For research article
Response to Reviewer 3 Comments
Dear Reviewer:
Thank you for your letter and the reviewers' valuable comments on our manuscript. We sincerely appreciate the time and expertise you have dedicated to evaluating our work.
We have carefully addressed all the comments and made substantial revisions to improve the manuscript. The changes are highlighted in red for additions.

Here is a series of specific modifications:

#1:**Introduction**
The introduction effectively frames the context of live-streaming commerce, the rapid growth of the business model, and the challenges of unequal bargaining power. Alao, the motivation for studying the "volume guarantee" mode is well explained.
The introduction is somewhat lengthy and includes detailed examples that could be moved to later sections.
The research gap could be stated more explicitly. For example: “Existing literature has inconsistent conclusions… therefore, our study introduces Nash bargaining fairness to address this gap.”
The research questions are present, but could be framed more directly at the end of the introduction in bullet points for clarity.
Try to condense the text, highlight the research gap more sharply, and clearly list contributions.
Response: Thank you for your constructive suggestion. We fully agree with your opinion. In the revised draft, we have significantly streamlined the introduction section:
1. **Streamlined content**: Some descriptive cases and background introductions have been removed to make the text more concise and the key points more prominent.
2. **Clarified research gap**: Following your suggestions, we have more directly pointed out the conflicting conclusions and limitations of existing research and clearly stated the research gap addressed in this paper.
3. **Clearly listed research questions and contributions**: At the end of the introduction, we have clearly outlined the three core research questions this paper aims to address. In the following paragraphs, guided by "First," "Furthermore," and "Additionally," we explicitly explain the main theoretical contributions and innovations of this paper, allowing readers to quickly grasp its core value.
We believe the revised introduction presents a clearer logic and more explicit research motivations and contributions. Here is the revised introduction:
1. Introduction
The live streaming is a new business model that has rapidly emerged in China and the world, it has opened up new sales channels and lowered market entry barriers, allowing more small and medium-sized enterprises (SMEs) and individual entrepreneurs to participate in the market economy (Kim et al., 2023). Through live streaming platforms, producers can interact directly with consumers, shortening the product chain from production to sales, enhancing efficiency, and reducing costs (Luo et al., 2025). Moreover, the format of live streaming adds a new dimension to product presentation. With live commentary and physical demonstrations by hosts, it enhances the shopping experience for users and increases the conversion rate of purchases (Bai et al., 2025).
However, some issues beneath the surface of prosperity are gradually exposed, particularly the inequality between live-streamers and manufacturers (Ye et al., 2024; Zhang et al.,2025). In the real life, the top live-streamer with a large size of fans often gain higher cooperative status and bargaining power due to their market impact, while small and medium-sized enterprises find themselves at a disadvantage due to their lack of brand influence (Qi et al., 2022). This phenomenon poses a severe threat to the healthy development of live-commerce and the socio-economic landscape (Lin et al., 2024). For instance, top-live-streamers may demand lower prices or higher commissions from

manufacturers, which can squeeze their profit margins (Duan et al., 2025). Moreover, to gain higher status, some live-streamers engage in data fraud such as "brushing orders," "buying followers," and "manipulating reviews," deceiving businesses and misleading consumers, resulting in a significant gap between actual live-commerce benefits and corporate expectations (Liu et al., 2025).

Many businesses enter the live-commerce field with high expectations for immediate sales results. However, the actual sales achieved through live streaming often fall short of expectations (Peng et al., 2024). The high costs and uncertain returns have led some companies to question the profitability of live streaming. As a result, the "volume guarantee mode" has emerged in live streaming, aiming to reduce manufacturers' risks and increase cooperation enthusiasm by ensuring sales volume (Zhang and Xu, 2023). Despite this, the unequal status between manufacturers and live-streamers seems to make the "volume guarantee mode" unappealing to the market and manufacturers, instead leading to more chaos in live-commerce and exacerbating issues such as data fraud, unfair competition, and contract disputes (Zheng, 2025).

To sum up, how manufacturers and live-streamers can make optimal decisions and design cooperation contracts to enhance social efficiency while ensuring mutual benefits has become a critical issue that urgently needs to be addressed for the development of live streaming.

However, Research on power asymmetry between manufacturers and live-streamers has yielded valuable yet conflicting insights. Qi et al. (2022) found manufacturers may sacrifice system efficiency with ordinary streamers but face profit loss with top influencers. Conversely, Ye et al. (2024) showed seller preferences are threshold-dependent on industry bargaining power and compensation demands. And, these studies share a critical limitation: they overlook the defining features of live-streaming supply chains, particularly the social network effect and strategic public domain traffic costs. This omission likely contributes to their inconsistent findings and limits their ability to propose effective coordination mechanisms against issues like data fraud and contract disputes (Zheng, 2025).

