Analysis of the Transaction Behavior of Live Broadcasters with Goods Based on the Multi-Stage Game under Dynamic Credit Index

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Abstract: In the live streaming transactions, the subject’s trading breach of trust frequently appears, which affects the healthy development of the industry. Therefore, from the perspective of internal supervision and governance, aiming at the interest relationship, behavior strategy, and game relationship between the live platform and the anchor and brand, this paper constructs a multi-stage honest transaction game model of the three behavior strategies, establishes a dynamic credit index mechanism, proposes a complaint compensation and cost-sharing strategy for breach of trust based on the change in dynamic credit index, and explores the influence of relevant parameters on the trading strategies of subjects. The research found that the internal penalty factor and the weight of dishonesty cost sharing can effectively restrain the behavior of transaction subjects; and the increase factor of dishonest transaction income is an important factor affecting the choice of behavior strategies of transaction subjects. Coefficients, internal and external penalty coefficients, as well as implementing a governance strategy of parallel rewards and punishments for trading entities, will assist in regulating the behavior of trading subjects.

Keywords: live streaming with goods transaction; dynamic credit index; subject behavior analysis; multi-stage game

1. Introduction

Since 2020, live streaming, as a new format and new driving force for the development of China’s e-commerce, has entered a stage of explosive growth. In March 2020, China’s National Development and Reform Commission, Ministry of Finance, and other departments issued the “Implementation Plan for Accelerating the Cultivation of New Consumption”, requiring the expansion of new retail formats and the development of live streaming economy. In July 2020, China’s National Development and Reform Commission, Cyberspace Administration, and other departments jointly issued “Opinions on Supporting the Healthy Development of New Business Forms and New Models to Activate the Consumer Market and Promote the Expansion of Employment”, and explicitly supported the development of new retail forms, such as live streaming and e-commerce. The characteristics of authenticity, real-time interactivity, community, and immersion in the “people-product-scenario” relationship of live streaming [1] result in a more intuitive shopping experience for consumers [2,3]. This leads to a substantial increase in the willingness and frequency of online consumption and has increasingly become a new growth driver for e-commerce platforms. According to the “2021 China Live Industry E-Commerce Report” published by Ariadne Consulting, the market size of China’s live streaming with goods exceeds CNY 1.2 trillion in 2020, with an annual growth rate of 197.0%. Moreover, it is expected to grow at an average annual compound growth rate of 58.3% in the next 3 years, and by 2023, the market size of live streaming with goods will exceed CNY 4.9 trillion.
However, due to the large number of participants, low entry threshold, and vague and irregular industry regulation and governance mechanisms [4], live streaming anchors and brands conspire to sell fakes and false marketing, coupled with the negative regulation of brands’ and anchors’ untrustworthy trading behavior by live streaming platforms. As a result, the sustainable and benign development of this new industry is greatly affected. Frequent untrustworthy behaviors in live streaming transactions have prompted the government to issue a series of policies to strengthen guidance and supervision, as well as to standardize the operation of the platform. For example, in April 2021, seven departments including the Internet Information Office of China and the State Administration for Market Regulation jointly issued the “Network Live Marketing Management Measures (Trial)”, which comprehensively defines the behavior of brand owners, live broadcast platforms, and anchors in live broadcast e-commerce specification. The standardization of live streaming delivery industry is an important basis to ensure the sustainable development of live streaming e-commerce industry. It is of great practical significance to guide the standardized development of live streaming e-commerce industry to explore the behavioral strategies of participants in live streaming delivery, build an honest trading mechanism, and put forward specific measures to regulate their behaviors. Issues related to live streaming e-commerce have attracted the attention and research of all parties. Many scholars have considered industry regulation and regulatory governance as the starting point, expounding the necessity of adjusting governance measures and innovating regulatory mechanisms to promote the sustainable development of the live e-commerce industry [4–7]. From the perspective of analyzing the behavior characteristics of transaction subjects, Peng Xing [8] studied the relationship between the anchor commission ratio, the platform commission ratio, and the anchor and platform service quality efforts. Other scholars have studied the impact of the characteristics of the anchor with goods on consumers’ purchase intentions, such as Lu Meng [9], Li [10], Fengjun Liu [11], and Nan Yang [12], etc. From the perspective of e-commerce supply chain decision-making, Cui [13] and Melda [14] studied the impact of different pricings, service levels, and other factors in the e-commerce supply chain on the decision-making of platforms and sellers. The above-mentioned studies mostly focus on the necessity of standardizing the live streaming e-commerce industry and the research on the behavioral strategies of single subjects. They have not provided an in-depth exploration of the transaction behavior between the live streaming subjects, such as the dishonest collusion behavior and game behavior of anchors and brands. At the same time, the relevant governance of live streaming transactions is mostly based on post-event fines from the perspective of external regulatory governance, and lacks a punishment mechanism design based on the transaction behavior and process of the subject from the perspective of the internal regulatory governance of transactions.

On the other hand, the current research on reputation management, incentive for honest transactions, and restraint mechanisms can provide useful reference for the analysis of honest transaction behaviors and punishment mechanisms for dishonesty in live streaming. In reputation management, some scholars have established credit risk mechanisms and models in e-commerce to improve the transaction environment and provide reference for decision makers [15–18]. In terms of incentive for honest transactions and restraint mechanisms, Wanglin Kang [19] proposed a trusted third-party mechanism based on registration fees and fraud penalties. Fengmei Yang [20] proposed the reduction in the risk of consumers in e-commerce transactions by constructing a deposit collection mechanism, a credit supervision mechanism, and a dishonesty punishment mechanism. Xie [21], Wu [22], and Chen [23] established an e-commerce credit management system based on the subject game model. Zhang [24], Baowen Sun [25], and Wang [26] proposed a transaction margin mechanism in e-commerce transactions, and found that traders would be constrained by the margin system and tend to be honest strategies. Lanlan Rui [27], Chengyi Le [28], and Wei Liu [29] introduced the credit evaluation incentive mechanism into the crowdsourcing platform based on the game model to guide participants to restrain their own behavior. However, the above studies mostly define e-commerce platforms and crowdsourcing platforms as the medium of transaction services, without considering the
dual attributes of “market” and “enterprise” of the platform itself. When establishing the
game model, the underlying assumption is that the platform is value-neutral, and it is not
included in the game analysis as a participant. In fact, the platform has benefited signifi-
cantly from live streaming, wherein it needs to perform regulatory duties. Moreover, the
enthusiasm of its supervision has an important impact on the establishment of an honest
trading mechanism and the choice of honest trading strategies by other participants.

Furthermore, the live streaming trading with goods is an economic activity of the
multi-agent cooperative game [30]. The subject’s goal is to minimize various costs while
ensuring the completion of the transaction. Therefore, determining a fair and reasonable
cost allocation plan is also an important condition for determining the sustainable and
healthy development of live streaming transactions. In the existing research results, the
introduction of cost-sharing strategies in the live streaming industry is still a preliminary
exploration. In this regard, the decision-making model of e-commerce supply chain mem-
bers is based on cost-sharing contracts in the context of platform data empowerment [31],
and the traditional e-commerce cost-sharing contract mechanism that considers the im-
 pact of goodwill on cost sharing under decentralized decision-making [32]. Moreover, it
can provide a useful reference for designing the cost-sharing strategy in the live delivery
transaction in this paper.

In summary, this paper will consider the enterprise attributes of the live streaming
platform under the perspective of internal regulatory governance, and construct a multi-
stage game model of integrity trading with the behavioral strategies of three parties: The
live streaming platform, the anchor, and the brand. By defining the dynamic credit index
of the three parties, we can construct a dynamic credit index mechanism that facilitates hon-
est trading, propose internal governance penalties and cost-sharing strategies for breach
of trust transactions based on changes in the dynamic credit index, and explore the influ-
encing factors that affect the choice of subject behavior strategies under the dynamic credit
index mechanism through the multi-stage game process analysis. Through the analysis of
the factors influencing the behavior of the subject of live band trading, the basic strategies
and specific measures for regulating the behavior of the subject are proposed, and the theo-
retical references are provided for promoting the standardization, integrity, sustainable,
and benign development of the new industry of live band trading.

