

Game Analysis on Supervision of Live Goods Problem with Tiktok Platform Participation Including the Absence of Lemon Market

Jiayi Quan^{1,a,*}

¹Shanghai Weiyu international school, Shanghai 200231, China

a. Joy_quan@163.com

**corresponding author*

Abstract: With the internet and technology development, the utilization rate of short video platforms has gradually increased, and online shopping has become very common. On September 20, 2016, Tiktok short video platform was launched. A TikTok mall is a delivery tool provided by Tiktok e-commerce for merchants. The platform reduces the threshold for merchants to meet the requirements and implements a comprehensive opening policy to obtain more user traffic. Inevitably, lowering the threshold brings the disadvantage of merchants selling fake and inferior products, leading to the lemon for the market and significantly impacting the platform atmosphere and user traffic. Based on the idea of mixed strategy and a journal about the online game theory of product quality, this paper adds more variables, taking into account the negative impact of Tiktok's actual scheme policy and lemon market. Constructing a game theory model including merchants and Tiktok regulatory department, analyze its nash equilibrium and derivative of each variable. Finally, find out that the lemon market exists on the Tiktok platform. Second, the higher cost of high-quality firms leads to strengthening supervision to prevent the low-quality firms from being driven out of the market. Third, the lower profit of low-quality goods, the merchants prefer to sell high-quality goods. The strategies selected by the regulatory authorities on the Tiktok platform and the strategies of the merchants are influenced by the production costs of different quality, the regulatory costs, and the rewards obtained from the efforts made by the regulatory authorities in sampling inspection. These factors will also influence their profits. This paper will prove the conclusion with accurate data.

Keywords: game analysis, lemon market, Tiktok platform

1. The Introduction of TikTok

TikTok is one of China's most popular social platforms for short videos. Officially launched in China as Douyin in September 2016, Tiktok was launched globally in 2017 [1]. Over time, Tiktok has become increasingly popular, becoming one of the most commonly used platforms for contemporary young people and the fastest-growing social media app worldwide. Users can create and share daily life, recommend products, make funny videos and live stream products on the platform. Videos are usually between 15 seconds and a minute long. Unlike other platforms like Kuaishou and Bilibili, Tiktok has a wealth of filters, music, animation, and camera effects that are

still being updated to enhance users' uploads better. Douyin and its overseas version, TikTok, had been downloaded nearly 67 million times as of January 2022 [1]. In May 2022, TikTok's daily active users reached 680 million, and its e-commerce scale reached 500-600 billion yuan [1].

2. The Ideal Developing Environment for TikTok

As TikTok has developed at a fast pace since it was launched in 2016 [1], there are several reasons why it can become the leading part of the short video industry.

The macro-environment in the first few years of TikTok created ideal business conditions for developing user-generated video content platforms in China. The paper "Research on Video Sharing Platforms" divides the reasons into three aspects [1]. (Jingyi Wu, 2021)

First, the government will formulate a strategy for TikTok's development. In 2016, the Chinese government promoted the "Internet Plus" and national big data strategy, supported the innovation and progress of the science and technology industry, and provided a favorable political environment for the short video industry [1]. Moreover, other industries, such as tourism, are on the rise, which has enhanced consumers' confidence and potential and boosted their consumption motivation.

Secondly, the economic background is the main factor in promoting TikTok's success. In 2014-2016, content creation in the field of short videos became a director for the investment industry [1]. As of 2016, 43 creators on the TikTok platform had received significant investments. Moreover, most of them became influential bloggers [1]. Among them, Papi Jiang, a Chinese Internet celebrity idol, received the most significant investment and became a benchmark for the financing possibilities of short video content creation. Moreover, its influence is also influential in this field. So, more investment and the direction of economic development have played a significant role in developing TikTok, a short video platform [1].

Third, Chinese Internet users account for half of the country's population, and many people use short video platforms to socialize and get new information. With the rapid development of the Internet, mobile Internet users have accounted for 90.1 percent of the total Internet users [1]. People use computers to work at work and use mobile phones to make a social network in their spare time, learn about news and facts, and use short video platforms to relax. Video of less than 1 minute meets users' needs for fragmented entertainment.

So the favorable macro environment created stable conditions for China's short video industry. As a result, 2016 was an excellent time for TikTok to enter this industry, and it has dramatically developed since it entered [1].