To address this gap, this article takes Nash bargaining fairness as the research background, considers the social network effect and traffic cost of live streaming, and uses the Nash bargaining model to depict the game behaviors between platforms, manufacturers, live-streamers, and consumers. This article analyzes the optimal supply chain decisions under the “general” and the “volume guarantee” commission mode, and explores the impact of social network attributes, fan size, and traffic costs on supply chain decisions (commission mode selection, price setting, traffic purchase), supply chain profit and social welfare. Within this framework, the following three issues were mainly studied under Nash bargaining fairness:

➢ (1) how do supply chain decisions, revenue, and social welfare depend on factors such as public traffic costs, social network effects and fan size of live-streamer?

➢ (2) how efficient is the “volume guarantee” mode, and is it better than the “general” mode?

➢ (3) how does unequal status (bargaining power) affect supply chain decision-making, profit and social welfare?

By examining the above issues, our results yield novel insights into coordination mechanisms within live commerce supply chains.

- First, we demonstrate that under a fair profit-sharing scheme, manufacturers and streamers can achieve supply chain coordination without relying on external "volume guarantee" contracts. This outcome is unique to environments where long-term cooperation and fairness are valued, as the Nash bargaining solution endogenously aligns individual incentives with the collective optimum.
- Furthermore, our analysis highlights the critical role of the streamer's social network. The size of the fanbase not only directly boosts demand but also amplifies the effectiveness of platform-based traffic, creating a multiplier effect on overall profits and social welfare.
- Additionally, we uncover a fundamental decoupling within the supply chain coordination mechanism: while the bargaining power determines the distribution of profits, it does not distort the operational decisions (pricing and traffic acquisition) that maximize the total supply chain value. This finding reveals that under Nash bargaining fairness, the pursuit of

individual interest naturally aligns with collective efficiency, making complex "volume guarantee" contracts redundant for coordination.

The structure of next parts is arranged as follows. The chapter 2 will sort out the literature related to the article and the contributions of this article. The chapter 3 constructs the basic model based on bargaining game. The chapter 4 solves the game equilibrium of the basic model, and analyzes the influence of social network effect and other factors on the equilibrium solution. The chapter 5 analyzes the basic model from two aspects: the difference of bargaining power and the maximization of social welfare. The chapter 6 summarizes the full text, summarizes the relevant management enlightenment and shortcomings.

#2: **Literature review**

The review is comprehensive, covering social operations management, supply chain decision-making in live streaming, and cooperation mode selection. It references relevant studies and explains how the paper extends prior work.

However, the section is very long and descriptive; at times it lists studies without strong synthesis.

It should emphasize more clearly what this paper adds beyond existing state of knowledge.

Some cited works are working papers (e.g., Qi et al. 2022 on SSRN); where possible, updated journal versions should be cited.

Try to synthesize findings into a table or figure if possible, and strengthen the statement of contribution relative to prior studies.

Response: Thank you for your suggestion. We have made key revisions to this section:

1. **Enhanced Synthesis**: We restructured the literature review, moving beyond a simple listing of references to better highlight the underlying logic and developmental trajectory. For example, in the social network effects section, we organized the review based on the "basic mechanisms-practical applications" framework, while in the supply chain decision-making section, we categorized the literature according to the decision-making entities: "platform-manufacturer-livestreamer."
2. **Highlighting Contributions**: We added a new subsection, "2.4 Research Gaps and Our Contributions," to systematically summarize three key research gaps and correspondingly articulate the theoretical contributions of this paper.
3. **Updated Citations**: We have verified and updated all cited references, ensuring that, where possible, formally published journal versions replace earlier working paper citations.
4. **Added Summary Table**: To more clearly present the literature framework and our contributions, we included a summary table comparing key studies' research focuses, main findings, and differences from our work, thereby clearly highlighting our innovations.

After the above steps, the revised literature review section is as follows:

2. Literature review

The rapid development of live streaming commerce has sparked extensive academic research into its operational mechanisms and efficiency. As it shown in Table 1, this study engages with three interconnected domains: social network effect, supply chain decision making, and cooperation mode selection in live streaming. This review systematically examines key literature across these fields to clarify current research progress and limitations, particularly focusing on how to optimize supply chain decisions and enhance efficiency and social welfare through fair cooperation contract design (especially commission models) in live streaming commerce, while considering core characteristics such as social network effects and traffic costs. This foundation establishes the groundwork for our research and highlights its innovative value.