2. Analysis of Subject Behavior

In live streaming, the live streaming platform profits by charging a live streaming
service fee and promoting and attracting traffic. The anchor profits by the “pit fee” and
commission paid by the brand, and the brand profits by the commercial placement and
supply of goods to the anchor. Figure 1 shows the relationship between the live broad-
casting platform, and the anchor and brand based on the collaboration constraint, and the
relationship between the anchor and brand based on the commission agent.

![Figure 1](image-url)

**Figure 1.** The relationship between the live broadcast platform and the anchor and brand
behavior strategy.
2.1. Analysis of the Behavior of Live Broadcast Platforms and Anchors and Brands under Collaborative Constraints

In live streaming with goods transactions, the live platform has the dual attributes of “market” and “enterprise”. As the bearer of responsibility for the quality of live streaming with goods, products, and services, the market attributes require the platform to supervise the responsibilities and urge the transaction subjects to effectively regulate business behavior and strengthen internal governance \[4, 30, 33\], and the enterprise attributes require the live streaming platform to make profits from live streaming with goods transactions and continuously expand the platform’s core competitive advantage in the market. Therefore, theoretically, the market attributes of the live streaming platform determine that the live streaming platform will actively supervise and restrict the trading behavior of the anchor and brand, and the enterprise attributes determine the collaborative win-win relationship between the live streaming platform and anchor and brand parties. However, in the process of seeking to maximize interests in order to achieve a significant increase in sales, increase the exposure rate and traffic of anchors, and increase the core competitive advantage of the live platform in the short term, the collaborative and win-win relationship between the live broadcast platform, and the anchor and brand will evolve into a collusive and dishonest relationship under the condition of the same interests. Specifically, to obtain greater revenue in order to gain more profits, the anchor and brand engage in dishonest transactions, such as false publicity and marketing of fake and shoddy commodities. Moreover, the live broadcast platform adopts a negative regulatory strategy, harboring the untrustworthy transaction behavior of the anchor and brand, as well as not taking punishment measures for its untrustworthy behavior and restrains it from adopting an honest transaction strategy. Furthermore, the live broadcast platform provides technical support to untrustworthy anchors and brands, such as traffic tilt and directional promotion technical support \[3\]. In summary, driven by interests, the live streaming platform may adopt negative regulatory strategies and generate collusive breach of trust transactions with anchors and brands. Based on this analysis, this relationship is included in the game model to explore the relationship between the behavior of multiple subjects of live band trading.

2.2. Analysis of the Relationship between Anchor and Brand under Principal Agency

The anchor accepts the brand party’s commission to conduct commercial sales promotion for the brand party to acquire customers and achieve the purpose of enhancing sales, and the anchor can be considered as the brand party’s agent. The behavior of both parties in the transaction jointly affects the income of live streaming. To maintain the brand reputation, the brand has the obligation to supervise the anchor’s breach of trust, such as misleading promotion of product function and efficacy, blurring the price range of goods, etc., and can report the complaint to the live broadcast platform when it is found to have a breach of trust. Similarly, the anchor can report the complaint to the live platform when it is found that the goods provided by the brand have quality defects, lack the after-sale guarantee service, blur the price range of goods and preferential conditions, etc. In addition, in the live streaming transaction, since the purchasing behavior of consumers is influenced by the anchor as a key opinion leader \[34\], in order to increase the volume of goods transactions, obtain higher transaction commission, greater traffic and visibility based on the principal-agent relationship, the anchor and brand will evolve into a collusive relationship under the consistency of interests. The brand relies on the traffic of the famous anchor, and both parties conspire to falsely advertise the quality and efficacy of products, and jointly deceive and mislead consumers, infringing on their legitimate rights and interests.

In summary, there are two kinds of behaviors of live broadcast platform behavior under the cooperative constraint relationship: Active supervision and negative supervision. Moreover, under the principal-agent relationship, the anchor and brand have two behaviors: Honest trading strategy and collusive dishonesty.
3. Relevant Concepts and Definitions

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

3.1. Live Banding Dynamic Credit Index Definition

Honest trading is an invisible driving force that has a huge contribution to the long-term development of enterprises. Moreover, for live streaming with goods trading subjects, the choice of honest trading can establish a deep connection with consumers, enhance customer stickiness, improve platform traffic, and enhance the recognition, reputation, and loyalty of the represented brand [28]. Therefore, by establishing a reputation management mechanism based on a dynamic credit index, it is possible to constrain the possible dishonest transactions and collusion behaviors of live delivery trading entities. The external supervision department and the live broadcast platform will judge the integrity or dishonesty of the transaction behavior of the main body, and record the updated credit index in real time. Specifically, for each honest transaction, the credit indices of the live streaming platform, anchor, and brand will be increased \( r_t \), and conversely, subtracted \( r_t \). Herein, \( R_t^m \) represents the dynamic credit index accumulated by the participants in the live streaming transaction in the \( t \) period and \( R_t^m = R_{t-1} \pm r_t \).

The trading credit management mechanism set in this paper considers the dynamic credit index of trading subjects as the core. Moreover, the credit index of other subjects can be referred to for deciding whether to trade before trading, changing the arbitrariness of subjects’ trading under the existing live band trading mechanism, and at the same time, motivating trading subjects to choose honest trading strategies in long-term trading.

3.2. Definition of Live Carryover Breach of Trust Transaction Costs

In the process of live band trading, excluding the fixed costs at the time of trading, additional transaction costs of breach of trust are incurred due to the breach of trust trading behavior of the participating subjects. For example, the additional marketing cost of introducing false quality information by enterprises to increase their revenue and the penalty cost after being discovered [35]. In this regard, the composition of the live carryover breach of trust transaction costs can be defined as two components: Breach of trust marketing costs and breach of trust transaction dispute costs.

Breach of trust marketing costs. The core of marketing communication lies in attraction and conversion [12]. In addition, the live broadcast platform needs to use the platform layout and other channels for packaging the anchor and brand party to attract traffic, which results in earning higher live service fees. When the subject generates a breach of trust transaction behavior to increase revenue, it is bound to produce credit loss and social reputation loss, which affects the overall revenue of the subject of live streaming with goods transaction. Moreover, to reduce social reputation loss and reshape consumers’ trust in brand parties, anchors, and live broadcast platforms, it is necessary to invest more funds in packaging and marketing for entities with low credit index and poor public opinion response, resulting in additional marketing costs for breach of trust.

Breach of trust transaction dispute costs. The breach of trust transaction behavior of the subject in the live carryover transaction leads to after-sales problems, such as returns and complaints from consumers and costs of dealing with breach of trust violations [36], such as return logistics costs, transaction compensation costs, and platform internal complaint investigation costs.

The transaction cost of untrustworthy live streaming is the credit transaction cost of the enterprise. Affected by the transaction behavior of the main body, the more frequent the untrustworthy behavior of the main body, the greater the increase in the untrustworthy cost [36]. Therefore, based on the subject’s dynamic credit index, the parameter \( c(R_t) \) is set, where \( c(R_t) \) denotes the coefficient of the change in the live carryover credit loss transaction cost according to the dynamic credit index, in order that the credit loss trans-
action cost increases in a corresponding proportion to the initial cost amount. Combining the change in the breach of trust transaction cost with the change in the subject’s credit, and dynamically adjusting the live tape breach of trust transaction cost according to the change in the subject’s behavior can effectively reflect the overall transaction situation, and provide the theoretical basis for the design of the breach of trust cost-sharing mechanism of the transaction subject.

