{1}{2} < r < 1$ ,  $\frac{\partial U_1^{N-2}}{\partial t} < 0$ ,  $\frac{\partial U_2^{N-2}}{\partial t} > 0$ .

Proposition 7 illustrates that under the market structure led by the e-platform, the improvement of brand advantage will drive the revenue growth of both the NB manufacturer and the e-platform within a specific parameter range. When the commission rate satisfies the condition  $0 < r < \frac{1}{2}$ , the revenue of the NB manufacturer rises with the increase of consumers' quality perception coefficient for SB products. On the contrary, when the commission rate is at an excessively high level, the rise of the SB's quality perception coefficient will lead to a decline in the manufacturer's revenue. No matter what the market condition is, the SB's quality perception coefficient consistently exerts a positive promoting effect on the e-platform's revenue.

When the commission rate falls within the range of  $0 < r < \frac{1}{2}$ , the NB manufacturer bears relatively low cost pressure under the low commission rate scenario. With the rise of the SB's quality perception coefficient and the growing consumer demand for SB products, the e-platform may facilitate the cooperation between the SB and the NB to balance the revenue of both parties. Under this circumstance, the manufacturer can take advantage of this opportunity to expand its business scale and reduce operation costs, thus realizing revenue growth. In contrast, when the commission rate is excessively high, the enhanced market competitiveness of the SB will seize the market share originally owned by the NB, which will eventually result in a drop in the manufacturer's revenue.

**Proposition 8.** Impacts of the fairness preference coefficient on operational decision variables and revenue outcomes.

- (1) When  $r > \frac{1}{2}$ ,  $\frac{\partial q^{N-2}}{\partial \tau_2} > 0$ ,  $\frac{\partial p_1^{N-2}}{\partial \tau_2} > 0$ ,  $\frac{\partial p_2^{N-2}}{\partial \tau_2} > 0$ ; when  $0 < r < \frac{1}{2}$ , if  $0 < t < t_0$ , then  $\frac{\partial q^{N-2}}{\partial \tau_2} < 0$ ,  $\frac{\partial p_1^{N-2}}{\partial \tau_2} < 0$ ,  $\frac{\partial p_2^{N-2}}{\partial \tau_2} < 0$ ; if  $t_0 < t < 1$ , then  $\frac{\partial q^{N-2}}{\partial \tau_2} > 0$ ,  $\frac{\partial p_1^{N-2}}{\partial \tau_2} > 0$ ,  $\frac{\partial p_2^{N-2}}{\partial \tau_2} > 0$ , where  $t_0 = \frac{1+r-\sqrt{17r^2-22r+9}}{2(r-1)}$ ;
- (2)  $\frac{\partial U_1^{N-2}}{\partial \tau_2} < 0$ ,  $\frac{\partial U_2^{N-2}}{\partial \tau_2} > 0$ .

Proposition 8 demonstrates that when the SB's quality perception coefficient surpasses a specific critical threshold, the e-platform's fairness concern coefficient exerts a positive driving effect on product quality, the respective retail prices of both brands, and the e-platform's own revenue, while it has an inhibitory impact on the earnings of the NB manufacturer. In the e-platform-led market regime, the influence of the e-platform's fairness concern coefficient on the NB manufacturer's revenue is completely opposite to its effect on the platform's own revenue. As the fairness concern coefficient increases, the platform will scale up its resource input to achieve fairness goals and strengthen its market competitiveness, which in turn promotes the upgrading of product quality and the rise of retail prices. This is a favorable development for the e-platform itself. The platform's SB achieves revenue growth through quality and price improvements, while the platform attracts more supply chain participants by providing a better cooperation environment and high-quality products, which further drives the growth of platform traffic and sales volume. In addition, the platform can expand its revenue sources through measures such as adjusting service fees, thus achieving total revenue growth via diversified strategies. In contrast, the situation is completely reversed for the NB manufacturer. Despite the potential for quality and price improvements, the NB manufacturer has to bear additional costs in the fairness-related adjustment process, and its pricing flexibility is greatly restricted. What is more, the NB manufacturer will be in a disadvantaged position in terms of profit distribution within the supply chain. Coupled with the enhanced competitiveness of the SB that seizes the market share originally held by the NB, the sales volume and profit margins of the NB manufacturer are significantly squeezed, which ultimately leads to the suppression of its revenue. The variation of the e-platform's fairness concern coefficient functions like a lever, boosting its own revenue growth at one end while curbing the revenue of the NB manufacturer at the other end.

**Corollary 3.** (1) When  $r < \frac{1}{2}$ , if  $0 < t < t'$  and  $0 < \tau_2 < \frac{r}{1-2r}$ , or if  $t' < t < 1$  and  $\frac{r}{1-2r} < \tau_2 < 1$ , then  $p_1^{N-2} > p_2^{N-2}$ ; when

$0 < t < t'$  and  $\frac{r}{1-2r} < \tau_2 < 1$ , or if  $t' < t < 1$  and  $0 < \tau_2 < \frac{r}{1-2r}$ , then  $p_1^{N-2} < p_2^{N-2}$ . In this case,  

$$t' = \frac{\sqrt{-2(\tau_2 + 1)(2\tau_2 r + r - \tau_2 - 2)}}{2(\tau_2 + 1)}.$$

$$(2) U_1^{N-2} < U_2^{N-2}.$$

Corollary 3 demonstrates that in the e-platform-led market regime with the platform's fairness concerns taken into account, the retail price of NB products is higher than that of S products when both consumers' quality perception coefficient for the SB and the e-platform's fairness concern coefficient are at a low level, or both are at a high level. On the contrary, when the SB's quality perception coefficient is low while the fairness concern coefficient is high, or when the quality perception coefficient is high while the fairness concern coefficient is low, the retail price of NB products will be lower than that of SB products. Under the dual low coefficient scenario, consumers show a stronger preference for purchasing NB products. Due to its high tolerance for supply chain revenue gaps, the e-platform will reduce the retail price of SB products to attract consumers, while the NB manufacturer will capitalize on its brand advantage to raise its retail price. In the dual high coefficient setting, consumers exhibit a high level of recognition for SB products. The NB manufacturer needs to adjust its pricing strategy by lowering prices to maintain market competitiveness, yet its inherent brand advantage can still support a certain price premium. At this point, the e-platform worries that the NB manufacturer will gain excessive revenue, so it increases the price of SB products to narrow the bilateral revenue gap, but it still cannot match the price premium brought by the NB's inherent brand advantage. For the scenario of low quality perception paired with high fairness concern, consumers have low recognition of SB product quality. Although the NB manufacturer could have set a higher retail price, the platform's strong fairness concerns drive it to seize market share by drastically cutting SB prices to narrow the revenue gap. This compels the NB manufacturer to lower its product prices to maintain sales volume, which essentially means the platform forces the manufacturer to give up part of its profits through a price war. For the scenario of high quality perception paired with low fairness concern, consumers have a high degree of recognition for SB products. The NB manufacturer is forced to cut prices to compete for market share. The e-platform prioritizes the maximization of its own revenue, enhances the quality premium of SB products by raising their retail prices, and squeezes the NB's market space through its traffic advantages. As a result, the NB manufacturer is trapped in the dilemma of a price war.