Table 1: Literature Summary and This Study's Contributions

Research Stream	Representative Literature	Focus of Existing Studies	Research Gaps	Contributions of This Study
Social Network	Hu and Chaudhry	Consumer engagement	Lack of integration with	Integration of social network effects into a

Research Stream	Representative Literature	Focus of Existing Studies	Research Gaps	Contributions of This Study
Effects in Live Streaming	(2020); Kim et al. (2023); Jing et al. (2025)	drivers; Platform paradigm amplified by network effects.	**bargaining fairness** and **joint supply chain decisions**.	**Nash bargaining framework** to analyze joint decisions and enhance efficiency.
Supply Chain Decision-Making in Live Streaming	H. Liu and S. Liu (2021); Ji et al. (2022); Lin et al. (2024); Zhang et al. (2025)	Platform fees; Pricing/quality decisions; Streamer effort/commission; Power structures.	Omission of explicit **fairness mechanisms**; Underexplored solutions for **equitable cooperation**.	Introduction of **Nash bargaining** to endogenize fairness. Demonstration of **efficiency-equity separation** (power affects distribution, not operations).
Cooperation Mode Selection in Live Streaming	Abhishek et al. (2016); Wang et al. (2024); Zhang and Xu (2025)	Comparison of resale vs. agency selling; "Volume guarantee" mode analysis.	**Inconsistent findings** on commission structures; Lack of theoretical guidance for **equitable contracts**.	Proof of the **ineffectiveness of the "volume guarantee" mode** under fair bargaining, providing a theoretical explanation for market observations.

The specific research details are as follows：

2.1. Social network effect in live streaming

As e-commerce evolved from the traditional shelf model to a trust-based and people-centered content model, live streaming commerce has been endowed with strong social attributes (Lu et al., 2016). The key to its development lies in leveraging the emotional trust and social presence fostered through interaction. Live streaming enhances the buyer's shopping experience and trust via real-time interaction between buyers and sellers. Streamers and consumers establish quasi-social relationships during live sessions, positively influencing consumers' purchase intention (Shan et al., 2020).

Existing scholarship has systematically validated the pivotal role of social network effects in enhancing live-streaming commerce. Foundational studies demonstrate that social ties, structural dynamics, and financial incentives collectively shape consumer engagement. Hu and Chaudhry (2020) established a theoretical framework integrating stimulus-organism-response models and relationship marketing theory, revealing that emotional commitment mediates the impact of both social and structural ties on participation, whereas financial ties exert indirect influence through this emotional conduit. Yu et al. (2023) subsequently extended this framework through a survey of 515 viewers, identifying direct positive correlations between social network effects and three dimensions of consumer support: emotional, instrumental, and economic. These findings have been further corroborated and refined in recent research by Zou

and Fu (2024), Shen and Wang (2024), and Khan et al. (2025), which collectively underscore the multidimensional mechanisms driving social influence in this domain.

Beyond foundational mechanisms, contemporary studies have explored advanced applications of social network dynamics. Kim et al. (2023) conceptualized live streaming as a platform paradigm amplified by network effects, positing that value creation follows a self-reinforcing feedback loop as streamers expand their follower networks and consumer bases synergistically. Fan et al. (2024) analyzed manufacturer strategies, demonstrating that stronger social connections between streamers and consumers increase the ROI of collaborating with high-influence streamers. Jing et al. (2025) introduced a multi-unit bargaining framework to examine manufacturer-influencer negotiations,

revealing that social influence exacerbates competitive disparities through a Matthew effect—dominant influencers consolidate market power at the expense of weaker players, compelling manufacturers to adopt dynamic partnership strategies. These advancements illustrate how social network effects transition from participation drivers to strategic decision-making levers in live-streaming ecosystems.

2.2. Supply chain decision making in live streaming

The inherent heterogeneity in streamer behavior underscores that live streaming commerce does not uniformly benefit manufacturers (Niu et al., 2023), necessitating nuanced research into supply chain decision-making. Early scholarship primarily addressed platform-level strategies, revealing how profit-sharing mechanisms shape operational outcomes. For instance, H.Liu and S.Liu (2021) demonstrated through Stackelberg game models that higher platform commission rates inadvertently suppress streamer effort, ultimately diminishing profits for all parties—a critical insight into incentive misalignment.

Concurrently, manufacturers' operational choices emerged as a central research strand. Ji et al. (2022) pioneered this domain by integrating social interaction effects into game-theoretic frameworks, establishing optimal pricing and quality decisions for celebrity-driven sales—a foundation this study formally extends. Subsequent work deepened this inquiry: Lin et al. (2024) employed Nash bargaining to dissect manufacturer-streamer negotiations, uncovering a strategic dilemma where brands face lower profits in live sales compared to traditional channels; crucially, they found that under low product-availability scenarios, prioritizing higher commissions over price reductions maximizes manufacturer returns. Further complexity was revealed by Zhang et al. (2025), whose analysis of power structures showed that product quality deteriorates under both streamer-dominated and manufacturer-dominated regimes

when commission ratios rise, whereas centralized decision-making preserves quality—highlighting governance as a key variable.

Parallel research explored streamer-centric strategies, focusing on commission structures (Qi et al., 2022) and effort optimization (Lin et al., 2024). These studies implicitly acknowledged the symbiotic manufacturer-streamer relationship, where commission rates and promotional effort directly influence pricing flexibility, sales volume, and joint profitability. Yet, this interdependence remained underexplored within a unified fairness framework—a gap this study addresses by embedding Nash bargaining as a core mechanism.