3.3. The Cost-Sharing Strategy of the Breach of Trust Transaction for Live Banding

The transaction cost of untrustworthy live streaming increases after some untrustworthy behaviors occur. To restrain the trading behavior of the main body, the cost allocation of the untrustworthy transaction of live streaming is used as a reward penalty, which is reflected in the game analysis of the main body transaction. Clearly, the trading subject will tend to choose the honest trading behavior in the transaction to share less transaction costs of breach of trust and maximize benefits.

In terms of cost-sharing methods, the classical Shapley value model allocates costs or benefits based on the marginal contributions of the participating subjects to the alliance, which avoids distributional egalitarianism. At the same time, this can objectively reflect the effect of the contributions of the participating subjects on costs as well as reflect the game cooperation among the subjects [37,38]. However, since the distribution model of the classic Shapley value model is based on the assumption of equal power and status of subjects [39], differences in subject behavior factors will destroy the rationality of the distribution plan [40]. Therefore, this paper draws on the analytical idea of the modified Shapley value based on contribution differences in the literature [39,41], considers the variability of the impact of the behavior of live bandwagon subjects on transactions, and assigns weights to transaction subjects using their dynamic credit indexes as credit contribution degrees to apportion the transaction costs of the live bandwagon distrust. Specifically, assuming that the dynamic credit index of the main body is \( R_i^m \) after the first transaction, then \( m = a, b, c \) represents the live streaming platform, anchor, and brand side, respectively. Assuming that the credit contribution ratio is \( P \), then we can get \( P = \left( P_i^a, P_i^b, P_i^c \right)^T = \left( \frac{R_i^a, R_i^b, R_i^c}{\sum_i R_i^m} \right)^T \), \((i = a, b, c)\). Second, the inverse relationship between the credit contribution and cost allocation weight is established as \( P' = 1 - P = 1 - \left( \frac{R_i^a, R_i^b, R_i^c}{\sum_i R_i^m} \right)^T \). After normalizing according to the proportion, we get \( (1 - P_i^m) / A, (i = a, b, c), A = \sum_{i=a,b,c} (\sum_{i=a,b,c} R_i^m / \sum_{i=a,b,c} R_i^m) \). After arranging the weight formulas for the distribution of untrustworthy transaction costs of live streaming platforms, the anchors and brands are as follows: \( \frac{R_i^a + R_i^b}{2\sum_i R_i^m} \), \( \frac{R_i^b + R_i^c}{2\sum_i R_i^m} \), \( \frac{R_i^c + R_i^a}{2\sum_i R_i^m} \) \((i = a, b, c)\).

4. Multi-Stage Game Model of Live-Broadcasting and Delivery Transaction Entities under the Dynamic Credit Index Mechanism

4.1. Model Assumptions

Combined with the above-mentioned analysis of the behavior of the main body carrying goods in the live broadcast, and referring to the assumptions of the literature [3,30] on the choice of the main body behavior strategy, the income of the main body carrying goods, and the game between the subjects, the dynamic credit index mechanism of the live broadcast goods is carried out. The multi-stage transaction game behavior of the subject is assumed as follows:

Hypothesis 1. The main body of the live broadcast with goods transactions adopts two behavioral strategies. The two strategies of the live broadcast platform are {active supervision, negative supervision}. When implementing the active supervision strategy, the supervision cost is Cs. When the untrustworthy transaction behavior of the anchor and the brand side is found, they will be punished, and the penalty factor is \( f(R_i^m) \). The behavior strategies are {integrity transaction, untrustworthy
transaction), and the income $H_t^m$ of the anchor and the brand party is related to the transaction amount $T_t$. When one of the anchor and the brand party chooses a dishonest transaction behavior, the income increase coefficient of the dishonest transaction entity is $\alpha$. For the honest transaction entity, this will cause income loss, and the income loss coefficient is $\mu_t$.

**Hypothesis 2.** When one of the anchor and the brand party chooses the untrustworthy behavior strategy first, while the other chooses the honest transaction behavior, the honest transaction subject files an appeal to the live broadcast platform, in order to protect its own interests and social reputation. The appeal fee is $S_t$, and the amount obtained after the appeal is successful. The compensation for loss of income is $B_t$, $B_t = \beta H_t^m$, and $\beta$ is the compensation factor. If the untrustworthy subject refuses to take the initiative to compensate, the compensation will be deducted from the security deposit $B(R_t^m)$ paid by the subject when he enters the live streaming transaction [24]. When one of the parties chooses the untrustworthy behavior strategy first, and the other party chooses the untrustworthy behavior strategy and is being complicit in dishonesty, the revenue increase coefficient of the anchor and the brand side is $\lambda$, and the loss coefficient of the live streaming platform is $\varepsilon_t$. The income of the live streaming platform comes from the income commission of the anchor and the brand side, and the revenue sharing coefficient is $\theta$. When the anchor and the brand side are both untrustworthy, the live streaming platform will choose a passive supervision strategy to conceal the untrustworthy trading behavior to increase the income. In the case of tripartite collusion, the transaction subject’s income increase coefficient is $\ell$, $\ell > \lambda > \alpha > 1$.

**Hypothesis 3.** The external regulator supervises the live band trading activity. Herein, the probability of finding the subject’s breach of trust trading behavior is $\gamma$, $\gamma \in [0, 1]$, the penalty intensity factor is $f$, and the penalty for the subject’s breach of trust behavior is $F_t = f \gamma H_t^m$.

**Hypothesis 4.** Considering the constraints of the dynamic credit index on the behavior of trading agents, the internal penalty strength factor $f(R_t^m)$, the marketing cost of breach of trust $K(R_t^m)$, and the dispute cost of breach of trust transaction $G(R_t^m)$ are set as the decreasing functions of the dynamic credit index $R_t^m$.

**Hypothesis 5.** In the absence of a dynamic credit index mechanism, the subject incurs a fixed cost of $C_m$ in the live band trading.

4.2. Dynamic Credit Index Mechanism Trading Process Design

The specific process of live band trading based on the dynamic credit index mechanism is shown in Figure 2.

Step1: In a single transaction, both the anchor and the brand make an honest transaction, and each dynamic credit index increases $r_t$.

Step2: In a transaction, if one of the anchor and the brand has dishonest behavior, causing losses to the other party’s income and loss of revenue to the other party, then the subject of integrity files a complaint with the live streaming platform. After the platform investigates and arbitrates, the subject of breach of trust is punished, while the subject of integrity is compensated. At this time, the live platform credit index of the honest subject increases $r_t$ and the credit index of the untrustworthy subject decreases $r_t$.

Step3: In a transaction, if the anchor and the brand both conspire to deal with the breach of trust, the live streaming platform actively participates in the supervision. Then, after discovering the breach of trust, it is reported to the external regulatory department for collaborative governance and imposes a punishment on it. At this time, the credit index of both parties in default decreases $r_t$ and the credit index of the live platform increases $r_t$.

Step4: In a transaction, if the anchor and the brand party conspire to conduct a dishonest transaction, then the supervision of the live broadcast station fails or becomes a passive supervision, and the three parties conspire to conduct a dishonest transaction. After the breach of trust is identified through consumer complaint feedback information [5] or external regulation of the backstage data of the live band trading, the threshold of ab-
normal traffic data [4], etc., is set and the external regulatory authority intervenes to for punishment. At this time, the credit index of all three parties is reduced by \( r_t \).

**Figure 2.** Trading process under the dynamic credit index mechanism.

### 4.3. Single-Stage Game Matrix of Subjects under Credit Index Mechanism

According to the above assumptions, since the current platform-led regulatory mechanism and penalties within live band trading are imperfect [7, 33], and the cost-sharing constraint for breach of trust is not considered, there is limited constraint on the subject’s breach of trust trading behavior. Therefore, when the income of dishonest transactions is greater than the income of honest transactions, it will gradually evolve into a dishonest behavior strategy. Based on the characteristics of the current existing trading model of live banding [3, 8, 30], the single-stage game payoff matrix of the participation of the live banding subjects in phase 1 trading, without the dynamic credit index mechanism, is established as shown in Table 1.