### 3.2.4. Comparison of decisions

By conducting a comparative analysis of the equilibrium outcomes in the e-platform-led market regime under various fairness concern settings, we derive the following corollary:

**Corollary 4.** (1) Under the condition that  $t > \sqrt{1-2r}$ .

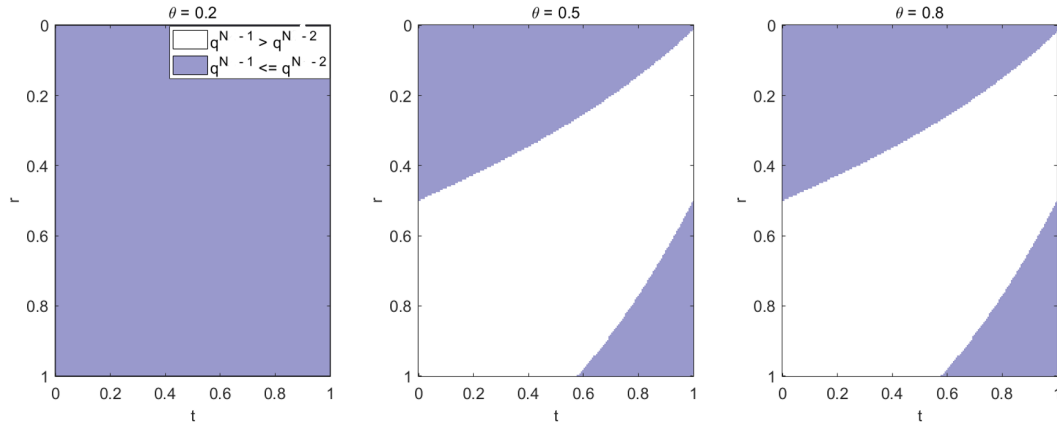
When  $0 < \tau_2 < \min\{\max\{\frac{2-t^2-r}{t^2+2r-1}, 0\}, 1\}$ , if  $t \in ((0, t_0) \cap (\sqrt{1-2r}, 1))$ , then  $q^{N-1} > q^{N-2}$ ,  $p_1^{N-1} > p_1^{N-2}$ ,  $p_2^{N-1} > p_2^{N-2}$ ; if  $t \in ((t_0, 1) \cap (\sqrt{1-2r}, 1))$ , then  $q^{N-1} < q^{N-2}$ ,  $p_1^{N-1} < p_1^{N-2}$ ,  $p_2^{N-1} < p_2^{N-2}$ ;

When  $\min\{\max\{\frac{2-t^2-r}{t^2+2r-1}, 0\}, 1\} < \tau_2 < 1$ , if  $t \in ((0, t_0) \cap (\sqrt{1-2r}, 1))$ , then  $q^{N-1} < q^{N-2}$ ,  $p_1^{N-1} < p_1^{N-2}$ ,  $p_2^{N-1} < p_2^{N-2}$ ; if  $t \in ((t_0, 1) \cap (\sqrt{1-2r}, 1))$ , then  $q^{N-1} > q^{N-2}$ ,  $p_1^{N-1} > p_1^{N-2}$ ,  $p_2^{N-1} > p_2^{N-2}$ .

(2) Under the condition that  $t < \sqrt{1-2r}$ . If  $t \in ((0, t_0) \cap (0, \sqrt{1-2r}))$ , then  $q^{N-1} > q^{N-2}$ ,  $p_1^{N-1} > p_1^{N-2}$  and  $p_2^{N-1} > p_2^{N-2}$  always holds; if  $t \in ((t_0, 1) \cap (0, \sqrt{1-2r}))$ , then  $q^{N-1} < q^{N-2}$ ,  $p_1^{N-1} < p_1^{N-2}$ ,  $p_2^{N-1} < p_2^{N-2}$ .

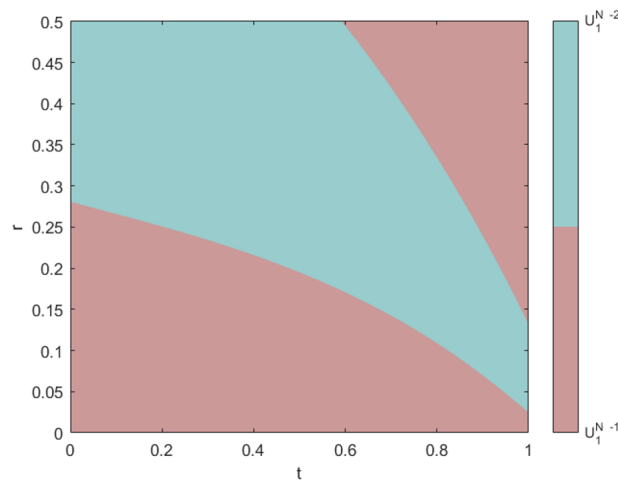
Corollary 4 reveals the discrepancies in market product quality levels and the corresponding retail prices under different fairness concern scenarios in the e-platform-led supply chain system. The findings show that when both the e-platform's fairness concern coefficient and consumers' quality perception coefficient for SB products are at a low level, the product quality levels and corresponding retail prices under the NB manufacturer's fairness concerns outperform the outcomes under the e-platform's fairness concerns. In contrast, when consumers' perception coefficient for the SB is at a high level, the opposite results are presented. Specifically, when the e-platform has a small fairness concern coefficient and consumers hold a low quality perception coefficient for the SB, consumers show a stronger preference for purchasing NB products. Under this

circumstance, the NB manufacturer improves product quality and optimizes its pricing strategy through its fairness concern behaviors, leading to a better performance in both quality and pricing compared with the outcomes under the e-platform’s fairness concerns. On the other hand, when the e-platform’s fairness concern coefficient is small but consumers have a high quality perception coefficient for the SB, consumers are more willing to purchase SB products. As a result, the e-platform improves the quality and pricing of SB products through its fairness concern behaviors, resulting in better quality and pricing performance compared with those under the NB manufacturer’s fairness concerns. Taking the product quality level as a representative indicator, we set the brand advantage parameter  $\theta$  as 0.2, 0.5 and 0.8 respectively, to compare the product quality differences between case  $N-1$  and case  $N-2$  under the combined effect of the SB perception coefficient and the commission rate. As shown in Figure 3, product quality does not always reach the optimal level under case  $N-2$ . With the gradual increase of brand advantage, the product quality in case  $N-1$  will outperform that in case  $N-2$  when the SB perception coefficient is at a high level.