2.3. Cooperation mode selection in live streaming

Supply chain decision-making aims to maximize profit in live streaming e-commerce. How this profit should be distributed, and how distribution affects the decisions and behaviors of supply chain actors, represents a subsequent challenge (Yang et al., 2024).

Currently, similar to general online sales, the primary cooperation modes are resale mode and agency selling mode, and the resale mode involves the streamer purchasing products wholesale from the manufacturer (Abhishek et al., 2016), the agency selling mode is commission-based, forming a principal-agent relationship (Fan et al., 2020). Numerous studies have explored the choice between these modes, considering factors such as fixed service fees (Zhang et al., 2023), discount pricing strategies (Ji et al., 2023), return policies (Hao and Yang, 2023), commission strategies (Wang et al., 2024) and Brand effect of manufacturers (Niu et al.,2025). For example， Wang et al. (2024) modeled a platform retail supply chain's sales/marketing choices via Stackelberg game to derive live-streaming agreement equilibria, finding retail prices rise with commissions and advising suppliers to partner with high- or low-influence streamers (not moderate) when using live channels.

On this basis, the "volume guarantee mode " studied in this paper is essentially a sub-model that influences the collaboration between manufacturers and streamers. Existing research often refers to it as the "target sales volume" or "sales commitment" (Xiao et al., 2024). Some studies suggest that this model can reduce streamers' moral hazards and enhance the stability of collaboration through shared risk allocation and incentive compatibility (Xu et al., 2024; Zhang and Xu ,2025). For example, Zhang and Xu (2025) investigated optimal proportional incentive contract design in live streaming

supply chains, demonstrating its superiority over linear contracts in achieving first-best solutions under threshold conditions and enhancing performance through commission-driven incentives.

2.4. Research gap and our contribution

Despite significant progress, critical gaps remain in the existing literature:

(1) While social network effects are recognized (Kim et al., 2023; Jing et al., 2025), their integration with bargaining fairness and its impact on joint supply chain decisions (pricing, traffic acquisition, commission bargaining) within the live streaming context requires deeper exploration.

(2) Research on supply chain decision-making has extensively analyzed factors like platform fees (H.Liu and S.Liu, 2021), manufacturer pricing/quality (Ji et al., 2022; Zhang et al., 2025), and streamer effort/commission (Lin et al., 2024). However, a key limitation is the frequent assumption of unequal power structures or the omission of explicit mechanisms to ensure fairness in the bargaining process between manufacturers and streamers. The inherent power imbalance is acknowledged as a problem (Ye et al., 2024; Zhang et al., 2025), but solutions promoting equitable cooperation are underexplored.

(3) Studies on cooperation mode selection, particularly regarding commission structures like the "volume guarantee" mode, reveal inconsistencies and practical challenges. For instance, conclusions about manufacturer preferences for influencers differ between Qi et al. (2022) and Ye et al. (2024), highlighting the difficulty in achieving fair decision-making. Existing research offers limited theoretical guidance for designing contracts that foster equitable cooperation between manufacturers and streamers, which is crucial for mitigating issues like data fraud and contract disputes (Zheng, 2025).

Therefore, this study bridges these gaps by introducing Nash bargaining fairness as the core research background. We incorporate the essential characteristics of live streaming—the social network effect and the streamer's public domain traffic purchasing behavior—to construct a dynamic game model involving the platform, manufacturer, streamer, and consumer. Within this framework, we analyze commission mode selection (comparing the "general" mode and the "volume guarantee" mode) and supply chain decision-making under fairness constraints.

#3: **Methodology**

The game-theoretical model is rigorous and carefully developed. Moreover, assumptions about players are clearly stated.

However, the section is mathematically dense, which may discourage some readers. Only one figure is included, more visual would improve accessibility.

Take care, the realism of some assumptions (such as symmetric information, uniform distribution of consumer valuation) is not fully justified.

Add intuitive explanations alongside formulas, provide numerical examples, and briefly discuss limitations of assumptions.

Response: We greatly appreciate your specific and important suggestions for revision.

1. **Adding intuitive explanations and numerical examples**: We have incorporated intuitive economic or managerial explanations alongside key formulas and derivations to help readers grasp the intuition behind the models. Additionally, in the results analysis section (Chapter 4), we have included multiple numerical examples and sensitivity analysis charts to visually demonstrate how parameter changes affect equilibrium outcomes, making theoretical findings more intuitive and accessible. For example, regarding Proposition 1(in Page 10), Proposition 2(in Page 11), and Proposition 5(in Page 15), we conducted numerical simulations for verification, as detailed below.

