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When should suppliers introduce a live-stream channel: The role of limited supply capacity

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A R T I C L E I N F O

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A B S T R A C T

The growth of e-commerce has driven numerous suppliers to adopt live-stream channels. However, most studies fail to account for capacity limitations in supply chains. This study examines a supplier with limited capacity collaborating with a streamer to conduct live-stream sales. Using a game-theoretical approach, we analyze how capacity constraints affect a supplier's decision to introduce live streaming through either direct or reselling channels. Our analysis reveals that a supplier is more likely to adopt a live-stream channel when the commission rate and consumers' additional costs associated with the live-stream channel are relatively low, provided capacity is not severely limited. Interestingly, even with a reselling channel, a supplier may benefit from a live-stream channel when consumer costs are relatively high. Moreover, a supplier with moderate capacity can sustain a live-stream channel at higher consumer costs than a supplier with low capacity. The study also reveals that the introduction of a live-stream channel always increases consumer surplus but does not consistently improve social welfare unless capacity is relatively abundant. Suppliers using direct channels require greater capacity to enhance social welfare than those using reselling channels. Furthermore, these results are robust across various extensions of the model.

1. Introduction

Live-stream e-commerce has experienced explosive growth in recent years (Bründl and Hess, 2016; Cai and Wohn, 2019; Li et al., 2023; Yu et al., 2018). In China, the market expanded from $575.41 billion in 2019 to nearly $685.06 billion in 2023, with projections reaching $1179.4 billion by 2026.[1] In the U.S., live-stream sales are expected to reach $35 billion by 2024, accounting for over 5 % of total e-commerce sales by 2026.[2-,3] Live-stream commerce integrates live broadcasting with e-commerce platforms, where streamers (or influencers) demonstrate and introduce products in real time and interact with viewers. This format reduces consumer uncertainty regarding product quality and showcases additional features that are not evident in traditional e-channels. As a result, live-streaming

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[1] https://www.statista.com/statistics/1127635/china-market-size-of-live-commerce/.
[2] https://www.ghostretail.com/post/top-live-shopping-statistics.
[3] https://www.shopify.com/enterprise/live-shopping.

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enhances the shopping experience, builds trust, and boosts demand (Hajli, 2015; Hou et al., 2022; Lu and Duan, 2024). Beyond selling products, streamers provide entertainment or educational live shows that offer value to viewers who do not make purchases (Gu et al., 2024). For example, Dong Yuhui, a former English teacher, blends discussions on history, culture, and personal experiences into his sessions, casually promoting product links during breaks. These engaging efforts, unrelated to product attributes, further enhance the shopping experience and drive demand (Hu et al., 2025; Zhao et al., 2024).

However, live-stream purchasing incurs additional costs to consumers, such as the need to participate during fixed session times instead of making on-demand purchases. Limited-time offers and promotional tactics can encourage impulse buying, potentially leading to higher product returns and reduced consumer utility. Consumers weigh the benefits of live-stream shopping against these extra costs to determine their preferred purchasing channel. Meanwhile, suppliers evaluate live-stream strategies by balancing the revenue potential against commission fees and the possible cannibalization of profits from traditional sales channels.

Suppliers typically collaborate with streamers in one of two primary ways to engage in live-stream sales. The first approach involves suppliers hiring streamers to sell their products through their own channels, such as online direct selling channels, in which live-stream prices are set by the suppliers. For example, Anta and Haier use this approach for live-stream sales (Yang et al., 2023; Zhang, 2023). This is similar to supplier encroachment, in which streamers focus on driving sales through supplier channels. The second approach involves suppliers collaborating with live-stream rooms operated by streamers under revenue-sharing contracts. In this case, streamers hold pricing power within the live-stream channel. For example, Estee Lauder, Lancôme, and YSL entrust their product sales to Li Jiaqi's live-stream room at a discounted price set by Li Jiaqi's team (Xin, 2020). The key distinction between these two approaches is who controls the pricing for the live-stream products. This study focuses on the latter form, as it better captures the dynamics of pricing strategies between suppliers and streamers as well as the expansionary impact of introducing live-stream channels on consumer demand.

The willingness to introduce a live-stream channel is driven by the expansion of consumer demand, making it highly attractive to brand suppliers (Sheu and Choi, 2019). Despite the need to pay commissions to streamers, collaborating with influential figures can boost consumer demand and sales substantially. Consequently, numerous suppliers, including Wuliangye and Samsung, enthusiastically embraced live-stream e-commerce to enhance product sales.[4].[5] Moreover, from a government perspective, the introduction of live-stream channels can benefit consumers and social welfare by improving consumer utility and increasing sales. For example, during the COVID-19 pandemic, the Chinese government encouraged suppliers to leverage live-stream channels to address disruptions in traditional sales channels for agricultural products. In some cases, local government officials have hosted live streams to promote and endorse local agricultural products (Wang et al., 2020; Si. 2021; Yu and Zhang 2022). This initiative not only helped agricultural suppliers manage excess capacity but also offered consumers various purchasing choices, thereby improving overall social welfare. However, despite the profitability and policy support associated with this sales channel, many suppliers, including major brands, such as Apple and Moutai, are yet to fully embrace it. Examples of diverse supplier decisions regarding the adoption of a live-stream channel are shown in Table 1.

A plausible explanation for the diverse industry practices is that while introducing a live-stream channel can significantly improve sales, i.e., result in the *promotion effect*, it may also lead to a profit loss in the traditional channel due to demand erosion caused by the introduction of a live-stream channel, i.e., *cannibalization effect*. Suppliers make decisions about introducing live-stream channels by weighing the trade-offs between these two effects, a topic extensively explored in the literature (Huang et al., 2024; Ji et al., 2023; Yang et al., 2023). A common assumption in these studies is that the supplier's capacity is unlimited. However, in practice, capacity constraints are prevalent and present significant challenges in supply chain management, affecting both operational strategies and profitability (Corsini et al., 2023; Dai and Nu, 2020; Lester, 2011; Ren et al., 2020; Sheu, 2006). For instance, iPhone X, a flagship product from Apple, has encountered production limitations owing to a shortage of OLED panels, which are crucial for its high-end features (Archie, 2017; Dong et al., 2021; Elahi et al., 2023). Similarly, brands such as Dell and Huawei have faced production limitations due to a lack of chip configuration (Xie et al., 2021). Given the widespread nature of capacity constraints, addressing supply chain challenges in the context of limited capacity is of considerable practical importance.

Live-stream sales can significantly amplify these challenges by triggering a rapid surge in product demand within a short period (Gu et al., 2024), often worsening supply chain capacity shortages. For instance, during a live-stream event, Jiaqi Li, known as the "Lipstick King," sold out 15,000 units of lipstick in just five minutes.[6] Hence, suppliers with limited capacity may find it challenging to fulfill the increased demand resulting from live-stream sales promotions. For instance, Watsons initiated a live-stream marketing campaign on January 11, 2022, offering a single box of hydrating face masks for only 0.01 Chinese Yuan (0.0014 US Dollars). This promotion generated such a high demand that it surpassed the company's limited supply capacity, leading to a significant shortage and posing a critical crisis for the company's operations and brand image.[7] Hence, suppliers with limited capacity are cautious about introducing live-stream channels. Apple, for instance, is yet to introduce live-stream channels partly because of capacity constraints on its components (Archie, 2017; Dong et al., 2021; Elahi et al., 2023). Therefore, a natural question arises: should suppliers introduce live-stream channels when their supply is limited?

Although the potential profitability of live-stream commerce is widely acknowledged, there is a notable gap in understanding how

4 https://m.thepaper.cn/newsDetail_forward_10432647.

5 https://news.samsung.com/in/samsung-to-launch-indias-first-ever-live-online-shopping-platform-samsung-now-heralding-the-pre-booking-event-of-galaxy-z-fold3-5g-galaxy-z-flip3-5g.

6 https://www.campaignasia.com/article/how-brands-are-taking-back-ownership-of-livestreaming-in-china/488024.

7 https://daoinsights.com/news/watsonss.

Table 1
Some examples of different suppliers' choices regarding live-stream channel inclusion.

Suppliers	The live-stream channel introduction choices
Apple	No official live-stream channel
Moutai	No official live-stream channel
Samsung	Launched its live online shopping platform, "Samsung Now," in India on August 20, 2021, and introduced the pre-booking event for Galaxy Z Fold3 and Flip3
Wuliangye	On December 16, 2020, Wuliangye joined the Taobao live broadcast room of Li Jiaqi, a famous Chinese streamer, to conduct an online live-streaming.

to effectively operationalize this emerging sales channel to maximize its benefits within the capacity constraints of the supplier. To bridge this gap, the following research questions are examined:

(1) Should suppliers with limited supply capacity, selling either directly or through an e-tailer platform, introduce a live-stream channel? If so, under what conditions would this be advantageous for the supplier?
(2) How does the introduction of a live-stream channel and the limited capacity influence the performance of the supply chain?
(3) Are consumer surplus and social welfare always enhanced by the inclusion of a live-stream channel?

To address these questions, this study examines a scenario in which a supplier with limited capacity sells products directly to consumers or resells them through an e-tailer, which acts as a benchmark. Subsequently, in the live-stream channel introduction scenario, the supplier, along with its existing sales channel, also has the option to implement the live-stream channel. In this scenario, the supplier must pay a fixed fee per unit of the product sold to the streamer. The main analysis assumes that the supplier incurs no production costs and that the traditional channel includes both the supplier's direct sales channel and the e-tailer's reselling channel. These assumptions are relaxed in the Extension section. This study has the following findings.

First, it highlights the significant impact of capacity constraints when a supplier considers introducing a live-stream channel. As the supplier lacks pricing control over the live-stream channel, it cannot counteract the potential cannibalization of its existing sales by simply adjusting live-stream prices. For the supplier, a low commission rate and low extra consumer costs in the live-stream channel are essential to adopt this strategy. However, when selling through a reselling channel, suppliers may also accept a live-stream channel, with relatively high additional consumer costs. Capacity further affects the selection of live-stream channel types. With limited capacity, the supplier can only adopt a live-stream channel with lower additional consumer costs. As capacity increases, live-stream channels with moderate extra costs become viable. Counterintuitively, even under tight capacity that cannot meet the demand of a single channel, the supplier may still introduce a live-stream channel because of its significant promotional effect.

Second, for the entire supply chain, having a larger capacity does not necessarily lead to profit maximization because of the heightened price competition. Instead, a slightly insufficient capacity creates a balance between moderate capacity and price competition, allowing the supplier to benefit more from the live-stream channel than from ample capacity. This counterintuitive conclusion stems from two key factors. First, ample capacity intensifies price competition between channels, driving down prices and reducing overall margins. Second, it diminishes streamers' motivation to provide superior live-stream services as competitive pressure undermines their efforts. Consequently, the profitability of the live-stream channel decreases with increasing capacity, ultimately reducing the total profit of the entire supply chain.

Finally, this study explores how supplier capacity affects consumer surplus and social welfare. We find that adopting live-stream sales always enhances consumer surplus, but does not consistently improve social welfare unless the supplier has a relatively abundant capacity. This is because consumers benefit from increased broadcasting efforts when capacity is low, and from lower sales prices due to channel competition when capacity is ample. However, while consumer surplus increases consistently, insufficient capacity leads to losses in supply chain profits and lowers overall social welfare. It is worth noting that suppliers using direct channels need a greater capacity to boost social welfare through live streaming than those relying on reselling channels. This is because live-streaming significantly reduces the double-marginalization effect in the reselling channel, amplifying its positive impact.