**Fig. 3.** Impacts of  $t$  and  $l$  on the relative magnitude of product quality in case  $N-1$  and case  $N-2$  under different NB advantages

By comparing the revenue performance of the NB manufacturer under two distinct scenarios, we find that in the e-platformed market regime, the NB manufacturer cannot always achieve higher revenue by adopting fairness concerns itself. When the SB’s quality perception coefficient is at an excessively high level and the commission rate rises, the manufacturer will actually gain higher revenue under the scenario where the e-platform holds fairness concerns, compared with the scenario where the manufacturer itself incorporates fairness concerns, as demonstrated in Fig. 4.



**Fig. 4.** Impacts of  $t$  and  $l$  on the revenue of the NB manufacturer under two different scenarios

#### 4. Numerical Analysis

Based on the aforementioned equilibrium solutions, this section conducts numerical simulation and case analysis using two decision making models to examine the impacts of NB advantage, the commission rate, and the SB quality perception coefficient on decision variables and revenues.

##### 4.1. The impacts of brand advantage, commission rate, SB perception coefficient and fairness concern coefficient on price decisions

###### (1) Brand advantage

In the e-platform-led market regime, the effects of NB advantage on the retail prices of both NB and SB products are presented

in Fig. 5 and Fig. 6. As shown in Fig. 5, when the NB manufacturer holds fairness concerns, brand advantage exerts a significant positive driving effect on the pricing of NB products. In addition, it is worth noting that brand advantage has an inhibitory effect on SB product prices, which is in line with the conclusions drawn in Propositions 4(1) and 6(1). A holistic analysis of Fig. 5 and Fig. 6 shows that the overall pricing level is generally higher under the scenario where the NB manufacturer has fairness concerns, compared with the scenario where the e-platform incorporates fairness concerns. Meanwhile, the retail price of the NB under the manufacturer’s fairness concerns presents a stronger upward growth potential with the increase of brand advantage.

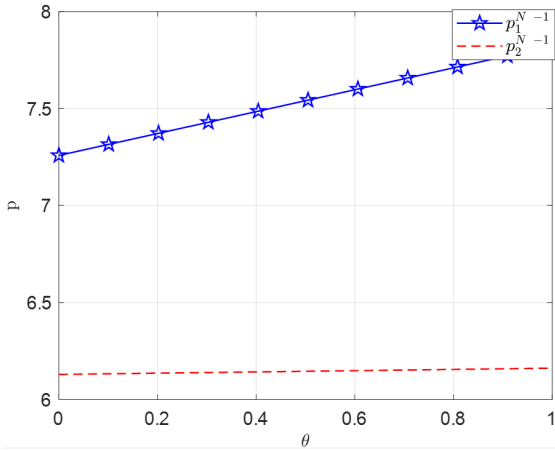


Fig. 5. Impacts of brand advantage on prices in case  $N-1$

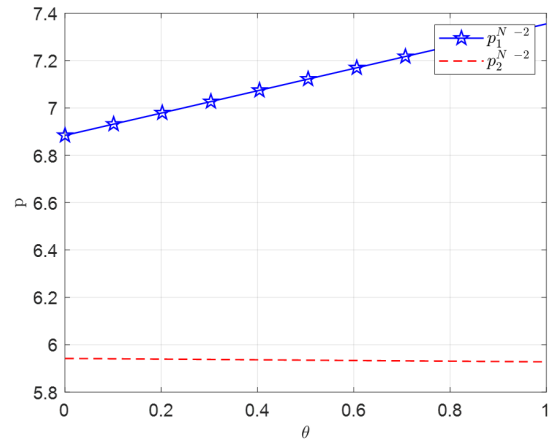


Fig. 6. Impacts of brand advantage on prices in case  $N-2$

(2) Commission rate

As shown in Fig. 7 and Fig. 8, the rise of the commission rate consistently exerts a positive promotion effect on product pricing under different fairness concern scenarios, which is consistent with the revenue derivation conclusions in Propositions 4(2) and 6(2). For the NB manufacturer, the rising commission rate will directly lead to the increase of its marginal operating costs, and the manufacturer will transfer part of the resulting cost pressure to end consumers. According to the analytical results in Proposition 6(2), the e-platform will simultaneously improve product quality and raise retail prices as the commission rate increases, thus forming a linkage mechanism between product quality upgrading and pricing adjustment. Further analysis of the influence of the e-platform’s fairness concern coefficient, as presented in Fig. 8, shows that when the platform’s fairness concern level is relatively low, the NB manufacturer can maintain its dominant position in pricing by virtue of its first-mover brand advantage. With the increase of the fairness concern coefficient, the price gap between the SB and the NB presents a nonlinear convergence trend along with the rise of the commission rate. When the commission rate exceeds a specific critical threshold, the retail price of SB products may even surpass that of NB products, forming a reversed price gap pattern.