From the revenue matrix, we know that in the first period of trading, under the active supervision of the live platform, the revenue of the anchor and the brand consider the integrity trading strategy as \((1 - \theta)H^t_1 - C_m\), and the revenue of both parties consider the bad faith trading strategy as \(\lambda(1 - \theta)H^m_1 - C_m - F_t\). Due to the imperfection of the internal regulatory mechanism, the punishment measures cannot be implemented in place after the active supervision of the live platform, and the restraint of the anchor and brand party’s dishonest trading behavior is not clear. At this time, the total gain of the anchor and brand party’s breach of trust trading strategy is higher than the honest trading strategy, and thus both parties will consider the (untrustworthy transaction, untrustworthy transaction) strategy. Due to the high labor costs involved in active regulation and the investment in developing an optimized regulatory technology platform [42], live streaming platforms gain \(\theta(H^a_1 + H^b_1) - C_t - Cs\) when they choose to actively regulate. Therefore, to reduce costs and expand benefits, live platforms will tend to choose negative regulatory strategies. Since the external regulation relies more on feedback from consumer complaints, there is a certain probability of punishment for the collusive breach of trust by three subjects, which
leads to a deviation from the (integrity transaction, integrity transaction, active supervision) strategy in the strategy choice of trading subjects. In addition, this is the case since the cooperation between live streaming with goods anchors, brands, and platforms is relatively irregular [5], such as the fact that an anchor can cooperate with different brands across platforms. Therefore, each transaction in a long-term live streaming bandwagon transaction can be viewed as a single transaction, and the subject will tend to choose the adoption of the (untrustworthy transaction, untrustworthy transaction, negative supervision) strategy in a long-term live streaming transaction under the current transaction mechanism without credit management constraints.

4.4. Single-Stage Game Matrix under Dynamic Credit Index Mechanism

Under the dynamic credit index mechanism, the regulation of the trading behavior of live band trading subjects is optimized, and the impact of the complaint penalty and the cost-sharing strategy of trading breach of trust on the subject’s revenue can have a constraining and warning effect on their breach of trust trading behavior, which is expressed in the matrix structure of the single trading game behavior, as shown in Table 2.

<table>
<thead>
<tr>
<th>Living Platform</th>
<th>Anchor</th>
<th>Brand Integrity Transaction</th>
<th>Brand Untrustworthy Transaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>active supervision</td>
<td>Integrity</td>
<td>(\theta(HF_t^a + HF_t^b) - G(R_t^a) - K(R_t^b) - Cs)</td>
<td>(\theta(1 - \theta)HF_t^a - G(R_t^a) - K(R_t^b))</td>
</tr>
<tr>
<td></td>
<td>untrustworthy</td>
<td>(\mu_t(HF_t^a + HF_t^b) - C_t - Cs)</td>
<td>(\mu_t(1 - \theta)HF_t^a - C_a)</td>
</tr>
</tbody>
</table>

| negative supervision | Integrity | \(\theta(HF_t^a + HF_t^b) - C_t - Cs\) | \(\mu_t(HF_t^a + HF_t^b) - C_t - Cs\) |
| | untrustworthy | \(\alpha(1 - \theta)HF_t^a - C_a - F_t\) | \(\lambda(1 - \theta)HF_t^a - C_a - F_t\) |

From the revenue matrix, we know that in this case, under the active supervision of the platform, when one of the anchor and the brand side chooses the honest trading strategy,
the total revenue of choosing the honest trading strategy is \((1 - \theta)H^t - G(R^m) - K(R^m)\), and the total revenue of choosing the dishonest trading strategy is \(\alpha(1 - \theta)H^m - f(R^m)H^m - F_t - G(R^m) - K(R^m)\). The total revenue for both parties choosing the conspiratorial dishonest trading strategy is \(\lambda(1 - \theta)H^m - f(R^m)H^m - F_t - G(R^m) - K(R^m)\). In analogy to the strategy choice under no dynamic credit mechanism, the internal grievance compensation and cost-sharing strategy under the dynamic credit index mechanism makes the compensation and the transaction cost of breach of trust significant for the subject’s benefit. There exists \((1 - \theta)H^m - G(R^m) - K(R^m) > \lambda(1 - \theta)H^m - f(R^m)H^m - F_t - G(R^m) - K(R^m)\), and thus the (integrity transaction, integrity transaction) strategy will be the trading strategy chosen by the anchor and the brand. When both the anchor and the brand choose the honest trading strategy, the total benefit of the live platform choice of positive regulation is \(\theta(H^t + H^t) - G(R^t) - K(R^t) - C_s\), and the total benefit of the choice of negative regulation is \(\theta(H^m + H^m) - G(R^m) - K(R^m) - F_t\). Compared with the strategy choice under no dynamic credit mechanism, for the live platform, although the negative regulation saves part of the regulatory costs, it will cause the loss of the platform’s reputation. Moreover, due to the serious negative public opinion impact of the collusion of the three parties with live goods breach of trust transactions, the feedback information of consumer complaints increases sharply, which will increase the probability of external regulatory departments. This will assist in the discovery of the collusion breach of trust behavior and quickly respond to the breach of trust transactions, in order to carry out post-investigation and governance [5], as well as to more severely punish their “knowingly” breach of trust behavior. Therefore, the punishment factor will increase. At this time, the revenue of the live streaming platform is \(\theta(H^t + H^t) - G(R^t) - K(R^t) - C_s > \theta(H^m + H^m) - G(R^m) - K(R^m) - F_t\); therefore, the live streaming platform will choose an active regulatory strategy.

Under the dynamic trading credit index mechanism, the (integrity transaction, integrity transaction, active supervision) strategy is the Nash equilibrium strategy of the single-stage game. Furthermore, the perfect Nash equilibrium of the long-term game, in which the (integrity transaction, integrity transaction, active supervision) strategy is a sub-game of live carryover trading subjects, can also be proven.

4.5. Multi-Stage Game Analysis Based on Dynamic Credit Index Mechanism

Based on the above analysis of the single-stage game matrix under the dynamic credit index mechanism, in accordance with the research results of Zhang [24] and Le [31] on the solution method of multi-stage game analysis, this paper analyzes the multi-stage game under the dynamic credit index mechanism as follows: First, in a single-stage game, a comparative analysis of the income difference of different trading strategies of the trading subject with or without the dynamic credit index mechanism forms the basis of the multi-stage game analysis. Then, based on the analysis results of the above stages, by comparing the differences in the return of the game subjects under the different strategy choices of the other two subjects, the critical threshold points of return of subjects that are discarded to choose different trading strategies are obtained from calculations, and the mechanism of why subjects choose different trading strategies are analyzed under the dynamic credit index mechanism. Finally, based on the analysis of the first two steps and on the premise that the subject can obtain greater returns in long-term multiple transactions under the dynamic credit mechanism, we explore the differences in benefits and the decision orientation of decision makers under the influence of strategies, such as grievance compensation, as well as the conditions for the stable operation of the dynamic credit index mechanism.

The main propositions obtained by analyzing the model matrix are as follows:

**Proposition 1.** Under the dynamic credit index mechanism, anchors and brands are willing to pay deposits to participate in live banding trading.

**Proof.** The initial margin paid by anchors and brands when they enter into a live banding transaction is the average transaction margin level in the live banding industry. Under
the dynamic credit index mechanism, the margin required to be paid by a trading entity each time it enters a live strip trade is related to the dynamic credit index, and the margin \( B(R_t) \) is an inverse function of the dynamic credit index \( R_t^m \). In the long-term transaction, with the dynamic credit index change, the transaction margin will be adjusted accordingly. When anchors and brands end a certain period of live band trading and are ready to quit, after dealing with the possible compensation for breach of trust appeals and penalties, the balance of the transaction deposit will be completely refunded to both parties involved in live trading. Therefore, the anchors and brands will choose to pay the deposit for enrollment in the live trading platform for live band trading.