This study makes two significant contributions to the literature. First, while previous studies such as Du et al. (2023) and Ji et al. (2023) primarily focus on the demand-side dynamics of introducing live-stream channels, this study broadens the scope by considering both the supply chain's demand and supply sides. This comprehensive approach reveals that capacity shortages can dampen suppliers' motivation to adopt live-stream channels, a factor not thoroughly explored in previous studies. This sheds light on how competition for limited production capacity can erode supplier profits, thereby providing valuable insight into the complexities of live-stream channel adoption. Second, it examines why certain firms are reluctant to embrace potentially lucrative live-stream channels, specifically from the perspective of capacity limitations. Unlike existing literature such as Yang et al. (2018), who discuss how suppliers can benefit from retailer overbuying behaviors in the context of capacity, this study addresses a different research question. By focusing on the impact of capacity constraints, this study provides a fresh perspective on the factors that influence supplier decisions regarding live-stream channel adoption. Additionally, while Yang et al. (2018) focus on scenarios in which the supplier sets prices in the direct channel, this study explores a situation in which the streamer determines prices in the live-stream channel, offering novel insights into this rapidly evolving area of research.

The remainder of this paper is organized as follows. Section 2 presents a comprehensive review of related literature. Section 3 presents the model used in the analysis. Section 4 explores the equilibrium outcomes for scenarios with and without the introduction of a live-stream channel under direct selling. Section 5 examines these outcomes under reselling. A comparison of the models in terms of the pricing decisions of supply chain members and their performance, with and without the introduction of a live-stream channel, is also integrated into these two sections. Section 6 extends the basic model in several directions. Finally, Section 7 concludes the study. The Appendix provides all the mathematical proofs.

2. Literature review

This study relates to two research streams: live-stream selling and limited capacity issues.

2.1. Live-stream selling

Live-stream commerce has gained significant attention in both academia and industry, particularly since the COVID-19 outbreak (Mitręga and Choi, 2021; Wang et al., 2024). Early research in this emerging field primarily focused on the motivations driving consumers to engage in live-stream purchasing. These motivations encompass social elements, such as the desire for community and interactive enjoyment (Cai and Wohn, 2019), as well as a mix of utilitarian and hedonic motives (Bridges and Florsheim, 2008). Product-related factors such as the fit between the product and its source and the suitability of the product content have also been examined (Park and Lin, 2020). Hsu et al. (2020) emphasize the importance of content quality and streamer satisfaction in shaping consumers' purchasing tendencies. Hou et al. (2022) emphasize the need for streamers to maintain a good reputation by providing high-quality products at competitive prices to attract consumers. Gu et al. (2024) find that streamers' entertainment enhances consumer enjoyment and influences their purchasing behavior. Consequently, allocating a significant bandwidth to entertainment, even with limited entertainment capabilities, is advantageous. Li et al. (2024) highlight the critical role of broadcasting efforts in shaping firms' decisions regarding live-stream strategies. These studies predominantly focused on unraveling consumer preferences and the key determinants guiding purchasing decisions in live-stream businesses.

Another facet of live-stream selling research investigates the factors that influence suppliers' or retailers' strategic decisions to adopt live-stream sales. Ji et al. (2023) explore live-stream channel strategies and pricing schemes, revealing a higher inclination to promote live-stream channels under dynamic pricing. Pan et al. (2022) emphasize the significance of streamers' selling ability and its impact on demand switching when adopting live-stream sales. Apart from the streamer's sales proficiency, manufacturers must also consider the share of the potential buyer base in the live-stream channel relative to the entire buyer base in their introduction strategies (Du et al., 2023). Huang et al. (2024) examine live-stream strategies in the context of competing suppliers, showing that the equilibrium strategy is contingent on commission fees and mismatch losses. Zhang et al. (2023) scrutinize manufacturers' choices of live-stream modes based on the types of streamers involved. Yang et al. (2023) consider the impact of spillover effects in a dual-channel supply chain involving a manufacturer and a streamer. Notably, most of this research assumes unlimited supplier capacity, making the live-stream channel a plausible choice for suppliers in profitable live-stream scenarios. By contrast, our model introduces the critical factor of limited capacity, which may deter suppliers from adopting live-stream strategies because of the risks of unmet demand and the negative impact of capacity competition on the supplier's own selling channel.

2.2. Limited capacity issues

The impact of limited capacity on channel strategy has been extensively examined in the literature. When capacity is constrained, it restricts downstream inventory and the supply chain's ability to fulfill customer needs. Özer and Wei (2004) examine inventory management and limited production capacity under uncertain demand, particularly when holding and shortage costs are high. Schwarz and Tan (2021) address optimal product rollover strategies under production capacity constraints by examining how firms should balance the pre-production of existing products with the introduction of new ones while adjusting pricing and production volumes accordingly. These studies aim to optimize product and inventory decisions in the face of costs (such as holding and shortage costs) and capacity constraints, thereby improving efficiency and reducing costs. In contrast, our study ventures into the realm of limited-capacity suppliers' channel strategies within the context of live-stream commerce. Hence, the focus shifts to maximizing profits by introducing a new channel while balancing the trade-offs between limited capacity and demand volume.

The exploration of optimal distribution strategies for suppliers with limited capacity has been a subject of study with insights from various perspectives. Cachon and Lariviere (1999) discuss the benefits of buyers' strategic withholding as an optimal distribution strategy for capacity-constrained suppliers. Xie et al. (2021) extend this discussion to retail platforms, uncovering withholding behavior when supplier capacity is constrained. Chen et al. (2013) explore strategic behavior driven by limited capacity, noting that higher-priority retailers may aggressively place orders to exclude others from the market. Porteus et al. (2010) investigate how leading firms can strategically exploit limited capacity by setting lower prices to create shortages, leaving opportunities for followers, and avoiding direct competition.

Numerous studies have investigated the border impact of supply capacity on supply chain operations. Lim et al. (2015) considered revenue sharing in the context of a retailer with limited storage space for products from multiple manufacturers. Pereira et al. (2023) introduce a robust optimization model to aid sales and marketing teams in defining the most profitable sales plan under limited capacity, integrating contract design, portfolio selection, and tactical production planning. Wang et al. (2025) investigate the impact of a limited supply of chips on a feature removal strategy for automotive manufacturers. Hu et al. (2023) develop a game-theoretic model to examine how online platforms can optimally allocate limited warehouse capacity among different products by considering the dual roles of platforms as marketplaces and resellers.

These studies traditionally addressed channel selection and operational challenges for suppliers facing limited capacity within traditional supply chain structures. By contrast, our study extends the exploration of supplier channel strategies to the emerging scenario of live-stream commerce. It emphasizes the critical role of capacity levels in shaping a supplier's choices regarding live-stream sales, offering unique implications for the dynamics of live-stream selling and nuanced considerations that suppliers must navigate in this innovative landscape.

The contributions of this study are summarized in Table 2.

3. Modeling framework

In this study, we consider a supply chain with a capacity-constrained supplier that sells products through either a direct selling channel or an e-tailer resale channel. Depending on the supply capacity conditions, the supplier has the option to introduce a live-stream channel in addition to the direct and e-tailer channels. For simplicity, we define the scenario in which the supplier sells products directly as the benchmark case, labeled scenario DN. The scenario in which a live-stream channel is introduced under the direct channel is referred to as Scenario DI. The scenario involving only the e-tailer channel is denoted as scenario EN, and the e-tailer channel with the introduction of a live-stream channel is denoted as scenario EI. The four scenarios are illustrated in Fig. 1.

Consumers are differentiated by their preferences v, which are uniformly distributed over the interval $[0,1]$. The supplier/e-tailer charges a price p_d in the direct/reselling channel. Let U represent the consumer's utility from buying the product. Hence, this utility is given by $U_d = v - p_d$.

The live-stream channel introduces unique features compared to the traditional e-channel. First, it allows streamers to provide detailed product presentations and foster interactions with consumers, thus reducing their uncertainty about product quality and increasing their willingness to purchase (Feng et al., 2024; Lin et al., 2024; Lu and Chen, 2021). Streamers with large followings or live events supported by government initiatives can significantly increase consumer trust in product quality through live-stream channels, which are often perceived as more reliable than traditional e-channels, where product quality varies widely.[8] Following Dong et al. (2025), Feng et al. (2024), and Li et al. (2024), we assume that consumers have a preference βv for live-stream channels, where $\beta > 1$. This parameter reflects the preference that consumers exhibit for live-stream channels relative to traditional e-channels.

Second, to attract more consumers, streamers often enhance their live-stream experiences by incorporating entertainment or educational elements alongside product promotions. For example, Dong Yuhui, a former English teacher, dedicates his live sessions to discussing topics such as history, culture, and personal experiences. Although he shares limited product information, his engaging broadcasts foster viewer enjoyment, often leading to enthusiastic purchases (Gu et al., 2024). It is important to note, however, that these additional services primarily enhance the shopping experience rather than directly influencing consumer preferences for the products themselves. We express the streamer's broadcasting effort as θ. Higher effort levels have the potential to increase demand in the live-stream channel but also incur a cost to the streamer, represented as $C(\theta)$. The effort cost is assumed to be increasing and convex in the effort level θ, that is $C(\theta) = \frac{\theta^2}{2}$, consistent with the literature such as Xiao et al. (2024) and Yang et al. (2023).

Despite its advantages, live-streaming has drawbacks that may deter consumers. For example, there is an opportunity cost of time spent watching live streams, during which consumers can engage in other activities (Gu et al., 2024). Additionally, live-streaming often requires consumers to make purchases within a fixed timeframe, unlike e-commerce channels that allow instant purchases at any time (Li et al., 2024). The short time window and promotional nature of live-streaming can also lead to impulse purchases, which may result in higher product-return rates. To account for these disadvantages, we assume that consumers incur an extra cost $t \in (0,1)$ when purchasing through the live-stream channel. This setting is consistent with prior studies such as Dong et al. (2025) and Pan et al. (2022). The streamer charges a price p_l in the live-stream channel. Therefore, following Dong et al. (2025) and Li et al. (2024), a consumer's utility from purchasing in the live-stream channel is expressed as $U_l = \beta v + \theta - t - p_l$.

If the supplier decides to introduce a live-stream channel, it compensates the streamer with a fixed commission fee at a rate of α based on the live-stream price. Many streamers adopted this payment mechanism. For example, Li Jiaqi, a leading influencer in China, takes a 20 % commission from the revenue generated through live-stream sales of bedding for a homeware company.[9] Following this practice, we assume $0 < \alpha < 1$ in the main model, consistent with established studies by Huang et al. (2024), Zhang et al. (2021), and Zhang et al. (2024).

When both direct/reselling and live-stream channels are present, the supplier/e-tailer and the streamer compete on pricing. A consumer purchases through the traditional channel if $U_d > U_l$ and $U_d > 0$. Conversely, a consumer chooses the live-stream channel if $U_l > U_d$ and $U_l > 0$. Based on these conditions, the basic demands in the traditional e-channel and the live-stream channel, denoted as q_d and q_l, respectively, can be represented as follows:

$q_d = \frac{p_l - p_d - \theta + t}{\beta - 1} - p_d$ and $q_l = 1 - \frac{p_l - p_d - \theta + t}{\beta - 1}$.

When the live-stream channel is not introduced, consumer's demand for the product depends solely on price, i.e., $q_d = 1 - p_d$. These demand functions are well established in marketing and economics literature (Dong et al., 2025; Li et al., 2024; Pan et al., 2022).

This study considers a supplier with limited capacity, which is a common challenge across various industries, especially when introducing a live-stream channel, where demand can surge rapidly. Several factors can explain this. First, companies like Watson have adopted restocking strategies to address stockouts resulting from live streaming.[10] However, these strategies do not fully address the

8 https://www.thepaper.cn/newsDetail_forward_23924643.

9 https://www.chinadaily.com.cn/global/2019–09/04/content_37507605.htm.

10 https://daoinsights.com/news/watsonss.

Table 2
A summary of main literature.