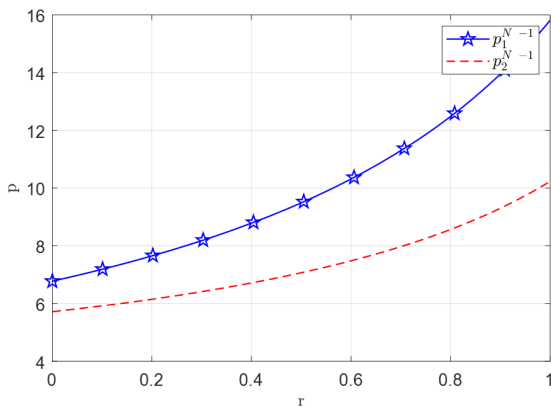


Fig. 7. Impacts of  $\tau$  (commission rate) on prices in case  $N-1$

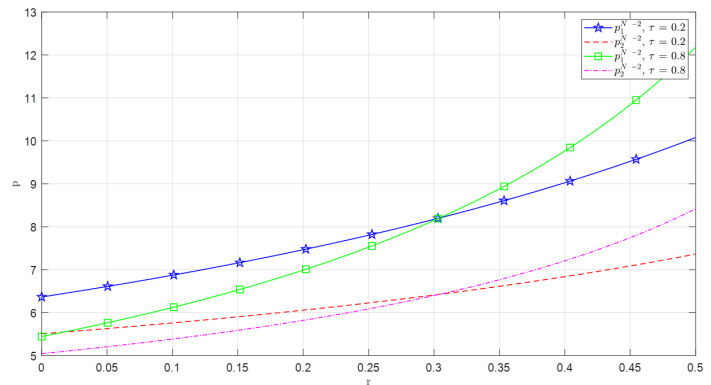
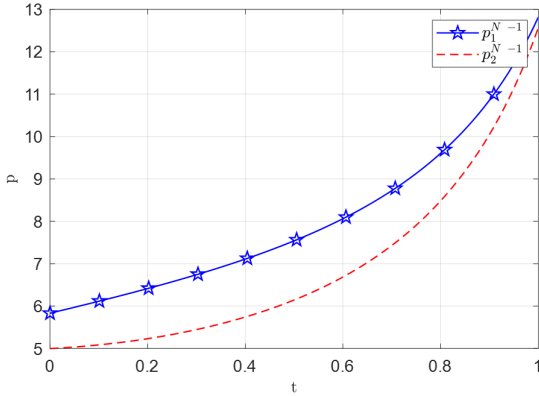


Fig. 8. Impacts of  $\tau$  (commission rate) on prices in case  $N-2$

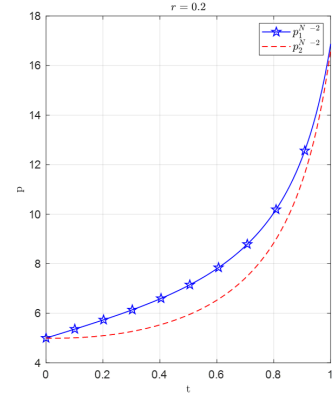
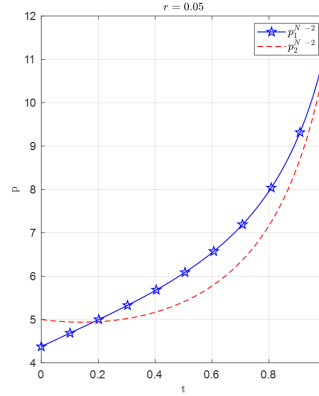
(3) Store brand perception coefficient

As shown in Fig. 9 and Fig. 10, the increase in consumers’ quality perception coefficient of SB products not only lifts the retail price of SB, but also exerts a positive upward driving effect on the retail price of NB products. The underlying reason is that as consumers’ recognition of SB quality improves, the e-platform gains more flexibility to raise SB prices to achieve higher revenue levels. Meanwhile, driven by the market interaction effect, this trend also drives the rise of NB product prices.

To maintain its market competitive advantage, the NB manufacturer will accordingly improve product quality or increase the added value of its brand, which further pushes up product prices. This finding is fully aligned with the conclusions derived in Propositions 4(3) and 6(3). The core difference between case  $N-1$  and case  $N-2$  lies in that, the promotion effect of the SB quality perception coefficient on SB retail prices in case  $N-1$  is stronger than that in case  $N-2$ . In case  $N-2$ , when the SB quality perception coefficient is not taken into account and the commission rate is low ( $r = 0.05$ ), the retail price of the SB is higher than that of the NB. At this point, as the SB quality perception coefficient increases, the NB price will also rise and eventually surpass the SB price. This is because high consumer recognition of the SB will in turn drive the NB to maintain its market dominant position by setting a price premium.



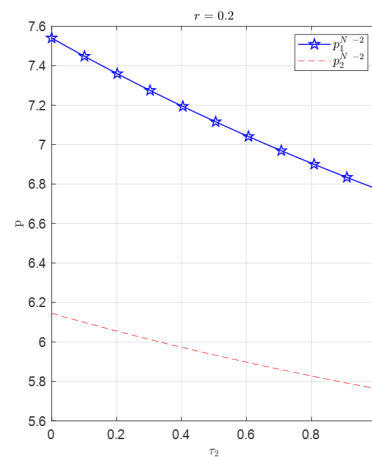
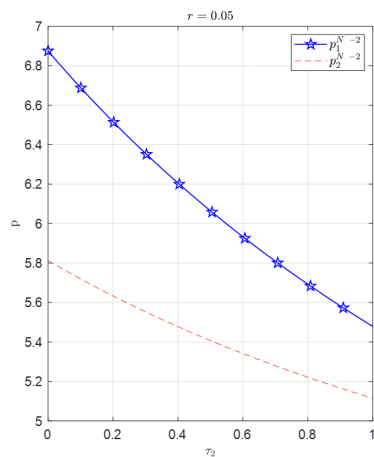
**Fig. 9.** Impacts of the SB perception coefficient on prices in case  $N-1$



**Fig. 10.** Impacts of the SB perception coefficient on prices in case  $N-2$

(4) Fairness concern coefficient

As shown in Fig. 11, the e-platform’s fairness concern coefficient drives the decline in the retail prices of both NB and SB products. For one thing, as the market leader, the e-platform can directly attract consumers and expand its market share by cutting SB prices, while simultaneously squeezing the living space of the NB. For another, the e-platform holds a more advantageous cost structure, which provides it with more sufficient room for price reduction. This finding is fully consistent with the analytical conclusions drawn in Proposition 8(1): fairness concerns drive the platform to proactively lower prices to vie for market share, while the NB manufacturer passively follows this pricing adjustment under the dual pressure of costs and market competition, ultimately forming an equilibrium outcome where the prices of both brands decline. This phenomenon reflects the trade-off between revenue maximization and fairness preference psychology made by the platform, as well as the disadvantaged status of the NB manufacturer under the channel dependency structure.



**Fig. 11.** Impacts of the e-platform’s fairness concern coefficient on prices in case  $N-2$

4.2. The impacts of brand advantage, commission rate, SB perception coefficient, and fairness concern coefficient on revenues

(1) Brand advantage

The effects of NB advantage on the revenue performance of both the NB manufacturer and the e- platform are presented in Fig. 12 and Fig. 13. With the growth of brand advantage, the revenue levels of the NB manufacturer and the e-platform both rise, which can be clearly explained in combination with the conclusions in Proposition 4(1). For one thing, the improvement of brand advantage drives the increase of retail prices for both national and SB products, thus boosting the revenue of both

parties. For another, the rise of brand advantage attracts more consumers, and the e-platform achieves higher sales volume and revenue growth by virtue of the strong brand endorsement of NB products, which is fully aligned with the conclusion in Proposition 5(1). A holistic analysis of Fig. 12 and Fig. 13 shows that when the e-platform serves as the market leader, the e-platform achieves higher revenue performance than the NB manufacturer. The core discrepancy is reflected in the fact that the growth rate of their revenues with the rise of brand advantage differs across various fairness concern scenarios. Although the initial revenue level is relatively low under the scenario where the NB manufacturer holds fairness concerns, it shows stronger revenue growth potential as brand advantage increases.