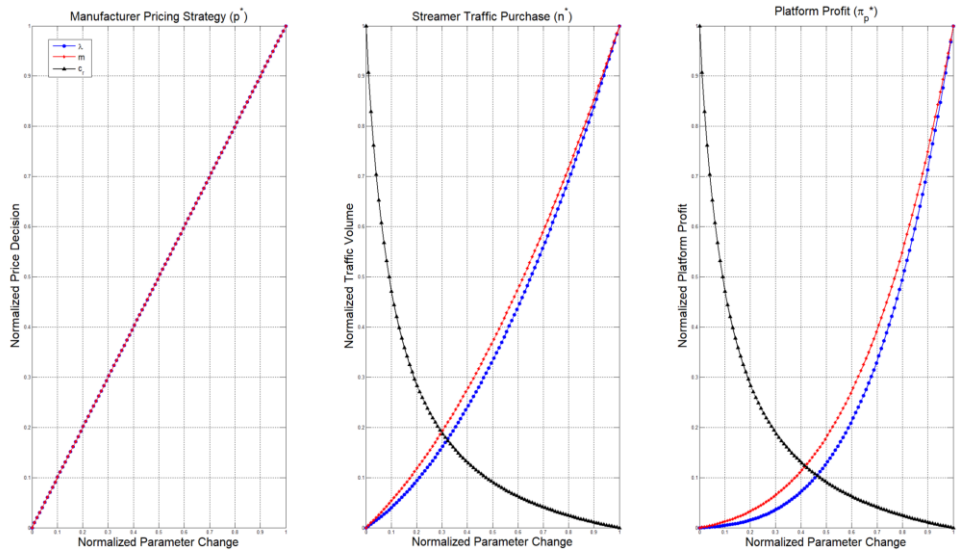


Figure 2. Supply Chain Decision Sensitivity Analysis（Let u=1, α=0,k=1）.

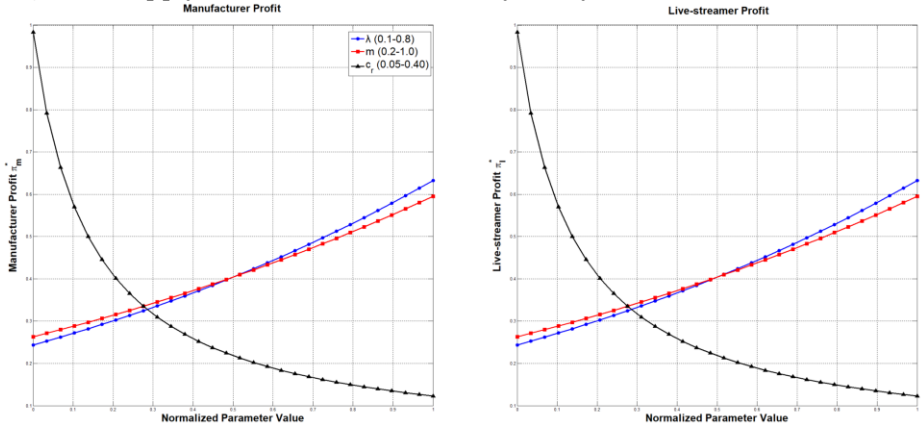


Figure 3. Supply Chain Profits Sensitivity Analysis（Let u=1, α=0,k=1）.

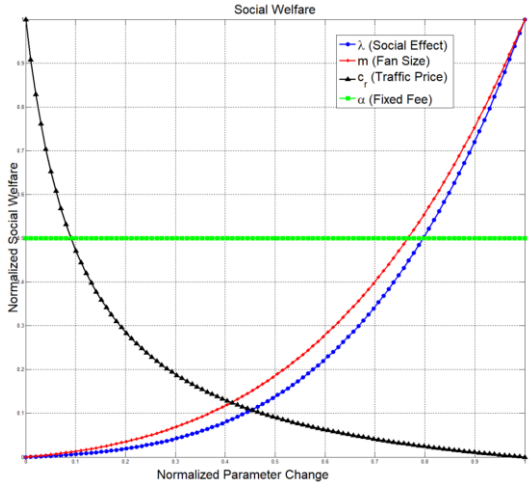


Figure 4. Social Welfare Sensitivity Analysis（Let u=1, k=1）.

2. **Discussing the reasonableness of assumptions**: In the model assumptions section (Section 3.3), we have added a dedicated paragraph discussing the rationale and limitations of key assumptions (such as symmetric information and uniformly distributed consumer valuations). We acknowledge that these assumptions simplify reality but emphasize that they are widely adopted in the relevant literature, facilitating analytical solutions and focusing on core mechanisms. We also note them as potential directions for future research relaxation (mentioned in the conclusions and future outlook section). Here are some details:

3.3. Research assumptions

(1) For the consumer

Different from the traditional sales channels, the live streaming with goods can enhance the emotional utility of the individual by establishing the emotional connection between the live-streamer and the audience. This is the source of social network effect, which helps to expand the influence of live streaming. However, this emotional connection is often linked by consumers' trust in the live-streamer, and there are great differences due to the personal characteristics of the live-streamers. In live streaming, the size of the live-streamer's fans is often the most intuitive representation of consumers' trust in the live-streamer, which can well reflect the live-streamer's influence in the social network. Therefore, we note the social network effect as λm，$\lambda m<u$. Where λ is the social network effect coefficient, and m is the average online fan size of live-streamer. It should be noted that the larger the average online fan size, the larger the live-streamer's fan size will generally be. Therefore, this paper also uses m to characterize the live-streamer's fan size.