Studies	Live-stream selling	Broadcasting effort	Limited capacity	Channel strategy
Bridges and Flosheim (2008), Cai and Wohn. (2019), Park and Lin (2020), Hsu et al. (2020), Pan et al. (2021), Hou et al. (2022)	✓			
Huang et al. (2024), Ji et al. (2023)	✓			✓
Zhang et al. (2023), Gu et al. (2024)	✓	✓		
Du et al. (2023), Yang et al. (2023), Li et al. (2024)	✓	✓		✓
Cachon and Lariviere. (1999), Özer and Wei. (2004), Porteus et al. (2010), Chen et al. (2013), Lim et al. (2015), Cao et al. (2015), Schwarz and Tan (2021), Pereira et al. (2023), Hu et al. (2023), Wang et al. (2025)			✓	
Yang et al. (2018), Pan et al. (2021)			✓	✓
Our paper	✓	✓	✓	✓

Note: "✓" indicates covered.

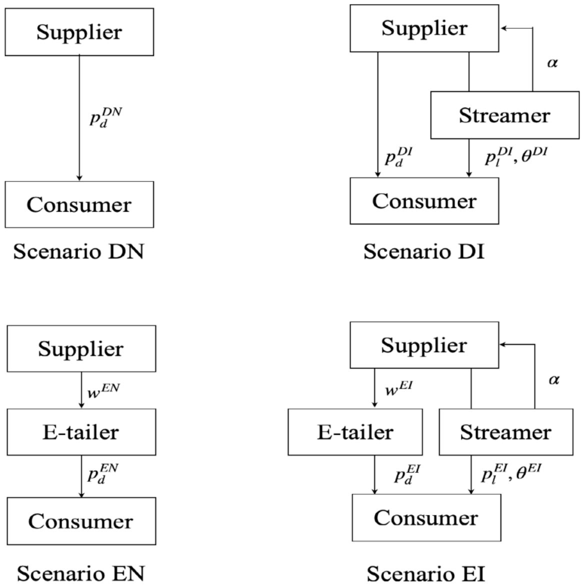


Fig. 1. Supply chain structures in different scenarios.

challenges of supply–demand imbalances, such as mass returns and negative consumer reviews. Therefore, it is essential to evaluate the feasibility of live-stream strategies to prevent operational disruptions rather than relying solely on restocking as a reactive measure. Second, replenishment is not a viable solution for many firms in response to demand spikes in live-streams. For instance, high-tech and automotive firms face production limitations due to shortages of critical components (e.g., chips),[11] while agriculture is constrained by natural factors and growth cycles.[12]

Considering the supplier's limited capacity, and in line with Cao et al. (2015), Xie et al. (2021), and Yang et al. (2018), we assume that the supplier's capacity is capped at K. Therefore, the total demand across both channels must adhere to the following constraints: $q_d \leq K$ in scenario DN/EN, and $q_d + q_l \leq K$ in scenario DI/EI, respectively.

The sequence of the game involving the supplier, e-tailer, and streamer is as follows: First, the streamer announces the commission rate α charged to the supplier for each unit sold through the live-stream channel. According to the agreement between the supplier and streamer, the supplier decides whether to introduce a live-stream channel. The supplier's decision regarding the live-stream channel is a long-term commitment that cannot be changed frequently, making it longer than decisions in subsequent stages. This is consistent with traditional wisdom, such as that of Huang et al. (2024) and Li et al. (2024). Second, suppliers and streamers determine their pricing strategies based on the selling mode and whether a live-stream channel is included. In the direct selling mode, the supplier determines the direct selling price p_d^{DN} in scenario DN. In scenario DI, the supplier determines the direct selling price p_d^{DI} whereas the streamer simultaneously determines the live-stream price p_l^{DI}. In reselling mode, the supplier determines the wholesale price, w^{EN}/w^{EI}. In scenario EN, the supplier determines the reselling price p_d^{EN}. In scenario EI, the supplier determines the reselling price p_d^{EI} while the

[11] https://www.netsuite.com/portal/resource/articles/erp/manufacturing-industry-challenges.shtml.
[12] https://www.fb.org/market-intel/cattle-supply-and-demand-issues-for-the-2022-marketing-year.

streamer simultaneously determines the live-stream price p_l^{EI}. Third, if the supplier introduces the live-stream channel, the streamer determines the broadcasting effort in the live-stream channel based on the prices in both channels. Finally, consumer demand is realized, and firms receive their respective payoffs. The detailed sequence of events is shown in Fig. 2.

The supplier faces a constant unit production cost, which is normalized to zero, aligning with established studies such as Arya et al. (2007), Guan et al. (2020), and Wang and Li (2021). In the extension section, we demonstrate the robustness of the main outcomes when we introduce positive production costs. A detailed overview of the notations is provided in Table 3.

4. The supplier sells the products via the direct channel

This section analyzes the equilibrium outcomes and the supplier's decision to introduce a live-stream channel when the products are sold directly in the market. Section 4.1 explores the equilibrium results for scenario DN in which no live-stream channel is introduced. Section 4.2 focuses on scenario DI, in which the live-stream channel is introduced. A comparison of these two cases is presented in Section 4.3. Subscripts DN and DI are used to distinguish between the two cases.

In scenario DN, the supplier determines price p_d to maximize profit via direct selling, constrained by production capacity K. Thus, the decision problems for the supplier are formulated as follows:

$$\begin{cases} \max\limits_{p_d} \pi_S = p_d(1-p_d) \\ \quad s.t. \quad 1-p_d \le K \end{cases} \tag{1}$$

Maximizing the profit function in Eq. (1) leads to the derivation of the supplier's optimal price, as Lemma 1 outlines.

Lemma 1. *The equilibrium outcomes under scenario DN depend on K, which are summarized below.*
(i) If $K > \frac{1}{2}$, the supplier sets $p_d^{DN} = \frac{1}{2}$, and product sales $q_d^{DN} = \frac{1}{2}$.
(ii) If $K \le \frac{1}{2}$, the supplier sets $p_d^{DN} = 1-K$, and product sales $q_d^{DN} = K$.

It is evident that when the supply is limited (i.e., $0 < K \le \frac{1}{2}$), a bigger capacity reduces the optimal direct price, i.e., $dp_d^N/dK < 0$. This phenomenon is attributed to the sales cap imposed by capacity constraint K. When the price drops below $1-K$, sales become less responsive to price changes, and further price reductions will not be able to notably boost demand. Consequently, the supplier lacks the motivation to set a price below $1-K$. As the supplier's capacity expands, the sales cap is lifted, enabling a strategic reduction in the direct selling price to stimulate sales.

4.1. Scenario DI: Introducing a live-stream channel

In scenario DI, the supplier introduces a live-stream channel to sell the product, allowing distribution through both the direct and live-stream channels. First, the supplier and the streamer simultaneously determine the optimal direct and live stream prices to maximize their respective profits. Then, according to the prices set in the first stage, the streamer sets the broadcasting effort level for the live-stream channel. The supplier's optimization problems are formulated as follows:

$$\begin{cases} \max\limits_{p_d} \pi_S = p_d\left(\dfrac{p_l - p_d - \theta + t}{\beta - 1} - p_d\right) + (1-\alpha)p_l\left(1 - \dfrac{p_l - p_d - \theta + t}{\beta - 1}\right) \\ \qquad\qquad s.t. \quad 1-p_d \le K \end{cases} \tag{2}$$

The optimization problems for the streamer are formulated as follows:

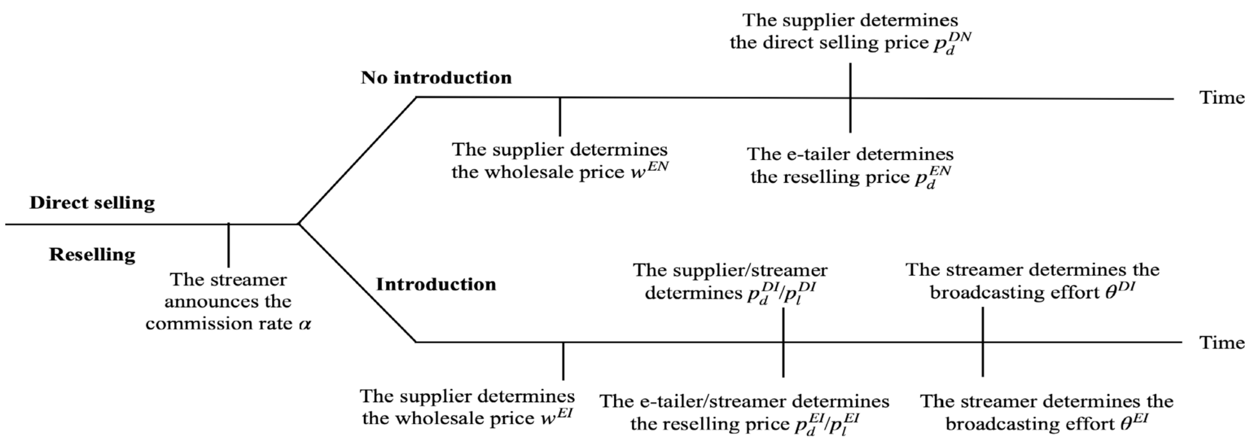


Fig. 2. The sequence of the game under direct selling/reselling.

Table 3
Notations.

Notations	Description
Parameters	
K	Capacity of the supplier
β	Consumer's preference for live-stream channel
t	Consumer's extra cost in live-stream channel
α	Commission rate in the live-stream channel
Decision variables	
θ	The streamer's broadcasting effort level
p_d	Retail price in the direct selling/ reselling channel
p_l	Retail price in the live-stream channel
Intermediate variables	
q_i	Demand of channel i, $i \in \{d, l\}$
π_S	Profit of the supplier
π_T	Profit of the streamer
π_R	Profit of the e-tailer
Π	Total profit of the supply chain
CS	Consumer surplus
SW	Social welfare

$$\max_{p_l,\theta} \pi_T = \alpha p_l \left(1 - \frac{p_l - p_d - \theta + t}{\beta - 1}\right) - \frac{\theta^2}{2} \tag{3}$$

The concavity of this problem can be proven easily. We have the equilibrium for scenario DI where $K > K_1$, $t_l \le t \le t_u$, and $\beta \ge 1.5$. This assumption ensures that a dual channel is commercially feasible; otherwise, only a single channel is viable. This assumption is widely used in the live-stream literature, such as Li et al. (2024) and Niu et al. (2025). By applying backward induction, we derive the equilibrium outcomes summarized in Lemma 2.

Lemma 2. *The equilibrium outcomes under scenario DI depend on K, t, α, β, which are summarized below:*

(i) If $K > \overline{K}$, the supplier sets $p_d^{DI} = \frac{(\beta-1)(2-t\alpha+(\alpha-2)\beta)}{(6+\alpha-4\beta)\beta-2}$, the streamer sets $p_l^{DI} = \frac{(\beta-1)((2t+2)\beta-2\beta^2-t)}{(6+\alpha-4\beta)\beta-2}$, $\theta^{DI} = \frac{\alpha(2(1-\beta)\beta+t(2\beta-1))}{(6+\alpha-4\beta)\beta-2}$, and the product sales $q_d^{DI} = \frac{t(\alpha(\beta-1)-2\beta+1)-\alpha(\beta-2)\beta}{(6+\alpha-4\beta)\beta-2}$, $q_l^{DI} = \frac{t(2\beta-1)-2(\beta-1)\beta}{(6+\alpha-4\beta)\beta-2}$.

(ii) If $K \le \overline{K}$, the supplier sets $p_d^{DI} = 1 - K$, the streamer sets $p_l^{DI} = \frac{(\beta-1)(K+t-\beta)}{2(1-\beta)+\alpha}$, and $\theta^{DI} = \frac{\alpha(K+t-\beta)}{2(1-\beta)+\alpha}$, and product sales $q_d^{DI} = \frac{(1+\alpha-2\beta)K-t+\beta}{2(1-\beta)+\alpha}$, $q_l^{DI} = \frac{K+t-\beta}{2(1-\beta)+\alpha}$.