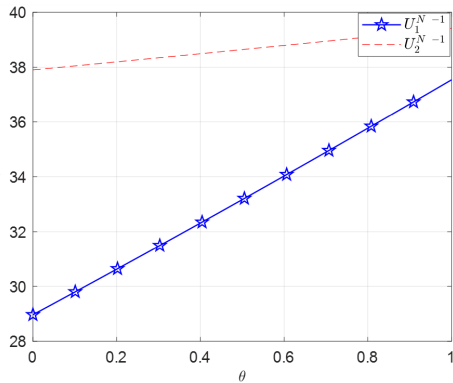


Fig. 12. Impacts of brand advantage on revenues in case  $N-1$

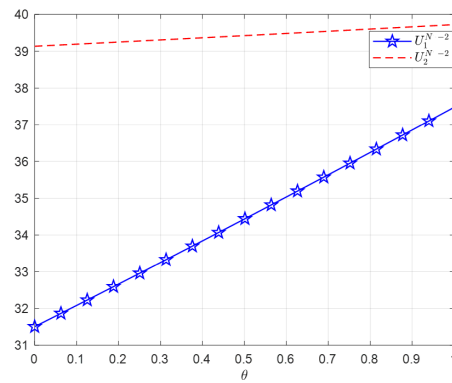


Fig. 13. Impacts of brand advantage on revenues in case  $N-2$

(2) Commission rate

The effect of commission rate fluctuations on the revenue performance of both supply chain parties presents significant heterogeneity. Fig. 14 and Fig. 15 demonstrate the influence of the commission rate  $r$  on the revenues of the NB manufacturer and the e-platform, within the parameter range of  $0 < r < 0.5$ . It can be found that the rise of the commission rate will suppress the revenue of the NB manufacturer, while driving the growth of the e-platform’s revenue simultaneously. This finding is consistent with real-world supply chain operation practices, and is fully aligned with the conclusions drawn in Propositions 5(2) and 7(2). According to the results shown in Fig. 14, under the scenario where the NB manufacturer holds fairness concerns, the manufacturer’s revenue is higher than that of the e-platform in the low commission rate range. Once the commission rate exceeds a specific critical threshold, the e-platform’s revenue will surpass that of the NB manufacturer. On the contrary, under the scenario where the e-platform has fairness concerns, the platform’s revenue always maintains a dominant level, no matter how the commission rate changes.

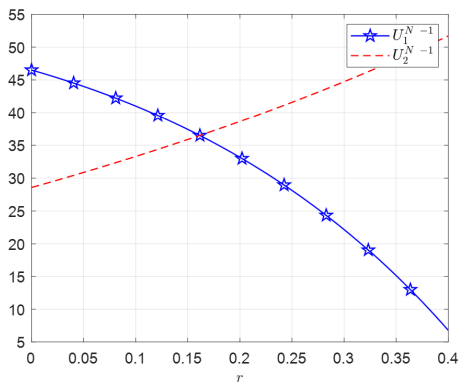


Fig. 14. Impacts of commission rate on revenues in case  $N-1$

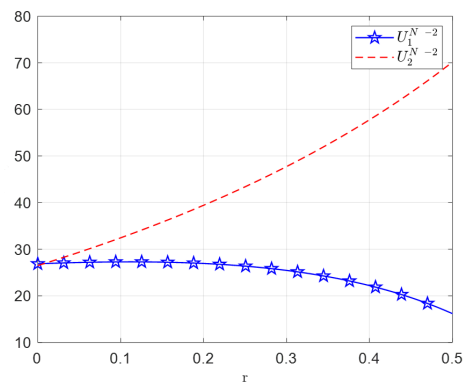
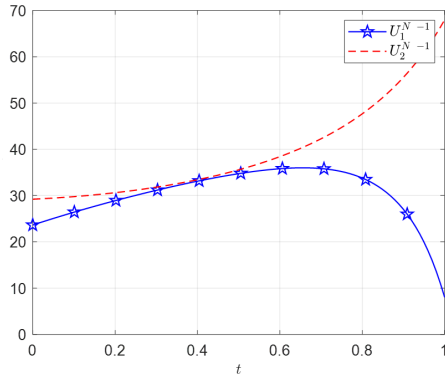


Fig. 15. Impacts of commission rate on revenues in case  $N-2$

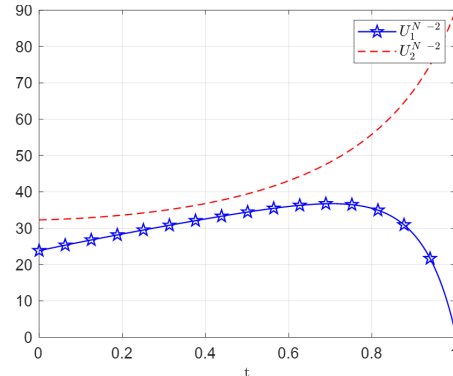
(3) Brand perception coefficient

Fig. 16 and Fig. 17 respectively present the influence of the SB’s quality perception coefficient on the revenue performance of both supply chain parties, under the two scenarios where fairness concerns are held by the NB manufacturer and the e-platform respectively. It can be found that as consumers’ quality perception coefficient for SB products rises, the e-platform will achieve continuous revenue growth, while the NB manufacturer’s revenue presents an inverted U-shaped trend that first rises and then falls with the increase of the SB’s quality perception coefficient. The underlying mechanism is that consumers’ growing recognition of SB products consolidates the e-platform’s dominant position in the market, and the platform forms a “Matthew effect” of the strong getting stronger by optimizing the product quality of its SB. The revenue curve of the NB manufacturer shows a typical inverted U shape, which essentially reflects the dynamic trade-off between the gradual erosion

of its brand advantage and the continuous rise of competitive pressure. When the SB’s quality perception coefficient is at a low level, the NB manufacturer can still maintain sustained revenue growth by virtue of its brand advantage and quality differentiation strategy. However, once the SB’s quality perception coefficient surpasses a specific critical threshold, the competitive advantage of the NB will be significantly weakened, and the intense market competition between the NB manufacturer and the SB will trigger an accelerated drop in the manufacturer’s revenue.