□

Proposition 2. When \( \beta H_t^m > S_t + (1 - \mu_t)(1 - \theta)H_t^m \), a good-faith trading entity files a complaint when it incurs a loss of revenue due to the actions of a non-trustworthy entity.

Proof. In live transactions, untrustworthy entities unilaterally engage in untrustworthy transactions, causing negative impacts and economic losses on honest entities. At this time, the honest subject can appeal against the behavior of the subject of the breach of trust transaction. When a defaulting trading entity causes a loss of revenue to a good faith entity, the honest subject revenue is:

\[
P_m = \mu_t(1 - \theta)H_t^m
\]  
(1)

When a good faith party files a grievance, it pays a grievance fee of \( S_t \) and receives compensation for the grievance:

\[
B_t = \beta H_t^m
\]  
(2)

To ensure that their own interests are not affected by untrustworthy subjects, honest transaction subjects will appeal to the live broadcast platform. When the compensation is greater than the sum of the appeal fee and the loss of income, which is:

\[
\beta H_t^m - S_t - (1 - \mu_t)(1 - \theta)H_t^m > 0
\]  
(3)

Therefore:

\[
\beta H_t^m > S_t + (1 - \mu_t)(1 - \theta)H_t^m
\]  
(4)

In this case, honest transaction subjects will definitely file a complaint with the live platform when they suffer a loss of revenue. □

Proposition 3. Under the influence of grievance compensation strategy, when \( \alpha (1 - \theta) < f(R_t^m) + \beta + f\gamma \), the anchor or brand will choose the honest trading behavior.

Proof. When one of the anchor or the brand is dishonest and the other chooses to trade in good faith, the honest trading subject will file a complaint when the income is damaged. At this time, the income of the dishonest trading subject is:

\[
P_m = \alpha (1 - \theta)H_t^m - f(R_t^m)H_t^m - \beta H_t^m - f\gamma H_t^m
\]  
(5)

When the increase in revenue of a defaulting trading entity is less than the sum of internal and external penalty penalties and compensation, the defaulting trading entity chooses an honest trading strategy, when there is:

\[
\alpha (1 - \theta)H_t^m - f(R_t^m)H_t^m - \beta H_t^m - f\gamma H_t^m < 0
\]  
(6)

which is:

\[
\alpha (1 - \theta) < f(R_t^m) + \beta + f\gamma
\]  
(7)

Therefore, under the grievance compensation strategy, anchors and brands will choose honest trading practices. □
Proposition 4. Under the dynamic credit mechanism, the anchor and the brand will not collude when \( \lambda (1 - \theta) < f(R^m_t) + f \gamma \).

Proof. When the anchor and the brand are complicit in the breach of trust transaction, the total benefits to both parties are:

\[
P_a = \lambda (1 - \theta) H^a_t - f(R^a_t) H^m_t - F_t
\]

(8)

\[
P_b = \lambda (1 - \theta) H^b_t - f(R^b_t) H^m_t - F_t
\]

(9)

The internal penalty factor \( f(R^m_t) \) is a decrement function of \( R^m_t \). Specifically, \( f(R^m_t) = \frac{k_1}{R^m_0} + c_2 \), for external regulatory penalties:

\[
F_t = f \gamma H^m_t
\]

(10)

When the internal and external regulation is effectively implemented, it is assumed that:

\[
\lambda (1 - \theta) H^m_t - f(R^m_t) H^m_t - f \gamma H^m_t \leq 0
\]

(11)

when \( \lambda (1 - \theta) < f(R^m_t) + f \gamma \), the revenue from the conspiracy between the anchor and the brand is smaller than the regulatory penalty, and both parties will not choose to conspire. \( \square \)

Proposition 5. Under the dynamic credit mechanism, when \( l(1 - \theta) < f \gamma \), the anchor, the brand, and the live streaming platform will not triangulate.

Proof. When the three parties are complicit, the total revenue of the anchor, the brand side transaction, and the live platform are:

\[
P_a = l(1 - \theta) H^a_t - F_t - G(R^a_t) - K(R^a_t)
\]

(12)

\[
P_b = l(1 - \theta) H^b_t - F_t - G(R^b_t) - K(R^b_t)
\]

(13)

\[
P_c = l \theta (H^a_t + H^b_t) - F_t - G(R^c_t) - K(R^c_t)
\]

(14)

At this point, the internal regulatory mechanism of the transaction fails and only the external regulatory authority exists for supervision. From the revenue analysis of anchors and brands, when the collusion revenue is smaller than the external regulatory penalty fine, then:

\[
l(1 - \theta) H^m_t - f \gamma H^m_t < 0
\]

(15)

Namely, when \( l(1 - \theta) < f \gamma \) is satisfied, the anchor and the brand will not choose the three-way collusion. Similarly, for live streaming platforms, when the collusion proceeds are smaller than the external regulatory penalty fines, then:

\[
l \theta H^c_t - f \gamma H^c_t < 0
\]

(16)

Namely, when \( l \theta < f \gamma \) is satisfied, the live streaming platform will not choose to participate in the three-way collusion. Since \( \theta \) is the revenue sharing coefficient between the anchor and brand and the live broadcast platform, its value range is \( \theta \in (0, 1) \), and the revenue is allocated to the anchor platform by both the anchor and the brand. In general, when \( \theta < (1 - \theta) \) is satisfied, the comprehensive condition \( l(1 - \theta) < f \gamma \) is obtained. When \( l(1 - \theta) < f \gamma \) is satisfied, the live streaming platform, the anchor, and the brand will not conspire to break the trust. \( \square \)
Proposition 6. Under the dynamic credit index mechanism constraint, when \( C_{t+1}^m < C_{t+1(ch)}^m \), none of the three parties involved in live band trading will deviate from the honest trading strategy.

Proof. The dishonesty transaction cost \( C_m^m \) of the transaction subject includes the breach of trust marketing costs \( K(R_m^m) \) and the breach of trust transaction dispute costs \( G(R_m^m) \), \( C_m^m = (K(R_m^m) + G(R_m^m)) \times c(R_i) \). Herein, \( c(R_i) \) is the credit factor, and thus \( c(R_i) = (1 - \sum R_m^m / R_T) \).

Assuming that the subject has been maintaining good faith transactions, the dynamic credit index has an upper limit, and after accumulating to a certain value, it is fixed and will not increase. Therefore, \( R_T \) is the sum of the maximum fixed values of the dynamic credit index accumulated by the subject after continuous good faith transactions. The cost function is a decreasing function of the dynamic credit index \( R_T \).

\[
K(R_m^m) = \frac{k_0}{R_T^m} + c_0, \quad G(R_m^m) = \frac{k_1}{R_T^m} + c_1
\]  

(17)

Let the trading situation be the same before period \( t \), then the total cost for a trading entity to continue to trade in good faith after period \( t \) is:

\[
C_{t+1}^m = \sum_{i=1}^{\infty} \{c(R_i)K(R_{t+1}^m) + c(R_i)G(R_{t+1}^m)\}
\]

(18)

The total cost for a trading agent to continue trading in good faith after being penalized for trading in bad faith in a period is:

\[
C_{t+1(ch)}^m = \sum_{i=1}^{\infty} \{c(R_i)K(R_{t+1}^m) + c(R_i)G(R_{t+1}^m)\}
\]

(19)