Lemma 2 presents the equilibrium outcomes for scenario DI. When the supplier has unlimited capacity (i.e., $K > \overline{K}$), both the supplier and streamer are willing to provide lower prices in both direct and live-stream channels. In this case, the consumer's extra cost has an inverse effect on the prices in both channels. Specifically, as the extra cost increases, the supplier raises the price in the direct channel (i.e., $\partial p_d^{DI}/\partial t > 0$), while the streamer lowers the price in the live-stream channel (i.e., $\partial p_l^{DI}/\partial t < 0$). This is because a high extra cost reduces the convenience of shopping via the live-stream channel, decreasing the consumer utility for purchases through that channel. Consequently, the streamer must lower the price to offset the increased costs. Conversely, a higher cost makes the direct channel more appealing to consumers, enabling the supplier to avoid price reductions and set a higher price. When the supplier's capacity is constrained (i.e., $K \le \overline{K}$), both the supplier and the streamer increase their prices in their respective channels compared to the case with unlimited capacity. The more limited the capacity, the higher the prices (i.e., $\partial p_d^{DI}/\partial K < 0$ and $\partial p_l^{DI}/\partial K < 0$).

4.2. Comparison of model: Scenarios DN and DI

After obtaining the equilibrium outcomes for scenarios DN and DI, we now move to compare these scenarios to determine whether the supplier should introduce a live-stream channel alongside direct marketing. We begin by comparing the prices and demands in both scenarios.

4.2.1. Comparison of demands and prices

To compare the prices and demands in scenarios DI and DN, we derive Propositions 1 and 2.

Proposition 1. *Comparing the prices in scenarios DI and DN, we have $p_d^{DI} \le p_d^{DN}$.*

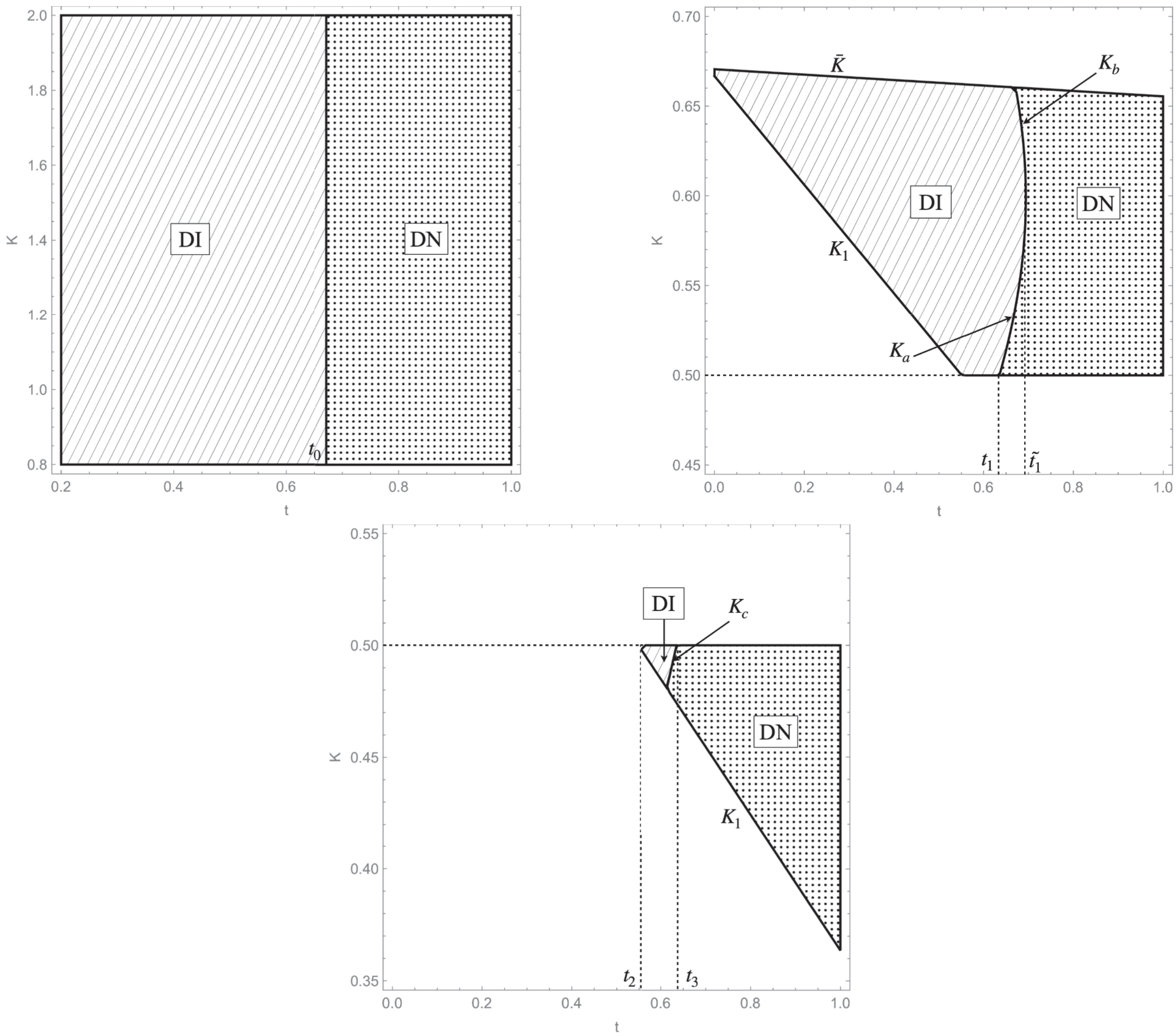
Proposition 1 shows that regardless of the capacity level, the supplier always sets a lower direct price in scenario DI than in scenario DN. When capacity is ample (i.e., $K > \overline{K}$), as the consumer's extra cost reduces, the supplier sets a lower direct price (i.e., $\partial \Delta p_d^{DI}/\partial t < 0$). This implies that a lower extra cost mitigates the negative utility that consumers associate with shopping on the live-stream channel, thereby diminishing the advantage of the direct channel. Therefore, the supplier must reduce the direct price more significantly to remain competitive in the live-stream channel. It is noteworthy that as the commission rate increases, the supplier should reduce the extent of its price cuts (i.e., $\partial^2 \Delta p_d^{DI}/\partial t \partial \alpha < 0$). In this scenario, if the extra cost of the live-stream channel is low, the supplier must lower the price to remain competitive while also ensuring that it maintains sufficient marginal profit from the direct channel. Therefore, the commission rate plays a crucial role in determining the degree of price reduction in the direct channel. When capacity is limited, the capacity level becomes the sole factor affecting the supplier's price reduction regardless of the extra cost or commission rate. Furthermore, higher capacity inhibits the supplier from lowering the price in the direct channel (i.e., $\partial \Delta p_d^{DI} / \partial K < 0$).

Proposition 2. *Comparing the demands in scenarios DI and DN, we have:*

(i) $q_d^{DI} < q_d^{DN}$, *if* $K > \overline{K}$ *and* $t < t_q$, *or* $K < min\{K_q, \overline{K}\}$.

(ii) $q_d^{DI} + q_l^{DI} \geq q_d^{DN}$.

Proposition 2 examines how capacity constraints affect the demands for both the direct channel and the entire supply chain. While conventional wisdom (Du et al., 2023; Zhang et al., 2021) suggests that adopting live-stream sales can intensify competition between channels and potentially reduce demand for existing channels, our findings lead to the opposite conclusion when considering both the consumer's extra cost t, and the supplier's capacity K. Specifically, in scenarios where the supplier has unlimited capacity (i.e., $K > \overline{K}$), if the extra cost is low (i.e., $t < t_q$), introducing a live-stream channel reduces the demand for the direct channel. With relatively low extra costs, consumers can obtain more utility from buying from the live-stream channel without incurring a high cost, such as watching a long live-stream show. These benefits of live-stream channels severely reduce the demand for traditional channels, which



(c) $0 < K \leq \frac{1}{2}$

Fig. 3. Supplier's live-stream strategies in scenario D.

aligns with prior studies. However, when the extra cost exceeds a certain threshold ($t > t_q$), the introduction of a live-stream channel increases demand for the direct channel, implying that a higher extra cost allows the direct channel to benefit from the introduction of the live-stream channel. When the supplier has limited capacity (i.e., $K \leq \overline{K}$), the capacity level negatively affects the sales price and positively affects the demand for the direct channel in the scenario DI. Thus, when the capacity is small (i.e., $K < \min\{K_q, \overline{K}\}$), introducing a live-stream channel reduces demand in the direct channel. Nevertheless, the introduction of the live-stream channel can improve the overall supply chain, as the increase in demand from the live-stream channel can offset the reduction in demand from the direct channel, resulting in an overall increase in total demand (i.e., $q_d^{DI} + q_l^{DI} \geq q_d^{DN}$).

From Propositions 1 and 2, it is evident that adopting live-stream sales always diminishes the profit of the supplier's direct channel, i.e., $\Delta\pi_d < 0$, a phenomenon termed the cannibalization effect. This effect is pronounced when capacity is limited (i.e., $K_1 < K \leq \overline{K}$), leading to a shortfall in capacity to fulfill demand in the direct channel. As capacity improves, the cannibalization effect diminishes, although not entirely. Conversely, introducing a live-stream channel can lead to additional profits for the supplier, a phenomenon referred to as the promotion effect. Revenue from the live-stream channel may compensate for losses in the direct channel due to interchannel competition. It is noteworthy that while a larger capacity generally enhances overall channel profitability, this may not be the case for the live-stream channel. This is because of increased price competition and the absence of strong incentives to improve broadcasting efforts. Therefore, the supplier faces two interdependent effects with conflicting consequences on profit: reduced profits in the direct channel due to cannibalization and intensified competition and potential revenue gains from live-stream sales balanced against the cost of commission fees to the streamer.

4.2.2. Supplier's decisions on the introduction of a live-stream channel

To decide whether to introduce a live-stream channel, the supplier must weigh the potential gains of this new channel against potential losses. Proposition 3 delves into this trade-off by comparing the supplier's profit with and without the live-stream channel, providing insights into the optimal channel strategy.

Proposition 3. *The supplier introduces a live-stream channel if one of the following conditions is satisfied*:

(i) $K > \overline{K}$, $\alpha < \alpha_0$, $t < t_0$.

(ii) $\max\{\frac{1}{2}, K_1, K_a\} < K < \min\{K_b, \overline{K}\}$, $\alpha < \alpha_1$, $t < \widetilde{t}_1$.

(iii) $\max\{K_c, K_1\} < K \leq \frac{1}{2}$, $t_2 < t < t_3$.

Proposition 3 demonstrates the conditions influencing the supplier's decision to introduce a live-stream channel when selling through the direct channel. While previous studies, such as Du et al. (2023) and Ji et al. (2023), suggest that suppliers are incentivized to introduce live streaming if the market potential is large and commission rates are low, our examination reveals that the decision is also influenced by supply side factors, particularly capacity levels, in addition to demand-side factors, such as consumer preferences for live-stream channels and commission rates.

The results of Proposition 3 are numerically illustrated in Fig. 3. When the supplier's capacity is ample (i.e., $K > \overline{K}$), as depicted in Fig. 3(a), the supplier is incentivized to introduce a live-stream channel if both the commission rate and the consumer's extra cost are low (i.e., $\alpha < \alpha_0$, and $t < t_0$). This is because a low extra cost enhances the promotion effect of the live-stream channel, and a low commission rate allows the supplier to benefit more from live streaming. In this scenario, the supplier's profit from live streaming offsets any loss in the direct channel, making the introduction of the live-stream channel appealing. This is consistent with the findings of Li et al. (2024) and Ji et al. (2023).