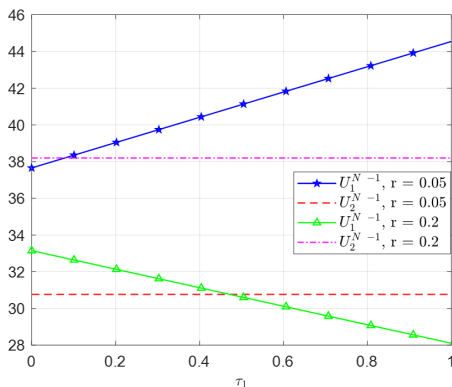
**Fig. 16.** Impacts of the SB perception coefficient  $t$  on revenues in case  $N-1$



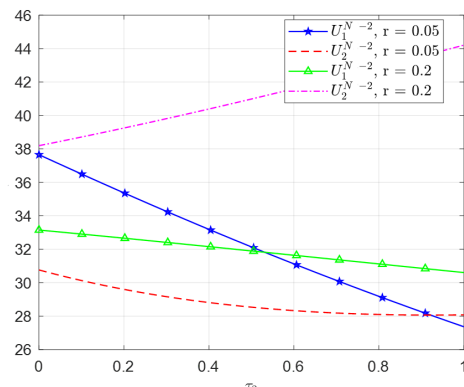
**Fig. 17.** Impacts of the SB perception coefficient  $t$  on revenues in case  $N-2$

(4) Fairness concern coefficient

Fig. 18 and Fig. 19 present the effects of the fairness concern coefficient on the revenue performance of supply chain members under two distinct scenarios. As can be seen from Fig. 18, the NB manufacturer’s fairness concern coefficient has no significant impact on the e-platform’s revenue. When the commission rate is low ( $r = 0.05$ ), a higher degree of fairness concern from the NB manufacturer will drive the growth of its own revenue. On the contrary, when the commission rate is high ( $r = 0.2$ ), the NB manufacturer’s revenue will decline as its fairness concern coefficient increases. The underlying logic is that under a low commission rate, the revenue growth generated by the NB manufacturer’s operational adjustments driven by fairness concerns can fully offset the additional costs brought by such fairness preference behaviors, thus achieving an overall increase in revenue. However, under a high commission rate, the NB manufacturer will face heavier cost pressure in market competition. Excessive attention to fairness may make the manufacturer adopt more conservative market strategies, such as being reluctant to cut prices to attract consumers, which will put the NB manufacturer at a disadvantage in market competition, restrict its sales volume growth, and ultimately lead to a drop in revenue. As depicted in Figure 19, when the e-platform serves as the market leader, the effect of the e-platform’s fairness concern behaviors on revenue presents more significant heterogeneity. When the commission rate is high ( $r = 0.2$ ), the e-platform’s fairness concern will boost its own revenue while suppressing the revenue of the NB manufacturer. When the commission rate is low ( $r = 0.05$ ), the rise of the e-platform’s fairness concern level will reduce the revenue of both supply chain parties. Nevertheless, when the fairness concern level is excessively high, the e-platform’s revenue will surpass that of the NB manufacturer. In summary, it is clear that fairness concerns do not always generate positive effects on the growth of a subject’s own revenue.



**Fig. 18.** Impacts of NB manufacturer’s fairness concern coefficient on revenue performance in case  $N-1$

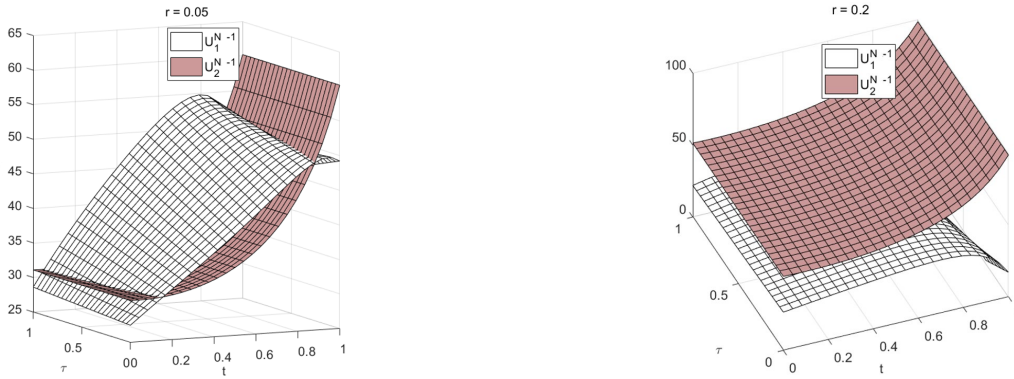


**Fig. 19.** Impacts of NB manufacturer’s fairness concern coefficient on revenue performance in case  $N-2$

4.3. Comparative analysis of revenues under dual influencing factors

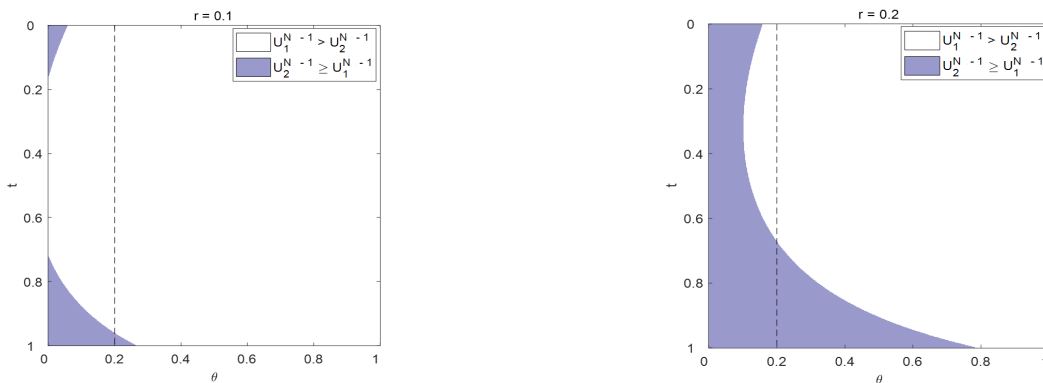
As shown in Fig. 20, the joint effects of simultaneous changes in the SB’s quality perception coefficient and the NB manufacturer’s fairness concern coefficient on the revenue performance of both supply chain parties are presented in case  $N-$

$I$ , with the commission rate set at 0.05 and 0.2 respectively. From the left panel of Fig. 20, it can be found that when the commission rate is low, the SB quality perception coefficient and the manufacturer's fairness concern coefficient exert a synergistic positive promotion effect on the NB manufacturer's revenue. When the coefficient  $t$  is excessively high, it will exert a suppressive effect on the manufacturer's revenue. Furthermore, when  $t$  reaches its minimum or maximum value, the revenue of the NB manufacturer will be lower than that of the SB. Through comparative analysis, it can be observed that the rise of the commission rate ensures that the e-platform's revenue is consistently higher than the SB's revenue, and the revenue gap between the two also widens with the increase of the commission rate.