Referring to the general expression of consumer utility, assume the expected utility of consumers is:

$$u_c = v + \lambda m - p \qquad (1)$$

v is the consumer's estimate of the value of the product. Without losing the generality, we note v~$U(0,u)$, which is the

fundamental embodiment of consumer heterogeneity, indicating that not all consumers entering the live studio have a desire to buy the product. In fact, this is a relatively common simplifying assumption in model construction, aimed at facilitating the derivation of analytical solutions for subsequent problems and their analysis. Many authoritative journal articles adopt this assumption (Den et al., 2022; Wang et al., 2025). In reality, consumers' value estimates often follow more complex and even unobservable distributions, which we will continue to refine in future research. λm is the social network effect, which is an important manifestation of the difference between live streaming and other channels; p is the retail price of the product in the live streaming.

Therefore, the market demand function is:

$$D = (m + n)\frac{(u-p+\lambda m)}{u} \qquad (2)$$

n is the number of consumers attracted into the live room through purchasing public domain traffic. This demand function reflects the unique structure of live-streaming sales, where total demand is jointly composed of the anchor's private traffic (online fans m) and paid public traffic n, and is modulated by the social network effect λm and product price p.

(2) For the manufacturer

The manufacturer can decide the price of the product independently, but the commission needs to bargain with the live-streamer. Suppose each unit of the product sold must pay a reward to the live-streamer β, that is the commission after the bargaining. In fact, the manufacturer always needs to pay a fixed service fee to the live-streamer, which is recorded as α. Therefore, the expected profit of the manufacturer is:

$$\pi_m = D(p - \beta) - \alpha \qquad (3)$$

This profit function reflects the actual revenue of manufacturers in live-streaming sales, where manufacturers pay a slotting fee while also needing to pay a certain percentage of sales as commission to the host. However, for the convenience of subsequent solving and analysis, we have simplified the form of the commission by directly assuming a fixed commission amount rather than as a proportion of the price. Nevertheless, this simplification does not affect our analysis of the results.

(3) For the live-streamer

In live streaming, the traffic in the live streaming room is generally composed of online fans (private domain traffic) and platform traffic (public domain traffic, the number of consumers recommended by the platform to the live streaming room). The live-streamer need not to pay for the online fans, but the platform traffic needs to be paid to the platform. Using the general cost and utility transformation function form for reference, let the

public domain flow cost be $12kn2cr$. Therefore, the expected profit of the live-streamer is:

$$\pi_l = \alpha + D\beta - \frac{1}{2}kn^2c_r \qquad (4)$$

It should be noted that，$12kn2$ represents the total amount of public domain traffic that needs to be purchased to convert n units of consumers into the live room. This form is more common in previous

studies that describe the cost problem (Liu et al., 2020; Li et al.,2021), and it indicates that the cost of traffic conversion increases, that is, with the increase of conversion volume, consumers per conversion unit entering the live room need to buy more public domain traffic. k is the conversion coefficient of public domain traffic. cr is the price of unit traffic which set by the platform. In reality, the platform often adopts intelligent recommendation, and will give priority to users who are interested in the product. The user recommended in advance are more likely to enter the live streaming room, and it will gradually decrease in the next recommendations. This form is exactly the description of this realistic background.

#4: **Results**

Some results repeat what is already intuitive (see this: higher traffic costs reduce welfare) without adding strong novelty.

Add figures or numerical case studies to illustrate the theoretical findings; emphasize the non-intuitive insights.

Response: Thank you! We have carefully considered your feedback and optimized the results section as follows:

1. **Highlighting Counterintuitive Findings:** We emphasized and conducted in-depth analysis on the non-intuitive or counterintuitive conclusions drawn in this paper. For example:

◦ Larger fan size lead to more purchases of public traffic in Page 10 (contrary to the intuition that "more fans mean less need to buy traffic").

A particularly counterintuitive finding emerges regarding the live-streamer's traffic acquisition behavior: rather than decreasing as the follower base expands, it increases. This observation contradicts the conventional intuition that a larger follower base naturally reduces the need for external traffic purchases. The underlying rationale is that a larger follower base enhances the live-streamer's social influence and amplifies the social network effects experienced by consumers. Consequently, the live-streamer becomes more effective at converting potential consumers attracted by public domain traffic into actual buyers. This increased conversion efficiency justifies a higher willingness

to pay for each unit of public domain traffic, leading to greater traffic investment.