When the supplier's capacity is moderately limited (i.e., $\max\{\frac{1}{2}, K_1\} < K \leq \overline{K}$), as depicted in Fig. 3(b), the supplier has sufficient capacity to operate only a direct channel. However, if a live-stream channel is introduced, the supply chain will experience a capacity shortage. In this case, both the capacity level and commission rate, as well as the extra cost, play critical roles in the supplier's decision to introduce a live-stream channel. Specifically, if the consumer's extra cost is very low (i.e., $0 < t \leq t_1$), a supplier with low or moderate capacity is incentivized to adopt live-streaming (i.e., $\max\{\frac{1}{2}, K_1\} < K < \min\{K_b, \overline{K}\}$). A low extra cost enhances the promotion effect, which outweighs the negative impact of limited capacity on the direct channel. However, as the extra cost increases (i.e., $t_1 < t \leq \widetilde{t}_1$), the live-stream channel becomes less profitable, and the cannibalization effect of the direct channel becomes more pronounced, particularly for suppliers with limited capacity. Consequently, only suppliers with moderate capacities can accommodate live-stream channels with higher consumer time costs. Consumer preferences for the live-stream channel significantly influence supplier strategies. Suppliers are more likely to accept higher commission rates and extra consumer costs in the live-stream channel when consumer preference for live-streaming is high. This explains why suppliers are eager to collaborate with top influencers such as Dong Yuhui and Luo Yonghao despite their live shows featuring extensive discussions on non-product topics and charging high commission rates. Suppliers are attracted to the substantial potential profitability associated with their large audiences.

When the supplier's capacity is very tight (i.e., $K \leq \frac{1}{2}$), as depicted in Fig. 3(c), it cannot meet the optimal demand of a single channel. However, counterintuitively, the supplier may still choose to introduce a live-stream channel if the capacity is not extremely tight (i.e., $\max\{K_c, K_1\} < K \leq \frac{1}{2}$). This is because of the considerable profitability offered by the live-stream channel. Scarcity capacity incentivizes the streamer to invest substantial effort in broadcasting, even at high service costs. For example, in 2020, Samsung collaborated with Li Jiaqi, a famous streamer in China, to sell its newly launched foldable smartphone, Galaxy Z Flip, through live streaming.[13] Despite the limited production capacity caused by screen shortages,[14] Samsung pursued live-stream sales because traditional channels could not generate sufficient demand for this emerging product. By leveraging real-time product introductions and the streamer's reputation, Samsung successfully generated consumer interest, resulting in the phone selling out in seconds. The parameters used for Fig. 3 are: $\beta = 2.2$, $\alpha = 0.1$.

4.2.3. Impact on supply chain performance, consumer surplus, and social welfare

This section investigates the impact of the supplier's decision to introduce a live-stream channel on supply chain performance, consumer surplus, and social welfare.

Proposition 4. *The introduction of a live-stream channel increases the total profit of the supply chain (i.e., $\Pi^{DI} > \Pi^{DN}$) if one of the following conditions is satisfied:*

(i) $K > \overline{K}$, $\alpha < \alpha_2$, $t < t_4$.
(ii) $max\{\frac{1}{2}, K_1, K_c\} < K < min\{K_d, \overline{K}\}$, $\alpha < \alpha_3$, $t < \widetilde{t}_5$.
(iii) $max\{K_1, K_e\} < K \le \frac{1}{2}$, $t_6 < t < t_7$.

Proposition 4 shows the effect of adopting a live-stream channel on a supply chain's total profit. When capacity is fully ample (i.e., $K > \overline{K}$), relatively low commission rates and extra consumer costs are crucial for increasing the total profit of the entire supply chain. This is because, under a high commission rate, the streamer raises the live-stream price to maximize marginal profit, while the supplier lowers the direct selling price to stimulate demand. These price adjustments by the streamer significantly erode the direct channel's profit and the increased profit from the live-stream channel is insufficient to offset these losses, ultimately reducing the entire supply chain's total profit. Furthermore, a relatively low extra consumer cost is essential for the'overall performance of a supply chain. If the extra cost is too high, the live-stream channel' benefits become insufficient to attract more demand. Instead, it intensifies the price competition with the direct channel, harming the supply chain's overall performance. Overall, both a low commission rate and low extra costs benefit not only the supplier but also the entire supply chain.

When the capacity is constrained (i.e., $\max\{\frac{1}{2}, K_1\} < K \le \overline{K}$), the total profit of the supply chain is influenced by the capacity level, the commission rate, and the consumer's extra cost. When the extra cost in the live-stream channel is very low (i.e., $t < t_5$), a low-to-moderate capacity (i.e., $\max\{\frac{1}{2}, K_1\} < K < \min\{K_d, \overline{K}\}$) benefits the entire supply chain. The low extra cost makes the live-stream channel more profitable than the direct channel under these capacity conditions. However, as the extra cost increases (i.e., $t_5 < t < \widetilde{t}_5$), weakening the promotion effect in the live-stream channel diminishes profitability. In this case, moderate capacity is necessary ($K_c < K < \min\{K_d, \overline{K}\}$) to optimize the total profit.

When the capacity is very tight (i.e., $\max\{K_1, K_e\} < K \le \frac{1}{2}$), the supply chain benefits from introducing the live-stream channel when $t_6 < t < t_7$. At an extremely limited capacity, there is intense competition between the two channels for the available capacity. This, coupled with a very low extra consumer cost in the live-stream channel, exacerbates the cannibalization effect on the direct channel. Consequently, a relatively intermediate additional cost is advantageous for the overall supply chain in this scenario.

Proposition 5. *When the supplier sells via a direct channel, the impact of introducing a live-stream channel on the consumer surplus (CS) and the social welfare (SW) are as follows:*

(i) $CS^{DI} > CS^{DN}$.
(ii) $SW^{DI} > SW^{DN}$, if $K > max\{K_1, K_{SW}\}$.

Proposition 5 shows how the introduction of a live-stream channel affects consumer surplus and social welfare in relation to capacity level. While previous studies (Du et al., 2023; Wang and Guo, 2023) show that the introduction of live-stream channels can enhance consumer surplus, our analysis reveals that this effect still holds when considering capacity constraints. Specifically, when capacity is limited (i.e., $K \le \frac{1}{2}$), it restricts the growth of supply chain demand but incentivizes streamers to enhance their broadcasting efforts, leading to an increase in consumer surplus. Conversely, as capacity increases (i.e., $K > \frac{1}{2}$), the additional demand stimulated by live-streaming is met, and the intensified price competition between the direct and live-stream channels further boosts consumer surplus. Even though consumer surplus will increase under limited capacity, the loss in supply chain profit results in a decrease in social welfare when capacity is insufficient (i.e., $K \le \max\{K_1, K_{SW}\}$). Conversely, when capacity is sufficient, i.e., $K > \max\{K_1, K_{SW}\}$, the supply chain can meet the increased demand generated by the live-stream channel. In this scenario, both the supplier and the streamer reduce their selling prices to accommodate higher demand, which benefits the consumer surplus. Although the price in the live-stream channel may exceed that in the direct channel under certain conditions, the increased demand outweighs the price effect, resulting in a net increase in consumer surplus. In addition, while sufficient capacity may not always result in higher overall profits for the supply chain, an increase in consumer surplus can compensate for profit loss, improving overall social welfare when the live-stream channel is introduced under these conditions (i.e., $K > \max\{K_1, K_{SW}\}$).

[13] https://cj.sina.com.cn/articles/view/6387997911/m17cc11cd703300mxgo?
[14] https://www.chinanews.com/cj/2019/11–20/9012345.shtml.

5. The supplier sells the products via the e-tailer online platform

This section examines the equilibrium outcomes and the supplier's decision to introduce a live-stream channel when products are sold on the e-tailer's online platform. Section 5.1 investigates the equilibrium results in scenario EN, in which the live-stream channel is not introduced. Section 5.2 analyzes scenario EI in which the live-stream channel is introduced. A comparison between the two scenarios is presented in Section 5.3. Superscripts EN and EI are used for clarity throughout the discussion.

5.1. Scenario EN: No live-stream channel

In scenario EN, the supplier reaches consumers exclusively through the e-tailer's online platform. In the first stage, the supplier maximizes profits by choosing the optimal wholesale price and anticipating the e-tailer's retail price in the reselling channel. The supplier's optimization problems are formulated as follows:

$$\begin{cases} \max\limits_{w} \pi_S = w(1-p_d) \\ \quad s.t. \quad 1-p_d \le K \end{cases} \tag{4}$$

In the second stage, given the wholesale price, the e-tailer determines the optimal retail price for the reselling channel. The optimization problems for the e-tailer are formulated as follows:

$$\max_{p_d} \pi_R = (p_d - w)(1-p_d) \tag{5}$$

The concavity of this problem can be proven easily. We solve this problem using backward induction, and the equilibrium results are summarized in Lemma 3.

Lemma 3. *The equilibrium outcomes under scenario EN depends on K, which are summarized below.*

(i) If $K > \frac{1}{4}$, the supplier sets $w^{EN} = \frac{1}{2}$, the e-tailer sets $p_d^{EN} = \frac{3}{4}$, and product sales $q_d^{EN} = \frac{1}{4}$.

(ii) If $0 < K \le \frac{1}{4}$, the supplier sets $w^{EN} = 1 - 2K$, the e-tailer sets $p_d^{EN} = 1 - K$, and product sales $q_d^{EN} = K$.

Lemma 3 is similar to Lemma 1 in that capacity levels influence retail prices, whereas limited capacity hinders the supplier's ability to stimulate demand through low pricing. However, unlike Lemma 1, in which the supplier sets the retail price directly, in Lemma 3, the e-tailer sets the retail price based on the supplier's wholesale price. This leads to a double marginalization problem in the reselling channel, which reduces the e-tailer's selling quantity. Consequently, the impact of capacity constraints is less pronounced in decentralized sales than in centralized sales.

5.2. Scenario EI: Introducing a live-stream channel

In scenario EI, the supplier sells products through both the e-tailer's reselling and live-stream channels. In the first stage, the supplier aims to maximize profits by setting an optimal wholesale price and anticipating the e-tailer's retail price in the reselling channel. The supplier's optimization problems are formulated as follows:

$$\begin{cases} \max\limits_{w} \pi_S = w\left(\dfrac{p_l - p_d - \theta + t}{\beta - 1} - p_d\right) + (1-\alpha)p_l\left(1 - \dfrac{p_l - p_d - \theta + t}{\beta - 1}\right) \\ \qquad\qquad s.t. \quad 1 - p_d \le K \end{cases} \tag{6}$$

In the second stage, based on the given wholesale price, the e-tailer and streamer independently determine the optimal retail prices in the reselling and live-stream channels, respectively. The respective optimization problems are formulated as follows:

$$\max_{p_d} \pi_R = (p_d - w)\left(\frac{p_l - p_d - \theta + t}{\beta - 1} - p_d\right) \tag{7}$$

$$\max_{p_l,\theta} \pi_T = \alpha p_l\left(1 - \frac{p_l - p_d - \theta + t}{\beta - 1}\right) - \frac{\theta^2}{2} \tag{8}$$

In the third stage, given the retail price, the streamer determines the optimal broadcasting effort for the live-stream channel by maximizing the profit function described in Eq. (8).

The concavity of this problem can be proven easily. The equilibrium for scenario EI is established under the conditions $K > K_1^E$, $t_l^E \le t \le t_u^E$, and $\beta \ge 1.5$ (otherwise, the dual channel is not commercially feasible, leaving only a single channel in operation). This assumption aligns with standard practices in the live-stream literature, such as Li et al. (2024) and Niu et al. (2025). Using backward induction, we derive the equilibrium outcomes summarized in Lemma 4.