For the live-carry trade participant, when the good faith trade is made in period \( t \), then \( R_{t+1}^m = R_t + r_t \); when a default transaction is made in period \( t \), then \( R_{t+1}^m = R_t - r_t \). At this point, \( c(R_{t+1}) \) increases with the decrease in the subject’s dynamic credit index, and overall this makes the transaction cost of breach of trust increase, in order that \( C_{t+1}^m < C_{t+1(ch)}^m \). Traders do not deviate from an honest trading strategy when the total cost-sharing amount incurred by the trader to produce a breach of trust is greater than the total cost of trading in good faith all the time. □

4.6. Equilibrium Results Analysis

Under the dynamic credit index mechanism, the live bandwagon subject choice of an honest trading strategy is a subgame perfect Nash equilibrium, which is conditional on:

\[
\beta > \max \{a(1 - \theta) - f(R_m^m) - 1(1 - \theta), (1 - \mu)(1 - \theta) + S_1 / H_m^m\}, \quad C_{t+1}^m < C_{t+1(ch)}^m
\]

Proof. From propositions 2 and 3, it is clear that under the grievance compensation strategy, when one of the anchor and the brand chooses the honest trading behavior and the other chooses the untrustworthy trading behavior, the subject of good faith will choose to complain under the condition \( \beta H_m^m > S_t + (1 - \mu)(1 - \theta) H_m^m \). If the appeal is successful, the dishonest transaction subject will receive a negative income due to compensation for the honest subject and internal and external punishment. When \( a(1 - \theta) < f(R_m^m) + \beta + f\gamma \) is established, the dishonest subject will choose to adopt the honest trading strategy. Therefore, \( \beta > \max \{a(1 - \theta) - f(R_m^m) - f\gamma, (1 - \mu)(1 - \theta) + S_1 / H_m^m\} \). For anchors and brands, the appeal compensation strategy under the dynamic credit index mechanism can enable them to choose the integrity trading behavior in long-term transactions. □

From Proposition 4, it is clear that when the anchor and the brand collude, the internal grievance compensation strategy fails. Then, it is necessary for the live streaming platform and external regulators to implement regulatory punitive measures to restrain their collusion. When the \( \lambda(1 - \theta) < f(R_m^m) + f\gamma \) condition is met, the anchor and the brand have a
negative revenue and do not choose to be complicit in the breach of trust. From proposition 5, it is clear that when the live streaming platform, the anchor, and the brand choose to collude in the breach of trust, the internal regulatory mechanism fails and is punished by the external regulator. When the \( I(1 - \theta) < f \gamma \) condition is satisfied, the three parties do not choose the collusion. Therefore, with the dominance of the external regulation, then \( f \gamma > \max \{ l(1 - \theta), \lambda(1 - \theta) - f(R^m) \} \). By integrating the aforementioned conditions for subjects to choose the equilibrium strategy under the internal grievance compensation strategy, the conditions to be satisfied for trading subjects to choose honest trading as a subgame Nash equilibrium under the dynamic credit index mechanism are obtained as \( \beta > \max \{ a(1 - \theta) - f(R^m) - l(1 - \theta), (1 - \mu_i)(1 - \theta) + S_i / H_i^m \} \).

From Proposition 6, the equilibrium strategy analysis from the perspective of the cost-sharing strategy of bad faith transactions, as well as the total cost of continuing to maintain good faith transactions after the completion of the \( t \) period of good faith transactions by trading agents is \( C^m_{t+1} \). If a trading entity is penalized for making a bad faith transaction in period \( t \), the total cost of continuing to maintain a good faith transaction is \( C^m_{t+1(ch)} \).

Moreover, under the dynamic credit index mechanism, \( C^m_{t+1(ch)} \) holds since the transaction cost of breach of trust increases as the dynamic credit index decreases. Clearly, in long-term transactions, the choice of honest trading behavior will achieve better returns, and thus the live platform, anchors, and brands will choose the (integrity transaction, integrity transaction, active supervision) strategy in the multi-stage game.

In summary, the long-term repetitive game under the dynamic credit index mechanism in the live platform, anchors, and brands will choose the (integrity transaction, integrity transaction, active supervision) strategy.

5. Mechanism Operation Simulation and Effectiveness Analysis

Strengthening internal regulatory governance and raising the industry’s access threshold has been the main tone of the policy to standardize the governance of the live banding industry in recent years. However, in the reality of live band trading, the credit regulation of participating subjects, access qualification review, and live platform supervision and governance has yet to be improved, for example, the famous Chinese e-commerce anchor Simba’s “Bird’s Nest in Sugar Water” incident. Herein, the live streaming platform Racer failed to fulfill its obligation to regulate the trading behavior of anchors and brands, but was allowed to re-enter its Racer account after 60 days of banning by external regulators. However, for the anchor to re-enter the industry, the corresponding qualification review process is missing. In the view of this, governments around China have introduced various regulatory policies, such as China Zhejiang Province to further promote the construction of an integrity system in the field of e-commerce and improve the industry standard for live streaming with goods; the “live e-commerce specification” was introduced at the end of 2020. This specification points out that the platform should establish a qualification audit mechanism for businesses and anchors, monitor the live broadcast, and strengthen the supervision of the commitments made by the business and anchors in the live broadcast, and distinguish the subject of the obligation for fulfillment. Based on the practical needs of the live banding industry to strengthen the internal governance of transactions and improve the credit supervision system, and in the context of the construction of the integrity system of the live banding industry in Zhejiang Province and the regulatory standardization requirements, a mechanism operation simulation is conducted to verify the effectiveness of the dynamic credit index mechanism of live banding transactions. Moreover, the initial assignment of the relevant parameters is as follows: \( k = 0.9, c = 0.5, H_i = 10, \theta = 0.2, S_i = 1, C^m = 2, R_T = 30 \).

5.1. Effect of Changes in Dynamic Credit Index \( R^m \) on Internal Penalty Strength Factor \( f(R^m) \)

The dynamic credit index serves as an important reference indicator to improve the qualification audit mechanism for anchors and brands, in order to reside in the live streaming platform, and is the basis for establishing the internal credit supervision of live stream-
ing with goods trading. The effect of a change in the dynamic credit index $R_m^t$ on the internal penalty strength factor $f(R_m^t)$ is shown in Figure 3. When the subject always maintains an honest trading behavior in the process of live-carry trading, the dynamic credit index $R_m^t$ continues to increase, the internal penalty strength factor $f(R_m^t)$ gradually becomes smaller, and the gradient of $f(R_m^t)$ decreases gradually with the increase in $R_m^t$. Simulation results indicate that the strength of the penalty intensity factor tapers off only when subjects accumulate sufficient credibility under the long-term honest trading behavior strategy. Conversely, if the subject always chooses to trade in bad faith, the upward gradient of $f(R_m^t)$ increases gradually with the decrease in $R_m^t$. This indicates that the live streaming platform will continuously strengthen the punishment according to the reduction in the dynamic credit index of anchors and brands to curb their continuous breach of trust, ensuring that the real-time adjustment of the dynamic credit index and punishment intensity factor has a significant effect on the impact of anchors’ and brands’ revenue under the internal regulatory governance of the live streaming platform. Therefore, this motivates the subjects to accumulate credibility and improve their own credit level through the long-term honest trading behavior.

**Figure 3.** Relationship between the dynamic credit index and internal penalty strength factor.

Reflecting on the practice, the live broadcast platform needs to improve the credit supervision system for anchor and brand parties according to the main trading behavior. Moreover, it needs to record, update, and publicize the dynamic credit index in real time after the transaction, and when the anchor or brand party produces a breach of trust trading behavior, the live broadcast platform adjusts the punishment strength factor in real time according to the change in the dynamic credit index, in order to punish their breach of trust trading behavior. This prompts the anchor and brand parties to choose the honest trading behavior under the drive of interests, and achieve the purpose of restraining the breach of trust behavior.