◦ Under Nash bargaining fairness, the 'guaranteed volume model' is always ineffective in Page 12 (contrary to the practice of promoting this model to incentivize sales).

Furthermore, a more significant finding emerges from our examination: the profits of the manufacturer and the live-streamer are invariant to the service fee α. The underlying rationale is that the bargaining process between the manufacturer and the live-streamer regarding the commission rate is, in essence, a negotiation over how to split the total revenue generated by the live-streaming activity. Within this framework, the service fee α acts merely as a transfer price or an internal accounting tool that recalibrates the baseline for commission negotiation. Consequently, it does not influence the final equilibrium of the profit-sharing arrangement, which is determined primarily by the relative bargaining power of the two parties.

◦ Bargaining power does not affect supply chain operational decisions (pricing, traffic) but only profit distribution in Page 14 (revealing the separability of efficiency and fairness).

The Proposition 3 offers an explanation, grounded in traffic cost and social network effects, for the widespread industry resistance to the "volume guarantee" commission mode. It demonstrates that regardless of which party—the manufacturer, the live-streamer, or both—sets the sales target threshold, the ultimate decisions on pricing, traffic acquisition, and the commission structure remain identical to those in a general mode without any threshold. This indicates that the contract designed under Nash bargaining fairness is already optimized; manufacturers and live-streamers cannot find a superior alternative to this arrangement.

The underlying reason for this phenomenon lies in the supply chain contract framework based on Nash bargaining fairness. Within this framework, the manufacturer and the live-streamer engage in a bargaining process to distribute the total profits generated from the live stream. The only avenue for either party to increase its own profit is to first expand the overall profit pie created by the

collaboration. Consequently, maximizing total supply chain profit becomes a common goal for both parties. To achieve this, they will consciously adopt optimal decisions without needing the external imposition of a sales threshold M.

This leads to the counterintuitive conclusion that the "volume guarantee" clause is essentially redundant under Nash bargaining fairness. The mutual desire to maximize the total profit pool naturally aligns their incentives, making additional restrictive thresholds unnecessary for ensuring efficient outcomes.

We discussed these counterintuitive findings in detail in the main text and provided economic explanations.

2. **Adding Charts for Clarity:** As mentioned above(#3), we added multiple sensitivity analysis charts (Figures 2, 3, 4) to visually illustrate the impact of key parameters—such as social network effects, traffic costs, and fan base size—on decisions, profits, and social welfare, making the results more compelling.

#5: **Discussions**

The discussion could be expanded to include potential policy implications.

It lacks reflection on limitations of the model and directions for future research (beyond what is briefly mentioned in the conclusion).

Response: Thank you for your constructive suggestion. We fully accept your suggestions and have made the following additions:

1. **Expanded discussion with policy implications:** We have explicitly added insights from our research findings for platforms, manufacturers, and policymakers in the Discussion section (Chapter 5 and the "Managerial Implications" section of Chapter 6). For example, we recommend that platforms implement differentiated traffic pricing strategies for top live-streamers to enhance social welfare, and suggest that policymakers encourage transparency in collaborations to reduce the risk of data fraud.

2. **Strengthened limitations and future research:** In the Conclusion section (Chapter 6), we have dedicated a subsection titled "6.3 Limitations and Future Research Directions" to systematically outline the main limitations of our model (e.g., the perfect information assumption, the single manufacturer-streamer scenario, and the focus on convergence effects). Based on these limitations, we have proposed several clear directions for future research (e.g., introducing information asymmetry, considering competitive environments, studying divergence effects, and conducting empirical validation).

The details of partial modifications are as follows:

6. Conclusion

The live streaming has emerged as a dominant force in e-commerce, fundamentally reshaping supply chain dynamics by integrating social networks with retail operations. This paper investigates how this integrated model influences the decisions of manufacturers, streamers, and platforms by developing a four-party game-theoretic framework that incorporates Nash bargaining to capture fairness concerns.

6.1. Summary of Main Findings

Our investigation yields several pivotal findings that challenge conventional wisdom and provide fresh perspectives on operational decision-making in this dynamic domain.

First, and most significantly, the study proves the inherent ineffectiveness of the "volume guarantee" mode under conditions of bargaining fairness. As established in Proposition 3, regardless of whether the sales threshold is set by the manufacturer, the live-streamer, or through joint negotiation, the resulting equilibrium decisions—optimal product pricing, traffic acquisition volume, and supply chain profit—are identical to those under the simpler "general" commission mode. This fundamental finding provides a theoretical explanation for the industry's observed resistance to such clauses. The reason is that Nash bargaining fairness inherently aligns the individual objectives of both parties with the goal of maximizing the total pie (joint profit). Any attempt to artificially constrain the outcome

with a sales threshold becomes redundant, as both parties are already intrinsically motivated to implement the system-optimal decisions.