Lemma 4. *The equilibrium outcomes in scenario EI depend on K, t, α, β, which are summarized below:*

(i) If $K > \overline{K}^E$, the supplier sets $w^{EI} = \frac{((4(\beta-2)\beta+3)\alpha+\beta-1)t+(2\beta-1)\alpha^2+2(1-\beta)(1+\beta)(2\beta-1)\alpha+(\beta-1)^2(8\beta-1)}{16\beta^3-2(15+7\alpha)\beta^2+4(2+\alpha)^2\beta-2(1+\alpha)^2}$, the e-tailer sets

$p_d^{EI} = \frac{\alpha(1-\beta)(4+\beta)(2\beta-1)+\alpha^2(3\beta-2)+2(\beta-1)^2(4\beta-1)+t(2\beta-1)((2+\alpha)\beta-2(1+\alpha))}{16\beta^3-2(15+7\alpha)\beta^2+4(2+\alpha)^2\beta-2(1+\alpha)^2}$, the streamer sets $p_l^{EI} = \frac{(\beta-1)((3+9t+3\alpha+4t\alpha)\beta-(11+8t+4\alpha)\beta^2+8\beta^3-2t(1+\alpha))}{16\beta^3-2(15+7\alpha)\beta^2+4(2+\alpha)^2\beta-2(1+\alpha)^2}$, $\theta^{EI} = \frac{\alpha((3+9t+3\alpha+4t\alpha)\beta-(11+8t+4\alpha)\beta^2+8\beta^3-2t(1+\alpha))}{16\beta^3-2(15+7\alpha)\beta^2+4(2+\alpha)^2\beta-2(1+\alpha)^2}$, and product sales $q_d^{EI} = \frac{(\alpha+4\beta-2\alpha\beta-3)\beta t+\left(\alpha\left(2+\alpha-5\beta+2\beta^2\right)-\beta+1\right)\beta}{16\beta^3-2(15+7\alpha)\beta^2+4(2+\alpha)^2\beta-2(1+\alpha)^2}$, $q_l^{EI} = \frac{((9-8\beta)\beta+(4\beta-2)\alpha-2)t+(\alpha(3-4\beta)+(\beta-1)(8\beta-3))\beta}{16\beta^3-2(15+7\alpha)\beta^2+4(2+\alpha)^2\beta-2(1+\alpha)^2}$.

(ii) If $K_1^E < K \le \overline{K}^E$, the supplier sets $w^{EI} = \frac{\left(4\beta^2-(2\alpha+5)\beta+\alpha+1\right)K+(\beta-1)t+(\alpha-3\beta+3)\beta}{(2(1-\beta)+\alpha)\beta}$, the e-tailer sets $p_d^{EI} = 1-K$, the streamer sets $p_l^{EI} = \frac{(K+t-\beta)(\beta-1)}{2(1-\beta)+\alpha}$, $\theta^{EI} = \frac{\alpha(K+t-\beta)}{2(1-\beta)+\alpha}$, and products sales $q_d^{EI} = \frac{(\alpha-2\beta+1)K-t+\beta}{2(1-\beta)+\alpha}$, $q_l^{EI} = \frac{K+t-\beta}{2(1-\beta)+\alpha}$.

Lemma 4 illustrates the interplay between the double-marginalization effect, as discussed in Lemma 3, and the impact of the live-stream channel, as outlined in Lemma 2, on equilibrium outcomes. To avoid redundancy, we omit further details here. However, it is noteworthy that the introduction of the live-stream channel alleviates the double-marginalization effect in the reselling channel when capacity is limited. As capacity increases, the supplier adjusts prices more aggressively than the e-tailer (i.e., $\partial w^{EI}/\partial K < \partial p_d^{EI}/\partial K$), effectively alleviating the double-marginalization effect by conceding a larger share of the marginal profit in the direct channel to the e-tailer. In addition, Lemma 4 underscores the impact of capacity on streamer decisions. When capacity is constrained, the steamer is incentivized to raise retail prices and allocate greater broadcasting effort to the live-stream channel, even at high service costs. This dynamic greatly intensifies the price competition between the two channels compared to the case with unlimited capacity.

5.3. Comparison of model: Scenarios EN and EI

Having determined the equilibrium outcomes for scenarios EN and EI, we now compare these scenarios to assess whether the supplier should introduce a live-stream channel in addition to the e-tailer's marketing. Our comparison begins with an analysis of the prices and demands in both scenarios.

5.3.1. Comparison of demands and prices

Next, we compare the prices and quantities of the two channels in the scenarios EN and EI. Proposition 6 summarizes these results.

Proposition 6. *Comparing the prices in scenarios EI and EN, we have*:

(i) $w^{EI} < w^{EN}$, if $K > max\{K_1^E, K_w\}$.

(ii) $p_d^{EI} < p_d^{EN}$.

Proposition 6 indicates that when capacity is insufficient (i.e., $K \le max\{K_1^E, K_w\}$), the supplier sets a higher wholesale price in scenario EI compared to scenario EN. This is because the supplier relies more heavily on wholesale profits from the reselling channel than on direct profits from the live-stream channel. However, owing to price competition between the reselling and live-stream channels, the e-tailer must lower the retail price in the reselling channel to compete for the limited capacity, despite facing a relatively high wholesale price. As capacity increases, the live-stream channel becomes more profitable, which benefits the supplier. In such cases, the supplier may lower the wholesale price to stimulate demand in both channels, although this results in a sacrifice of wholesale profits for the e-tailer. When capacity constraints are moderate, introducing a live-stream channel can reduce the margins for both the supplier and e-tailer, thereby mitigating the double-marginalization problem.

Proposition 7. *Comparing the demands in scenarios EI and EN, we have*:

(i) $q_d^{EI} < q_d^{EN}$, if $K > \overline{K}^E$ and $t < t_q^E$, or $K < min\{K_q^E, \overline{K}^E\}$.

(ii) $q_d^{EI} + q_l^{EI} \ge q_d^{EN}$.

Proposition 7 compares the demand dynamics between scenarios EI and EN. As established in Proposition 2, the introduction of a live-stream channel increases overall demand in a centralized selling scenario. This principle remains valid in a decentralized selling scenario, where the supplier leverages an e-tailer distribution channel. However, in the decentralized setup, the double-marginalization effect suppresses demand in the reselling channel under specific conditions: when capacity is abundant (i.e., $K > \overline{K}^E$) and the extra cost is small (i.e., $t < t_q^E$), or when capacity is limited (i.e., $K < \min\{K_q^E, \overline{K}^E\}$). Consequently, the live-stream channel plays a more significant role in boosting the total demand in the decentralized scenario than in the centralized scenario.

5.3.2. Supplier's decisions on the introduction of a live-stream channel

To assess the decision to introduce a live-stream channel, we now evaluate the supplier's potential gains from the live-stream channel against the losses incurred in the reselling channel. Proposition 8 compares the supplier's overall profit between scenarios EI and EN, offering valuable insights into the supplier's optimal channel strategy.

Proposition 8. *The supplier introduces a live-stream channel if one of the following conditions is satisfied*:

(i) $K > \overline{K}^E$, if $\alpha < \alpha_0^E$, or if $\alpha > \alpha_0^E$, $t < t_1^E$ or $t > t_2^E$.

(ii) $max\{K_1^E, K_a^E\} < K \le \overline{K}^E$, $t < \widetilde{t}_3^E$ or $t > \widetilde{t}_3^{E'}$.

Proposition 8 shows that the supplier's capacity, K, commission rate, α, and consumer extra cost, t, significantly impact the supplier's strategy for introducing a live-stream channel. Fig. 4 presents the results of Proposition 8. When the supplier's capacity is fully ample (i.e., $K > \overline{K}^E$), as depicted in Fig. 4(a), a low commission rate (i.e., $\alpha < \alpha_0^E$) makes the streamer with little motivation to exert substantial broadcasting effort in the live-stream channel, thereby diminishing the cannibalization effect of live-streaming on the reselling channel. This motivates the supplier to adopt live streaming. As the commission rate increases (i.e., $\alpha > \alpha_0^E$), the extra consumer cost plays an essential role in the supplier's decision regarding live-streaming. If the extra cost is sufficiently low (i.e., $t < t_1^E$), the greater attraction in the live-stream channel forces both the supplier and the e-tailer to lower their prices, thus alleviating the double-marginalization effect in the reselling channel. Coupled with the high profitability of live-streaming in this case, the supplier is willing to introduce a live-stream channel. Counterintuitively, the supplier is also likely to introduce a live-stream channel when the extra consumer cost is high (i.e., $t > t_2^E$). In this scenario, the streamer exerts less broadcasting effort and reduces the live-stream price, reducing the cannibalization effect of the live-stream channel on the reselling channel. Consequently, the supplier can set a higher wholesale price and obtain higher demand in the reselling channel. The promotion effect of the live-stream channel on both price and demand in the reselling channel explains why the supplier may adopt the live-stream channel even when the extra cost is high.

When the capacity is limited (i.e., $K_1^E < K < \overline{K}^E$), as depicted in Fig. 4(b), the supplier will consider its capacity level in addition to α and t when deciding whether to introduce a live-stream channel. Similar to the scenario with unlimited capacity, a low commission rate and either low or high extra costs are necessary conditions for the supplier to adopt live streaming. Within these conditions, a moderate to high capacity incentivizes the supplier to introduce a live-stream channel (i.e., $\max\{K_1^E, K_a^E\} < K < \overline{K}^E$). However, when capacity is tight, the streamer increases broadcasting efforts to attract more consumers, intensifying the competition for the limited capacity with the e-tailer's reselling channel. This significantly undermines the supplier's wholesale profit in the reselling channel. In this scenario, the profit from the live-stream channel cannot compensate for losses in the reselling channel, leading the supplier to choose to sell exclusively through the reselling channel when capacity is tight. The parameters used for Fig. 4 are: $\beta = 1.6, \alpha = 0.4$.

Proposition 9. *The introduction of a live-stream channel increases the total profit of the supply chain (i.e., $\Pi^{EI} > \Pi^{EN}$) if one of the following conditions is satisfied:*

(i) $K > \overline{K}^E$, if $\alpha > \alpha_1^E$, or if $\alpha < \alpha_1^E$, $t < t_5^E$ or $t > t_6^E$.

(ii) $\max\{K_1^E, K_c^E\} < K \le \min\{K_d^E, \overline{K}\}$, $t < \widetilde{t}_7^E$ or $t > \widetilde{t}_7^{E\prime}$.

Proposition 9 demonstrates the conditions under which the supplier's introduction of a live-stream channel increases the entire supply chain's total profit, considering that the supplier also sells products through the e-tailer's reselling channel. When the capacity is fully ample (i.e., $K > \overline{K}^E$), a live-stream channel with either relatively low or high extra consumer costs benefits the entire supply chain. The reasons are as follows: Firstly, when the extra cost is relatively low (i.e., $t < t_5^E$), consumers prefer to purchase from the live-stream channel unless the price in the reselling channel is appealing enough. As a result, both the supplier and e-tailer lower their prices in the reselling channel, thereby mitigating the double-marginalization problem in the reselling channel and benefiting the entire supply chain. Second, when the extra cost in the live-stream channel is high (i.e., $t > t_6^E$), the live-stream channel's profitability diminishes significantly, which softens the cannibalization effect on the reselling channel. In this scenario, both the supplier and e-tailer increase their prices to capture higher margins. Although some demand in the reselling channel is eroded by the live-stream channel, the increased profitability of the live-stream channel compensates for the loss in the reselling channel, thereby increasing total supply chain profit.

When capacity is constrained (i.e., $K_1^E < K < \overline{K}^E$), both the capacity level and extra cost significantly impact the profit of the entire supply chain. Specifically, if the extra cost in the live-stream channel is sufficiently low (i.e., $t < t_7^E$), a low or moderate capacity (i.e., $K_1^E < K < \min\{K_d^E, \overline{K}^E\}$) benefits the entire supply chain upon the introduction of a live-stream channel by the supplier. This is because a live-stream channel with low extra consumer costs can bring considerable demand and profit to the supply chain, even if it reduces the profitability of the reselling channel. However, the increased profit from the live-stream channel offsets the loss from the reselling channel, thereby benefiting the entire supply chain. If the extra consumer cost is relatively high, only a moderate capacity benefits the entire supply chain in scenario EI. This is because a larger extra consumer cost reduces the profitability of the live-stream channel and intensifies the competition for capacity between both channels, thus hurting the entire supply chain if a live-stream channel is introduced with insufficient capacity. Overall, it is important to choose a live-stream channel with an appropriate extra cost based on capacity level.