### 5.2. The Effect of Dynamic Credit Index $R_m^t$ on the Breach of Trust Marketing Costs $K(R_m^t)$

Without the loss of generality, the dynamic credit indices of trading subjects after several consecutive trading periods are considered, as shown in Table 3. According to the assumptions of the previous proposition, there is an upper limit to the dynamic credit index accumulated by the live band subject, and it may be useful to set the maximum value of the dynamic credit index to 10, then $R_T = 30$. Considering $K(R_m^t)$ as an example, we need to study the change in the critical value of the transaction cost function of credit failure when the dynamic credit index of the subject changes. According to the analysis of the dynamic credit index and the cost of breach of trust in proposition 6, the impact of the change in the dynamic credit index of the live streaming platform, the anchor, and the brand on the cost-sharing weights and marketing costs in successive periods of the transaction are shown below.
5.2. The Effect of Dynamic Credit Index on the Breach of Trust

The dynamic credit index of honest trading of trading agents, the smaller the proportion of the cost to be shared.

Table 3. Table of changes in critical values when the dynamic credit index changes.

<table>
<thead>
<tr>
<th>(R^a_t, R^b_t, R^c_t)</th>
<th>∑R^m_t(m = a, b, c)</th>
<th>d_1, d_2, d_3</th>
<th>K(R^a_t), K(R^b_t), K(R^c_t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1,3,9)</td>
<td>13</td>
<td>(0.461, 0.385, 0.154)</td>
<td>(0.52, 0.44, 0.17)</td>
</tr>
<tr>
<td>(2,4,8)</td>
<td>14</td>
<td>(0.429, 0.356, 0.214)</td>
<td>(0.46, 0.38, 0.23)</td>
</tr>
<tr>
<td>(3,5,7)</td>
<td>15</td>
<td>(0.4, 0.333, 0.267)</td>
<td>(0.4, 0.33, 0.26)</td>
</tr>
<tr>
<td>(4,6,6)</td>
<td>16</td>
<td>(0.375, 0.313, 0.313)</td>
<td>(0.35, 0.29, 0.29)</td>
</tr>
<tr>
<td>(5,7,5)</td>
<td>17</td>
<td>(0.353, 0.294, 0.353)</td>
<td>(0.31, 0.25, 0.30)</td>
</tr>
<tr>
<td>(6,8,4)</td>
<td>18</td>
<td>(0.333, 0.278, 0.389)</td>
<td>(0.26, 0.22, 0.31)</td>
</tr>
</tbody>
</table>

The analysis of the relationship between the dynamic credit index and the cost of breach of trust can be seen in Figure 4. The total cost of breach of trust marketing K(R^a_t) to be shared by the three parties of the live-carry transaction decreases as the sum of the dynamic credit index of the three parties increases. The share of marketing cost for breach of trust K(R^a_t), K(R^b_t) between the live broadcast platform and the anchor gradually decreases with the increase in dynamic credit index R^a_t, R^b_t, and the share of marketing cost K(R^c_t) for breach of trust to be borne by the brand increases with the decrease in its dynamic credit index R^c_t. This simulation result shows that based on the dynamic credit index mechanism of the cost-sharing strategy of bad faith, when trading agents choose the honest trading behavior, the dynamic credit index increases, the credit coefficient associated with the total cost of bad faith trading decreases, and the overall cost to be shared decreases. Whereas, the larger the dynamic credit index of honest trading of trading agents, the smaller the proportion of the cost to be shared.

Figure 4. Trends in the impact of changes in credit indices on cost sharing.

As reflected in the internal credit construction and regulatory governance of the live band trading industry, the cost-sharing strategy for breach of trust as a credit constraint and revenue influence factor plays a positive role on the behavioral strategy choice of trading subjects. Moreover, to share less costs and maintain the stability of trading cooperation, the live streaming platform, anchors, and brands will choose the honest trading behavior in long-term transactions, in order to accumulate a higher dynamic credit index and obtain higher revenue in subsequent transactions. Therefore, in the governance of the live streaming bandwagon industry, establishing a cost-sharing strategy associated with the dynamic credit index can promote the standardization of the trading behavior of industry participants.

5.3. Impact of Changes in Compensation Factor β and Loss of Earnings Factor μ_t on the Earnings of Honest Subjects

In the internal governance system of live band trading, the complaint compensation strategy based on the dynamic credit index mechanism encourages anchors and brands to
monitor each other when trading, and when one party produces a breach of trust, the other party can file a complaint to achieve compensation for their own gains and lead to the punishment of the party who has broken the trust. Based on the assumptions of the analysis of the internal grievance compensation strategy in the aforementioned propositions 2 and 3, in the current trading period, the damaged revenue of the honest subject is set to $H_i = 10$, the revenue distribution coefficient to the live platform is set to $\theta = 0.2$, and the grievance cost is set to $S_t = 1$.

The impact of the change in the compensation coefficient and the loss of revenue coefficient on the total revenue of honest trading subjects is shown in Figure 5. When the compensation factor $\beta$ increases continuously, the total proceeds $P_t$ from a successful compensation of a good faith subject’s complaint will increase accordingly. When the untrustworthy income loss coefficient $\mu_t$ continues to increase, $P_t$ will gradually decrease. When $\mu_t$ is large and $\beta$ is small, there will be a situation where the income of honest transaction subjects is $P_t < 0$. This is due to the fact that in the live streaming transaction, the change in the untrustworthy income loss coefficient $\mu_t$ is affected by the specific transaction behavior of the subject. When a subject uses a false advertisement, etc. to make a sharp increase in the sale of goods in a bad faith transaction, then the coefficient of loss of revenue $\mu_t$ for the honest subject will also increase. When the compensation coefficient $\beta$ is not adjusted to increase in a timely manner, the compensation does not cover the loss of earnings of the good faith entity, resulting in its total earnings being less than zero. Therefore, under the grievance compensation strategy, to ensure the gains of honest trading subjects and encourage honest subjects to continue to maintain the honest trading behavior, the live platform’s grievance compensation coefficient for honest subjects should be adjusted according to the actual trading gains to cover their loss of gains.

Reflecting on the specific practice of internal governance of live band trading, the live platform, as a regulatory implementer, needs to continuously improve the internal regulatory model, build a new model of parallel regulation of rewards and punishments, and take strict punitive measures against the subjects of trading in bad faith to stop the frequent occurrence of trading in bad faith with strong deterrence, while providing revenue incentives for the subjects of honest trading to maintain the honest trading behavior in long-term trading.

5.4. Impact of the Change in the Internal Penalty Intensity Factor $f(R^m_t)$ and the Earnings Increase Factor $\lambda$ on the Earnings of Colluding Defaulting Subject

According to the analysis of proposition 4, when the anchor and the brand conspire to make a breach of trust transaction, the internal grievance compensation strategy fails, and then the live streaming platform and the external regulatory authority manage in concert to punish the two parties for conspiring to breach trust. Based on the previous assumptions, the factor for the strength of the penalty generated by the external regulation is set as $f = 0.2, \gamma = 1$. 
The impact of the change in the revenue coefficient and the internal penalty factor coefficient on the total revenue of the conspiracy to defraud trading subjects is shown in Figure 6. Herein, $P_l$ will gradually increase as the coefficient of the increase in the gain from a breach of trust $\lambda$ increases, and the gain of a breach of trust will become smaller as the internal penalty intensity factor increases. In the case where the gain from a breach of trust $\lambda$ is small and the penalty $f(R^m)$ increases gradually, there will be a situation where the gain from a breach of trust for the trading agent is $P_l < 0$. This is due to the fact that when the anchor and the brand increase their revenue after conspiring to breach trust in live banding, the live platform adjusts the internal penalty factor coefficient to increase the penalty, in order to severely punish the anchor and the brand for conspiring to breach trust. Moreover, this will result in the plummeting of the revenue of the anchor and the brand under the conspcription of a breach of trust transaction. Furthermore, when the penalty is larger, the penalty will cover their breach of trust revenue, making the anchor and the brand revenue less than zero.