Second, the research quantifies the dual role of the social network effect, moving beyond qualitative descriptions. Proposition 1 reveals that the social network effect coefficient and the streamer's fanbase size act as complementary drivers that simultaneously increase the optimal product price, the optimal traffic purchase volume, and the commission rate. This positive correlation between fanbase size and traffic acquisition is particularly noteworthy, countering the intuition that larger fanbases reduce the need for paid traffic. Instead, as Proposition 2 clarifies, a larger fanbase amplifies the marginal utility of each unit of acquired traffic by enhancing consumer trust and social utility, thereby making additional traffic investments more profitable. This creates a virtuous cycle where influential streamers can justify both higher prices and greater marketing expenditures.

Third, the model delineates the distinct impact of bargaining power from operational decisions. A key insight from Proposition 4 is that while the relative bargaining power of the manufacturer and streamer directly affects the profit distribution by influencing the final commission, it has no bearing on the optimal product price or traffic volume. This separation indicates that the efficiency of the supply chain (the size of the total profit) is determined by market factors and the social network, while the equity of the collaboration (the division of profit) is determined by bargaining power. This finding underscores that fostering operational efficiency and ensuring fair profit distribution are two separate, addressable challenges.

Finally, the analysis provides clear guidance for social welfare optimization. Proposition 5 establishes that social welfare increases with the social network effect and fanbase size but decreases with the platform's traffic price. This leads to a

critical managerial implication, formulated in Corollary 1: platforms can enhance overall welfare by implementing a differentiated traffic pricing strategy. Reducing traffic costs for top streamers with large fanbases encourages higher traffic acquisition, which in turn boosts transactions, supply chain profits, and consumer surplus, creating a more vibrant and efficient ecosystem.

6.2. Theoretical and Practical Implications

The findings carry significant implications for both theory and practice. Theoretically, this study contributes to the literature on supply chain coordination by introducing Nash bargaining fairness as a viable and efficient alternative to traditional incentive contracts in settings characterized by intense human interaction and relationship-building, such as live streaming. It bridges the gap between operations management and social commerce theories by formally modeling the economic value of trust and social influence.

From a practical standpoint, our results offer clear guidance for various stakeholders:

For Manufacturers: The pursuit of partnerships should prioritize streamers with a large and engaged fanbase, as the social network effect is a quantifiable driver of profitability. More importantly, managers can simplify contract negotiations by moving away from difficult-to-enforce "volume guarantee" clauses and focusing instead on establishing a fair bargaining process for profit-sharing. For example, a small cosmetics brand could prioritize collaboration with a beauty streamer who has a highly engaged community of 1 million followers, even if the commission rate is higher, because the amplified social network effect can justify the cost and lead to higher total profit than partnering with ten streamers each having 100,000 followers.

For Platforms: The pricing of public domain traffic should not be uniform. To enhance overall ecosystem health and social welfare, platforms should adopt a differentiated pricing strategy, offering preferential rates to high-impact streamers. This encourages greater traffic acquisition, boosts transaction volumes, and creates a virtuous cycle of growth. A platform could implement a tiered traffic pricing system. For instance, streamers with over 10 million followers might receive a 20% discount on public traffic purchases, incentivizing them to drive more transactions and enhance overall ecosystem vitality, as indirectly supported by the exclusive partnerships between platforms and top streamers like Xinba.

For Policymakers: Encouraging transparency and fairness in manufacturer-streamer collaborations can help mitigate the risks of data fraud and contract disputes, promoting the sustainable

development of the live-streaming industry. For instance, a public certification system for streamers' follower authenticity and sales performance data could be developed. This would
reduce information asymmetry between manufacturers and streamers, mitigate risks of data fraud, and create a more trustworthy ecosystem where Nash bargaining fairness can be effectively achieved.

6.3. Limitations and Future Research Directions

While this study provides valuable insights, it is not without limitations, which also present opportunities for future research.

First, the model operates under the assumption of perfect information. Future work could incorporate information asymmetry, such as the streamer's private knowledge about their true conversion capability or the prevalence of "fake followers," which would introduce signaling and screening dynamics.

Second, the model focuses on a single manufacturer-streamer dyad. Extending the analysis to a competitive setting with multiple streamers or manufacturers would yield insights into market structure and competitive strategy.

Finally, the social network effect is modeled primarily as a convergence mechanism. Investigating products where consumer behavior is driven by a desire for differentiation (e.g., luxury goods) would require integrating divergence effects into the model. Empirical validation of the proposed model using real-world transaction data from leading platforms represents another promising research avenue.

Once again, we sincerely appreciate the insightful review and invaluable suggestions from the reviewers. Your comments have greatly helped us improve the rigor, clarity, and academic contribution of our paper. We have thoroughly and carefully revised the manuscript based on all your feedback. We believe the revised version has significantly enhanced quality and hope it now meets the journal's publication standards.

We kindly request your review once more. Should there be any further questions or suggestions, we are ready to make additional modifications and improvements.

Best regards,