Proposition 10. *When the supplier sells via an e-tailer's reselling channel, the impact of introducing a live-stream channel on the consumer surplus (CS) and the social welfare (SW) are as follows:*

(i) $CS^{EI} > CS^{EN}$.

(ii) $SW^{EI} > SW^{EN}$, if $K > \max\{K_1^E, K_{SW}^E\}$.

Proposition 10 illustrates the effects of a dynamic equilibrium between a supplier's capacity and live-stream sales on consumer surplus and social welfare in a resale scenario. Live-stream sales, which are known for their efficiency and strong consumer engagement, help suppliers mitigate overproduction and reduce product backlogs. Live streaming offers consumers additional live services, making it an attractive option. Recognizing these benefits, governments have provided substantial policy support, with some actively participating in live-stream practices.

This support was especially evident during the COVID-19 pandemic when disruptions to traditional sales led to product surpluses and severe sales challenges for farmers. In response, the Chinese government implemented policies to integrate farmers into e-commerce platforms, addressing unsold products and enhancing consumer welfare through live-stream promotions (Si, 2021; Wang et al.,

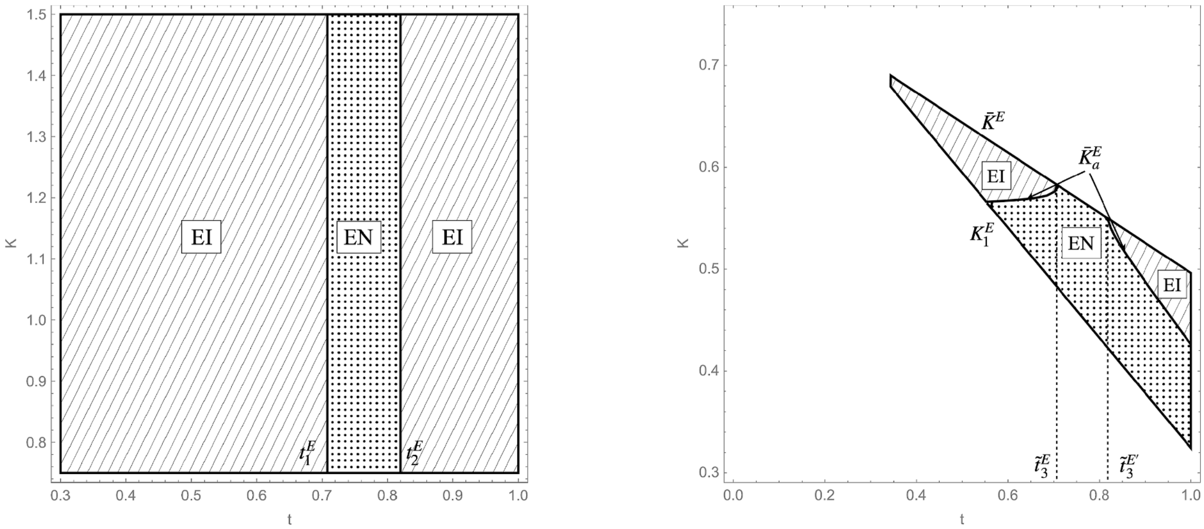


Fig. 4. Supplier's live-stream strategies on scenario E.

2024; Yu and Zhang, 2022). The findings of Proposition 10 validate the practical value of live-stream sales initiatives by governments and firms. Unlike the direct sale scenario, the reselling channel experiences a double-marginalization effect, which negatively impacts consumer surplus. Thus, the supplier can leverage live streaming more effectively to improve consumer surplus when operating a decentralized channel. However, lower capacity undermines the supply chain's profits. Therefore, a higher capacity (i.e., $K > \max\{K_1^E, K_{SW}^E\}$) is necessary to ensure that the introduction of live streaming improves social welfare.

6. Extensions

In the preceding section, the analysis, excluding the consideration of the supplier's production costs and the positive externality of the live-stream channel, indicates that limited capacity could dissuade the supplier from adopting live-stream sales. In this section, we expand the base model in various dimensions to test its robustness and provide additional insights into the decision to introduce a live-stream channel when facing capacity constraints.

6.1. *Considering the supplier's production costs*

In this section, we incorporate production costs to test the robustness of our conclusions. We derive the equilibrium outcomes for scenarios with and without the live-stream channel, considering the supplier's production cost, denoted as c. The analysis reveals that while the equilibrium results are affected by cost levels, the core findings remain unchanged, underscoring the robustness of the main analysis.

In line with the main model, in model DN/EN, the supplier refrains from adopting live-stream sales and sells products exclusively through a direct selling channel. The supplier's production cost settings align with those outlined by Zhou et al. (2023). In this setting, the supplier's profit-maximizing problems in the model DN are reformulated as follows:

$$\begin{cases} \max\limits_{p_d} \pi_S = (p_d - c)(1 - p_d) \\ \quad s.t. \quad 1 - p_d \le K \end{cases} \tag{10}$$

The profit-maximizing problems of the supplier in model EN is reformulated as follows:

$$\begin{cases} \max\limits_{w} \pi_S = (w - c)(1 - p_d) \\ \quad s.t. \quad 1 - p_d \le K \end{cases} \tag{11}$$

In model DI/EI, the supplier introduces a live-stream channel and sells products via both direct selling/reselling and live-stream channels. Thus, the supplier's profit-maximizing problems in model DI are reformulated as follows:

$$\begin{cases} \max\limits_{p_d} \pi_s = (p_d - c)\left(\dfrac{p_l - p_d - \theta + t}{\beta - 1} - p_d\right) + ((1-\alpha)p_l - c)\left(1 - \dfrac{p_l - p_d - \theta + t}{\beta - 1}\right) \\ \qquad s.t. \quad 1 - p_d \le K \end{cases} \tag{12}$$

The supplier's profit-maximizing problems in model EI are reformulated as follows:

$$\begin{cases} \max_{w} \pi_s = (w-c)\left(\frac{p_l - p_d - \theta + t}{\beta - 1} - p_d\right) + ((1-\alpha)p_l - c)\left(1 - \frac{p_l - p_d - \theta + t}{\beta - 1}\right) \\ s.t. \quad 1 - p_d \le K \end{cases} \tag{13}$$

The profit maximization problems of the e-tailer and streamer models remain consistent with those of the basic model. Applying backward induction, we obtain the optimal decisions and equilibrium outcomes and then compare the supplier's profits between models DI/EI and DN/EN to derive the optimal strategy for introducing a live-stream channel. Numerical examples for the case $K \le \overline{K}$ are presented in Figs. 5 and 6, while similar results for the case $K > \overline{K}$ are omitted for brevity. The parameters used in Fig. 5 are $\beta = 2$, $\alpha = 0.1$, and in Fig. 6 are $\beta = 1.6$, $\alpha = 0.35$.

A high commission rate discourages the supplier from adopting live-stream sales, whereas a low commission rate highlights capacity as a critical factor in a live-stream strategy. Specifically, when consumers' extra costs are low and capacity is moderate, suppliers are motivated to introduce live-stream channels. Interestingly, when suppliers sell products through the reselling channel of an e-tailer, the relatively high extra cost motivates the supplier to introduce a live-stream channel. The impact of production costs on these strategies is illustrated in Figs. 5 and 6. In scenarios with relatively low production costs, as illustrated in Fig. 5(a) and 6(a), suppliers are more likely to introduce a live-stream channel than in those with higher production costs, as illustrated in Fig. 5(b) and 6(b). Therefore, the decision to introduce a live-stream channel involves a delicate balance between increased demand, limited capacity, and the potential for profits that can offset additional costs.

6.2. Considering the positive externality of the live-stream channel

As a novel channel, the live-stream channel can have a positive externality on traditional sales channels, thereby benefiting them. This positive impact on the demand for other channels is defined as the spillover effect (Abhishek et al., 2016; Peng et al., 2023; Yang et al., 2023; Zhao et al., 2023; Zhen et al., 2022). In this section, we consider the positive externalities of live-streaming and examine the supplier's strategies regarding the adoption of live-stream channels.

The sequence of events follows the same structure as the basic model. Incorporating the positive externality, consistent with established studies (Li et al., 2024; Yang et al., 2023), the demand functions for the two channels are given by:

$q_d = \frac{p_l - p_d - \theta + t}{\beta - 1} - p_d + \tau q_l$ and $q_l = 1 - \frac{p_l - p_d - \theta + t}{\beta - 1}$.

The profits of supply chain members in this scenario remain the same as those in the basic model. We derive the equilibrium outcomes by backward induction, as detailed in the Appendix. Given the complexity of obtaining closed-form comparison results, we conduct extensive numerical studies to examine the supplier's preferences between scenarios DN and DI and scenarios EN and EI. The observations are presented in Figs. 7 and 8, which show how the spillover effect influences the supplier's strategies regarding live-stream channels when $K \le \overline{K}$. Similar results would apply for the case when $K > \overline{K}$, and are thus omitted in this section. The parameters used for Fig. 7 are $\beta = 2$, $\alpha = 0.1$, and for Fig. 8 are $\beta = 1.6$, $\alpha = 0.35$.

Propositions 3 and 8 show the conditions under which the supplier prefers scenarios DI and EI. The impact of the spillover effect aligns with this pattern. Specifically, when network externalities are considered, the main results of the basic model hold true: larger capacity, lower commission rate, and low extra costs continue to motivate the supplier to introduce a live-stream channel. Zhen et al. (2022) show that the positive externality of an online channel can eliminate horizontal competition among different channels. Consistent with the literature, the spillover effect of live-stream channels helps mitigate the cannibalization of existing channels in the

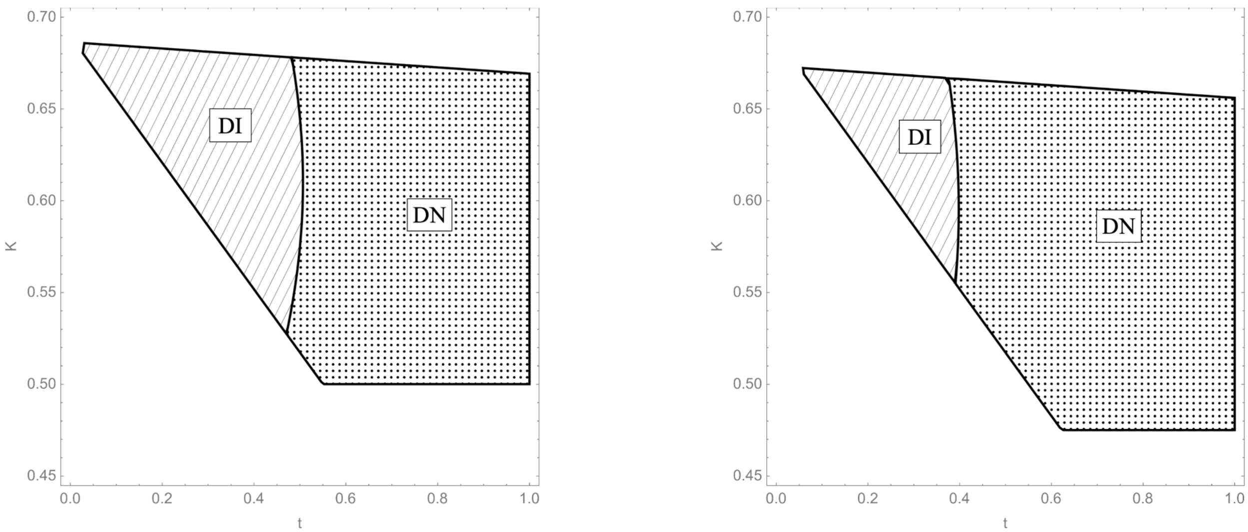


Fig. 5. Supplier's live-stream strategies considering costs in scenario D.