As shown above, in 2020, the Chinese Internet celebrity anchor Simba conspired with the bird’s nest brand to sell fake bird nests in syrup during the live broadcast. After the incident was fermented, the anchor and the brand recalled all the products sold, refunded consumers, and were fined USD 2.9 million by the market supervision department. After the external regulatory authorities punished and dealt with this collusion dishonest transaction, not only did the two parties not obtain positive benefits, but their social reputation and credit situation dropped sharply. Similar to the inference of proposition 4, when both parties collude in a breach of trust transaction, in the presence of internal regulatory governance mechanisms, the live streaming platform collaborates with external regulators to govern and punish both parties for the breach of trust. This can have a warning effect on the anchors and brands to choose the honest trading behavior in subsequent transactions and reshape their own credit system.

5.5. Impact of the Change in the External Penalty Intensity Factor $f$ and the Earnings Increase Factor $\lambda$ on the Earnings of Colluding Defaulters

According to the analysis of proposition 5, when the live platform is negatively regulated and conspires with the anchor and the brand to produce a breach of trust transaction behavior, the internal regulatory governance mechanism fails completely at this time. Moreover, based on the feedback from consumers’ complaints and the monitoring of the background data of the live band trading by the external regulator, the external regulator punishes the three parties for conspiring to breach trust.

The impact of the change in the coefficient of revenue increase and the coefficient of the external penalty factor on the total revenue of the conspiracy to defraud trading subjects is shown in Figure 7. Herein, $P_l$ will gradually increase when the coefficient of the increase in the gain from a breach of trust $l$ increases. When the external penalty intensity factor increases, the gain from a breach of trust will become smaller. In the case of a small gain coefficient $l$ and a gradually increasing penalty intensity factor $f$, the gain for a defaulting
trading entity is $P_t < 0$. This is due to the fact that the live streaming platform, anchors, and brands produce a tripartite collusion of breach of trust in live banding to increase their revenue. This will have a negative social opinion impact and lead to a lack of credit in the live banding industry, jeopardizing the sustainable and benign development of the industry. Therefore, the external regulator adjusts the penalty intensity factor, which will result in negative tripartite gains for breach of trust when the penalty intensity factor is sufficiently large.

Figure 7. Effect of external penalty strength factor $f$ and revenue enhancement factor $l$ on $P_t$.

As shown above, on 9 May 2022, in response to the Simba and bird’s nest brand selling counterfeit incidents at the end of 2020, the China Henan Consumers Association once again proposed punishment requirements for the negative supervision of live broadcast platforms, anchors, and untrustworthy behaviors of brand owners, as well as the used consumer civil public welfare. The litigation case was heard publicly. The Kuaishou live broadcast platform, the anchor Simba and its product selection company, and the bird’s nest brand party jointly assumed the responsibility of refunding one and compensating three. The total amount of punitive damages was RMB 59.785617 million, and the total amount of compensation was RMB 79.714156 million. Similar to the inference of proposition 5, in the livestreaming with goods transaction, when the live streaming platform adopts a negative regulatory strategy and conspires with the anchor brand side to cause a worse social impact in the breach of trust transaction, the external regulatory department increases the punishment for the three parties. Moreover, the three parties not only do not gain extra high revenue in the breach of trust transaction, but also their social reputation and credit level are sharply reduced by the transaction behavior. Therefore, under the strong influence of external sector regulation, this will produce constraints on live banding tripartite subjects, in order that they can choose the honest trading behavior in long-term transactions.

6. Discussion

(1) The dynamic credit index mechanism considers the credit index of the transaction subject as the core. Before the transaction, the live streaming platform can decide whether it can participate in the transaction according to the credit index of the anchor and the brand party. Moreover, the anchor and the brand party can choose whether to cooperate according to each other’s credit index. The deposit paid to participate in the live streaming is related to the dynamic credit index; the larger the credit index, the less the deposit paid. Currently, this mechanism has changed the arbitrariness of the subject entering the live broadcast with goods.

In the transaction, the internal penalty strength factor and the sharing weight of the transaction cost of breach of trust are related to the dynamic credit index of the subject. When the dynamic credit index of the subject is low, it needs to accept a larger penalty after generating a breach of trust, and at the same time, share more transaction cost of the breach of trust. The dynamic credit index runs through the whole process of live band trading, which can play an effective regulatory role on restraining the trading behavior of the subject.
(2) In the internal regulatory mechanism, the live streaming platform acts as the regulator of live streaming transactions, supervising the anchors and brands and enforcing punishments when they produce untrustworthy transactions. The internal regulatory mechanism makes up for the current lack of internal governance in the live streaming bandwagon industry. At the same time, considering the corporate attributes of the live streaming platform, it is included in the credit supervision system as a participating subject. When it chooses to negatively regulate and conspire with anchors and brands to breach credit, the external regulatory authority leads the governance of penalties for the three-way conspiracy of live streaming platform, anchors, and brands to breach credit. The implementation of the regulatory live platform as well as the external regulatory departments need to establish a diversified regulatory mechanism, collaborative supervision with consumers, innovative regulatory technology, effective regulation of the platform’s negative regulation and collusion breach of trust, and real-time and accurate punishment of live platform with the main breach of trust transaction behavior, while broadening the regulatory governance ideas, the implementation of parallel governance model of rewards and punishments, in order to promote the sustainable and benign development of the live platform with the goods industry.

(3) In the live band trading, the main factor that affects the choice of the live band trading subject to choose the breach of trust behavior is the increase coefficient of the gain of breach of trust trading. However, the breach of trust behavior of the subject can be restrained when the compensation coefficient and the penalty enforcement coefficient are large. Therefore, the live broadcast platform and external regulatory authorities need to dynamically adjust the amount of compensation and penalty enforcement according to the actual revenue of the transaction, in order to play a warning role to the trading subject while not affecting its enthusiasm to enter the practice of live band trading.

(4) The dynamic credit index designed in this paper is not limited to the credit situation of multiple anchors and brands that is counted by only one live streaming platform. However, it can be used to build a credit index information sharing platform and establish a supervisory system of mutual cooperation and credit information sharing among various live streaming platforms, in order to supervise and manage the credit of trading subjects in an all-round and industry-wide manner.

(5) The limitation of this paper is that the model analysis results are based on research assumptions. Ideally, it is believed that whether the subject chooses to trade in good faith depends entirely on his own will and the strategy of another subject. Other factors are not considered significantly, and thus there are factors that are not fully considered. On the other hand, consumers, as a part of the live streaming transaction, have a great influence on the main body’s strategy selection. Future research can consider consumers as the main body of the game and build a four-party game model.

7. Conclusions

Based on the analysis of the behavioral characteristics of the participants in the live streaming transaction, this paper designs an honest transaction mechanism based on the change in the dynamic credit index of the subject, and builds a multi-stage game model. Under the dynamic credit index mechanism, the three subjects reach a balanced decision. The complaint compensation and punishment strategy dominated by the live platform makes up for the lack of internal supervision and governance of the live streaming transaction under the existing trading mechanism, which is the cost-sharing strategy of dishonesty.

As a credit constraint condition and income influencing factor, the cost-sharing strategy of dishonesty plays a positive role on the behavior choice of the transaction subject. The live platform cooperates with external regulatory authorities to carry out supervision and governance, which can effectively prevent collusion and dishonesty. This is carried out through measures to strengthen autonomy within the transaction and coordinate external regulatory governance, in order to standardize the transaction behavior of the
main body and to promote the healthy and prosperous development of the live streaming industry. The dynamic credit index mechanism established in this paper is a useful exploration in establishing credit management and innovative supervision in live streaming with the goods industry, which can achieve the purpose of promoting the regulation of live streaming with the goods business model and creating a good trading environment, as well as providing theoretical reference for the sustainable and healthy development of live streaming with the goods model.

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