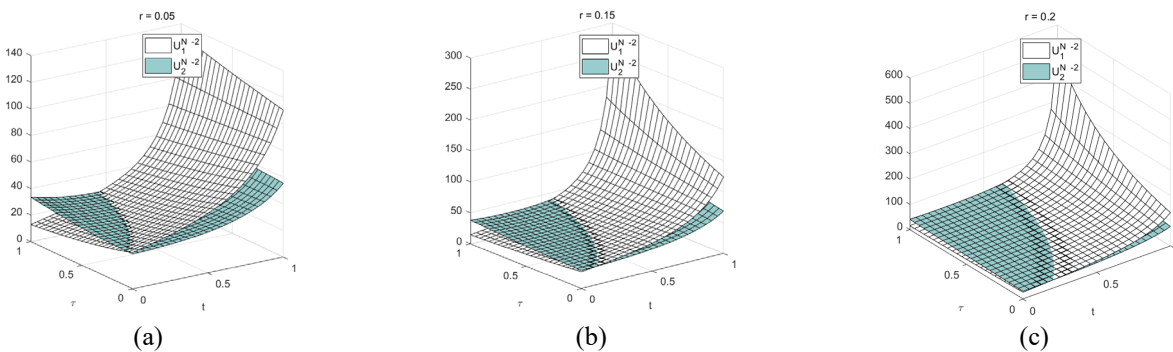
**Fig. 20.** Impacts of  $t$  and  $\tau$  on revenues under different commission rates in case  $N-1$

As illustrated in Fig. 21, in case  $N-1$ , when the commission rates are 0.1 and 0.2 respectively, the impacts of simultaneous changes in brand advantage and the SB perception coefficient on the relative magnitude of the revenues of both parties are shown. Through comparative analysis, it can be found that with the rise of the commission rate, the scope where the e-platform's revenue outperforms that of the NB manufacturer under the combined effect of brand advantage and the SB perception coefficient will expand significantly. This is mainly because a higher commission rate increases the income of the e-platform from the NB manufacturer, thereby strengthening its revenue advantage and weakening the NB advantage.



**Fig. 21.** Impacts of  $\theta$  and  $t$  on revenues under different commission rates in case  $N-1$

As illustrated in Fig. 22, in case  $N-2$ , when the commission rates are 0.05, 0.15, and 0.2 respectively, the impacts of simultaneous changes in the SB perception coefficient and the e-platform fairness concern coefficient on the revenues of both parties are shown.



**Fig. 22.** Impacts of  $t$  and  $\tau$  on revenues under different commission rates in case  $N-2$

A comparison reveals that under the joint effect of the SB perception coefficient  $t$  and the e-platform fairness concern coefficient  $\tau$ , a moderate rise in the commission rate can drive the revenue growth of both the NB manufacturer and the e-platform. Meanwhile, with the increase of the commission rate, the scope where the e-platform's revenue surpasses that of the NB manufacturer also shows a significant expanding trend. To further elaborate on the impacts of commission rate fluctuations on the revenue performance of supply chain stakeholders, we set the SB quality perception coefficient to 0.2, 0.5, and 0.8 respectively for the analysis. In line with the actual operational practices of the e-commerce supply chain, the value range of the commission rate is set to  $0 < r < 0.2$ , to explore the combined impacts of the commission rate and the e-platform's fairness concern coefficient on the revenue of both parties, as illustrated in Figure 23. Through comparative analysis, it is observed that when the SB perception coefficient is at a low level ( $t = 0.2$ ), as shown in Figure 23 (a), the e-platform is more inclined to maintain a revenue-dominant position. The rise of the e-platform's fairness concern coefficient will enhance the platform's own revenue, while curbing the revenue of the NB manufacturer. When the fairness concern coefficient is at a low level, the increase in the commission rate will promote the growth of the NB manufacturer's revenue. However, as the degree of fairness concern increases, a rise in the commission rate will result in a decline in the manufacturer's revenue. When the SB perception coefficient is set to 0.5, the e-platform only holds revenue dominance in a small parameter range. The rise of the fairness concern coefficient will decrease the NB manufacturer's revenue, while the e-platform's revenue presents a U-shaped trend of initial decline followed by subsequent growth with the increase of the commission rate. Ultimately, when the SB perception coefficient is at a high level ( $t = 0.8$ ), the NB manufacturer will occupy a dominant position in terms of revenue.

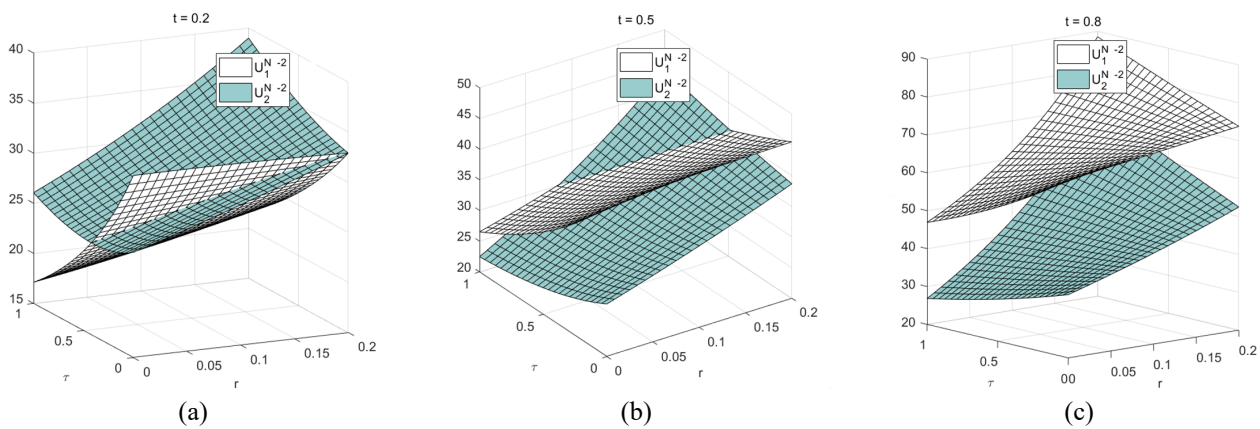


Fig.23. Impacts of  $r$  and  $\tau$  on revenues under different commission rates in case  $N-2$