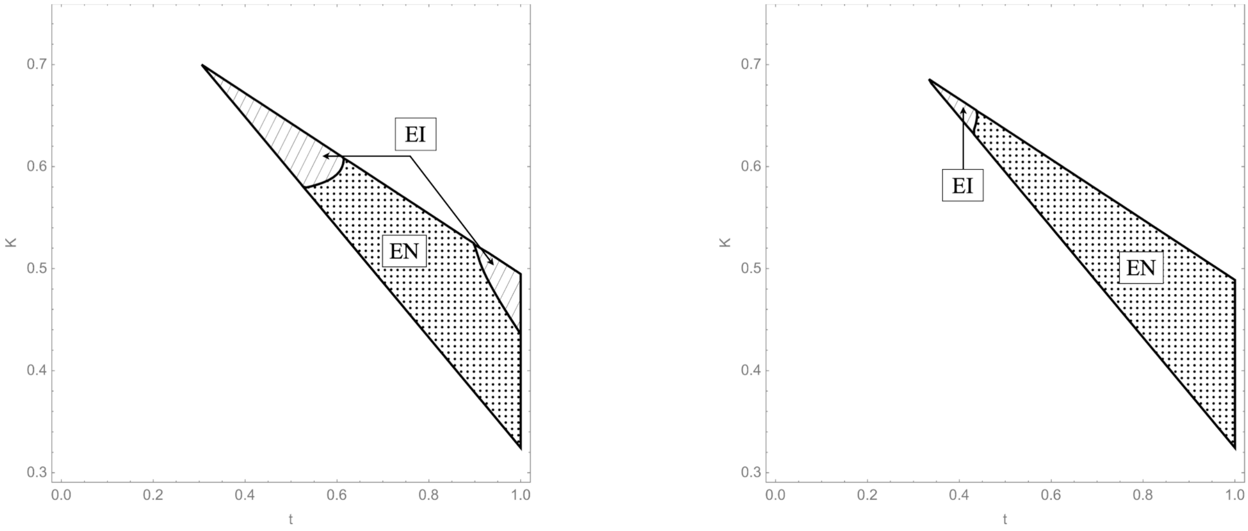


Fig. 6. Supplier's live-stream strategies considering costs in scenario E.

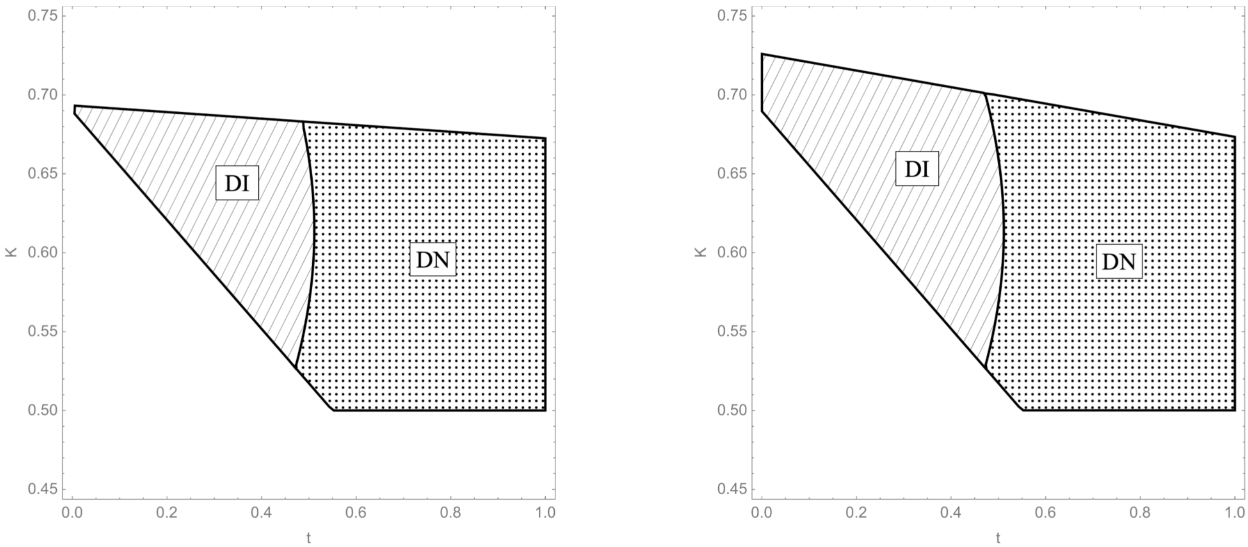


Fig. 7. Supplier's live-stream strategies considering positive externality in scenario D.

context of limited production capacity. This is because demand spillover from the live-stream channel to the traditional channel discourages the streamer from excessively reducing the live-stream price, thereby alleviating channel competition. Figs. 7 and 8 illustrate how the positive externality of the live-stream channel increases the supplier's motivation to adopt it.

7. Conclusion and managerial implications

7.1. Concluding remarks

While the inclusion of a live-stream channel can swiftly increase consumer demand, suppliers grapple with the decision due to capacity constraints. The dilemmas of whether a capacity-constrained supplier should adopt a live-stream channel and how capacity influences the introduction strategy and pricing decisions are crucial. Our objective is to identify the optimal conditions for introducing a live-stream channel and scrutinize how capacity shapes supply chain members' decisions and profits. To achieve this, a stylized game-theoretical model was developed; this could offer valuable insights to both academic researchers and practitioners.

The investigation yields the following key results. First, we find that a low commission rate and low extra consumer cost in the live-stream channel incentivize the supplier to introduce a live-stream channel, consistent with established studies such as Li et al. (2024) and Pan et al. (2022). However, under certain conditions, a supplier selling via a reselling channel may also benefit from a live-stream

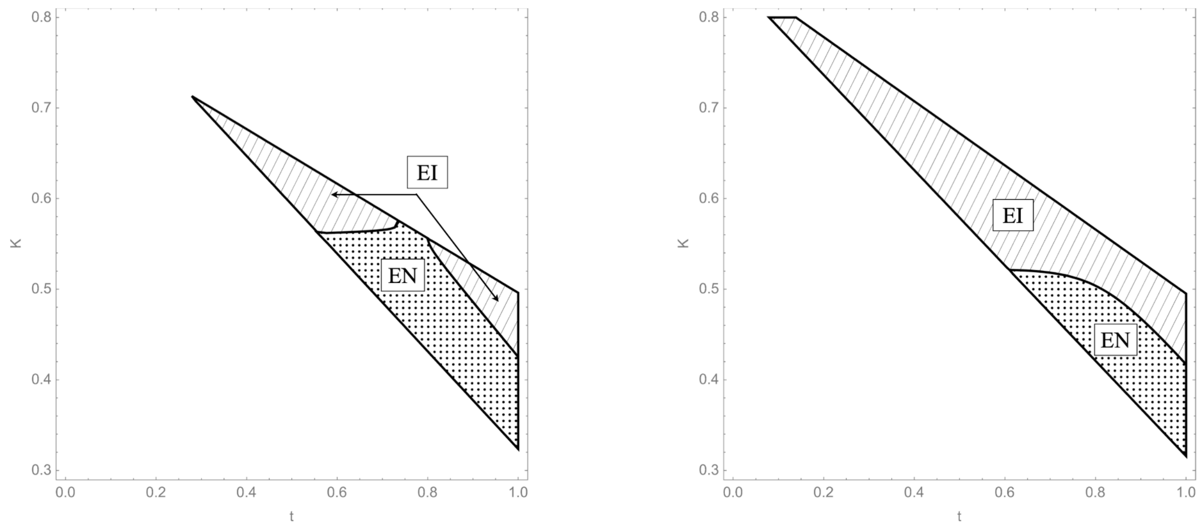


Fig. 8. Supplier's live-stream strategies considering positive externality in scenario E.

channel with a high extra consumer cost, as it diminishes the negative impacts of the double-marginalization problem in the reselling channel. Furthermore, our study emphasizes the crucial impact of capacity constraints on the supplier's live-stream strategy. Specifically, with a relatively small capacity, the supplier can only opt for live-stream channels with lower extra consumer costs to ensure profitability. As capacity increases, the supplier can accommodate live-stream channels with higher extra consumer costs because the resulting growth in overall demand offsets reduced profitability in the live-stream channel.

Second, we discuss how introducing a live-stream channel affects supply chain performance. We find that a low commission rate and small extra consumer costs make the live-stream channel profitable, benefiting the entire supply chain. As the extra cost increases, only a supply chain with moderate capacity can take full advantage of live streaming. From a supply chain perspective, unlimited production capacity does not guarantee maximum profits owing to fierce price competition. Instead, maintaining slightly insufficient capacity can strike a balance between capacity and price competition, resulting in optimal profits.

Finally, this study explores the impact of capacity levels on consumer surplus and social welfare. The findings indicate that including a live-stream channel always increases consumer surplus but does not consistently increase social welfare unless capacity is relatively abundant. This is primarily because consumers derive greater benefits from the introduction of live-stream channels than from the supply chain, regardless of capacity levels. When the capacity is insufficient, an increase in consumer surplus fails to offset the losses incurred by the supply chain, resulting in a decline in social welfare. Suppliers operating a direct channel need a larger capacity to increase social welfare through live-streaming compared to suppliers using an e-tailer's reselling channel because live-streaming greatly reduces the double-marginalization effect in the reselling channel.

In the extension section, we confirm the robustness of the main findings by considering additional factors such as production costs and network externalities.

7.2. Managerial implications

This study generates valuable insights for managers when considering the adoption of live-stream channels amid capacity limitations. First, suppliers should carefully assess their capacity before venturing into live-streaming. Although introducing a live-stream channel can boost considerable demand, insufficient capacity can severely erode profits from traditional e-channels. This challenge is exemplified by companies such as Apple, which have refrained from adopting live-streaming for high-end products such as those with limited OLED panel supplies (Dong et al., 2021; Elahi et al., 2023; Lockamy, 2017). Conversely, launching a live-stream channel at a reasonable commission rate can be advantageous if the supplier has sufficient capacity.

Second, live streaming may have mixed effects on the supply chain. While it can reduce product uncertainty and provide live entertainment during broadcasts, thus benefiting consumers, it can also intensify price and capacity competition with traditional e-channels, potentially harming them. The impact of production capacity plays a significant role in determining how effectively live-streaming can be used. It is crucial to balance the advantages of live-streaming for consumer welfare against the potential negative impacts on traditional channels. For example, during the COVID-19 pandemic, the Chinese government encouraged live-streaming to offset disruptions in traditional agricultural sales channels. This support has played a significant role in the success of live-streaming in China (Si, 2021; Wang et al., 2020; Yu and Zhang, 2022). By contrast, countries with less developed manufacturing sectors, such as

Indonesia and India, have implemented measures to protect traditional sales channels, thereby restricting the growth of live-streaming.[15]-.[16]

Therefore, companies and governments should consider both the demand-side benefits of live-streaming and the supply-side constraints when formulating live-stream strategies. This includes evaluating production capacity and the ability to effectively meet increased demand within the supply chain.

7.3. Limitations and further research

This study has several limitations that deserve further consideration. First, it is assumed that the streamer's sales capacity is unlimited, which contrasts with the practical scenario in which streamers often have limited capacity compared to traditional retailers. Considering this, suppliers' choices of live-stream strategies are affected. Second, we assume that the streamer endogenously determines the commission rate. Future research could explore the dynamics of bargaining between suppliers and streamers regarding commission rates. Furthermore, considering the discount factor in the live-stream channel as a negotiation point between the supplier and streamer adds another layer of complexity that warrants exploration. Finally, while this study focuses on supplier's capacity constraints and the challenges of meeting the increased demand for live-stream sales, it does not address replenishment and inventory management within these constraints. Future research should focus on these aspects to enhance the applicability and depth of the findings.

CRediT authorship contribution statement

Shuai Xiang: Writing – original draft, Software, Methodology, Investigation, Formal analysis, Conceptualization. **Chun-lai Shi:** Writing – original draft, Validation, Methodology, Investigation, Formal analysis. **Qin Zhou:** Writing – review & editing, Validation, Supervision. **Wei Geng:** Investigation, Conceptualization.

Declaration of competing interest

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

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tre.2025.104175.

Data availability

No data was used for the research described in the article.

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