### 5. Conclusion

The launch and continuous development of SB by e-platforms have emerged as a dominant development trend in the global retail sector, and this trend has shown an increasingly prominent growth momentum in recent years. With the intensification of market competition among e-platforms and the continuous diversification of consumer demand, SB have not only become a core strategic tool for platforms to carry out differentiated market competition, but also help platforms secure higher profit margins and stronger control over the supply chain and end market. On this basis, this study takes the e-platform as the market leader in the supply chain, who is responsible for determining the quality level of products in the market. By constructing Stackelberg game models under the fairness concern scenarios of different supply chain members, this study focuses on the influence mechanism of product quality levels on pricing decisions and revenue performance, and conducts a systematic comparative analysis of decision-making heterogeneity under two distinct fairness concern scenarios.

Our research yields several important and insightful theoretical findings. First, we find that when the e-platform acts as the market leader, brand advantage can no longer simultaneously drive the price growth of both supply chain parties. In case  $N-1$ , the enhancement of brand advantage exerts a positive promoting effect on the retail prices of both NB and SB products, though its driving effect on the retail price of SB products is extremely limited. In case  $N-2$ , brand advantage still has a significant positive effect on the retail price of NB products, but exerts a mild inhibitory effect on the retail price of SB products. In case  $N-1$ , brand advantage presents a positive promoting effect on product quality levels. However, in case  $N-2$ , the impact of brand advantage on product quality exhibits a two-stage heterogeneous feature. Specifically, when the commission rate is below a specific critical threshold, the increase in brand advantage will lead to a decline in product quality. Once the commission rate exceeds this critical threshold, the improvement of brand advantage will significantly enhance product quality.

Second, an increase in the commission rate will drive the simultaneous improvement of product quality and the retail prices of both supply chain members. The underlying mechanism for this phenomenon is that, as the market leader, the e-platform obtains higher revenue from the rising commission rate, and allocates this part of the income to product quality upgrading to attract more consumers and expand its market share, which in turn enhances consumers' willingness to pay a price premium for high-quality products. The rise of consumers' quality perception coefficient for SB products will not only lift the retail

price of SB products, but also drive the increase of NB product prices. The core heterogeneity lies in that, the promotion effect on the SB's price in case *N-1* is stronger than that in case *N-2*. In case *N-2*, when the commission rate is low, the SB may even lose its price dominance as the SB quality perception coefficient rises, with its retail price eventually surpassed by that of the NB.

Finally, our research demonstrates that in both case *N-1* and case *N-2*, the rise of the fairness concern coefficient can effectively improve product quality levels, but exerts an inhibitory effect on the retail prices of both NB and SB products. Moreover, when the commission rate is at a high level, the increase in the fairness concern coefficient will lead to a reduction in the revenue of the NB manufacturer, while driving the growth of the e-platform's revenue simultaneously.

Our study also provides significant and practical management insights and policy implications for market participants, industry regulators and policymakers. For e-platforms, when formulating and adjusting commission rate strategies, it is essential to fully take into account the fairness preference behaviors of supply chain members, as well as their heterogeneous effects on the revenue distribution among supply chain stakeholders and the overall market competition pattern. Under the condition that brand advantage and the SB quality perception coefficient remain unchanged, although raising the commission rate can narrow the price gap between SB and NB products and increase the e-platform's revenue (which may help the platform gain a dominant revenue position in the market), an excessively high commission rate will trigger market competition imbalance and the loss of cooperative manufacturers, ultimately leading to a decline in the platform's revenue. Therefore, it is critical to avoid price wars or excessive squeeze on upstream manufacturers' profit space caused by unreasonably high commission rates. For NB manufacturers, it is necessary to flexibly adjust their operational and pricing decisions according to commission rate changes, and should neither blindly adopt a low-margin and high-turnover strategy, nor simply transfer the increased commission costs to end consumers. Under a low commission rate scenario, the NB manufacturer should avoid over-reliance on its brand advantage to prevent product quality degradation. In the context of a high commission rate, the manufacturer can fully leverage its brand advantage to set a reasonable price premium, and maintain its revenue competitiveness through brand value.

For e-platforms, when formulating and adjusting commission rate strategies, it is critical to fully account for the fairness preference behaviors of supply chain members, along with their heterogeneous impacts on revenue allocation among supply chain stakeholders and the overall market competition pattern. With brand advantage and the SB quality perception coefficient held constant, while raising the commission rate can narrow the price gap between SB and NB products and boost the platform's revenue (potentially helping the platform secure a dominant revenue position in the market), an excessively high commission rate will trigger market competition imbalance and the loss of cooperative manufacturers, ultimately leading to a decline in the platform's overall revenue. For this reason, platforms must avoid price wars or excessive squeeze on upstream profit margins driven by unreasonably high commission rates. For NB manufacturers, it is necessary to flexibly adjust their operational and pricing decisions in response to changes in commission rates, and should neither blindly adopt a low-margin, high-turnover strategy nor simply pass on the additional commission costs to end consumers. In a low commission rate environment, manufacturers should avoid over-reliance on their brand advantage to prevent the degradation of product quality. Under a high commission rate scenario, they can fully capitalize on their brand advantage to set reasonable price premiums, and sustain their revenue competitiveness through brand value.

We briefly explain some limitations of this study and provide potential ideas and directions for future work. First, this study has not yet incorporated contract coordination into the research framework. Future research could on the one hand consider scenarios where both supply chain members exhibit fairness concerns. On the other hand, future work could introduce contract coordination mechanisms to mitigate the negative effects caused by fairness concerns thereby providing more practical and advantageous guidance for the actual operations of e-commerce supply chains. Furthermore, this study mainly focuses on the competitive game between a single NB manufacturer and a monopolistic e-platform. In actual operations NB manufacturers may establish a presence on multiple e-platforms and some or all of these e-platforms may offer SB. Therefore, future studies could consider supply chain structures involving dual platforms or dual brands to more comprehensively characterize the competition dynamics between platform SB and NB.

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#### **Data availability**

Data will be made available on request.

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## Endnotes

- <sup>1</sup> See <https://www.cnnic.cn/>.  
<sup>2</sup> See <http://images.mofcom.gov.cn/dzsws/202306/20230609104929992.pdf>.  
<sup>3</sup> See <https://www.163.com/dy/article/JGV6L1630514BOS2.html>.

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