2.1. The Problems Caused by the Fast-paced Development

Amid the rapid growth of the Internet and the impact of COVID-19, short video platforms like TikTok have created a new platform for live streaming [1]. Livestream of goods and online shopping on the platform have boosted economic recovery, helped lift people out of poverty, and reduced unemployment. However, TikTok's rapid development has also caused some problems, such as product quality problems, resulting in inadequate supervision of merchants and a less strict punishment system for merchants, resulting in a lemon market and high-quality goods leaving the mall.

George Akerlof developed the theory of the market for lemons in his 1970 book *The Market for Lemons* [2]. This phenomenon refers to that because the seller knows more about the product quality than the buyer, the low-quality product will become the domain part of the product in the market, and the low-quality product will be sold, making the quality of the product in the market continuously decline, forming the information asymmetry in the market [2]. Furthermore, because the platform is the only link between sellers and buyers, the problem of the lemon market in online

trading will be more and more severe because it is difficult for buyers to guarantee the information sellers provide.

According to the investigation, in the past few years, some merchants sold fake and inferior products to users through live broadcasts and advertising on the Tiktok platform, thus causing the problem of information asymmetry. These merchants have seriously infringed on the consumer rights and interests of users. Because consumers can only know product information online through pictures, advertisements, and videos rather than physical objects, the user cannot judge the quality of the goods through only information. Therefore, users aware of the risk of buying fake and inferior products will only offer the average price in the market. This will harm the merchants who sell high-quality products. They cannot profit on this platform, and no one is willing to buy their products. In the long run, they will withdraw from the market because they cannot resist the risk of bankruptcy. In the end, only merchants selling low-quality products will be left on the Tiktok platform, and the quality of the entire platform will be reduced. Finally, users may leave the platform. This is the lemon market. [3]

Several online platforms take action to solve the problems met during the development. For example, some online transaction platforms established credit scoring for merchants and consumers to promote the transaction [3]. In contrast, other platforms promised to compensate the consumers who received low-quality products for three same products, which stimulates a part of consumers to believe in them and consume their platform [3].

Through reading the "Game Analysis on Supervision of Quality Problems of Live Goods with Short Video Platform Participation" (Liu Han et al., 2022). They have found the problem of fake products in the short video platform, and lots of them focus on three parties: government, platform, and merchants [4-7]. Besides, No paper focused on a specific platform, such as Tiktok. In fact, according to "General Rules for the Management of E-commerce Creators", the Tiktok platform will regularly select merchants to inspect products, which is a sampling inspection. The strength of sampling inspection depends on the supervision cost paid by the platform. We will think from this perspective to formulate merchant strategies.

Most importantly, searching a large number of papers about problems of the products in online platforms, we found that no one mentioned the part of lemon with the combination of actual occasions, and few of them contact reality. As a result, some variables were added by us to the basic model of one of the papers we searched for corresponding to reality.

As the supervision of the quality problems on online platforms like TikTok also needs to be strengthened, the rest of the paper will have a specific explanation using the model to describe the solutions.

3. Assumption of Game Theory Model

The paper will focus on the game between merchants and platforms. Based on reality, here is the assumption.

Assumption 1: According to "Game Analysis on Supervision of Quality Problems of Live Goods with Short Video Platform Participation" (Liu Han et al., 2022). All players are rational and guide their behavior to maximize their interests [4].

Assumption 2: Player1 is the merchant on the TikTok platform, which has two strategies: producing high effort high quality and low effort low-quality products, respectively. Player2 is the platform. According to the official website of Tiktok, the platform will randomly select a few products from products for inspection by sampling inspection to judge whether the batch of products is qualified. This involves the problem of sampling inspection technology. The more money you spend on sampling inspection, the easier it is to inspect low-quality products. On the

contrary, if the cost of supervision is small, almost zero, the less low-quality products are detected—two strategies: strict supervision and weak supervision [4].

Assumption 3: The cost of high-quality products, which is C_1 , is higher than that of low-quality products, which is C_2 [4]. Because the price of high-quality products will be higher than that of low-quality products, so the revenue of high-quality products, R_1 , is greater than that of low-quality products, R_2 .

Assumption 4: Revenue for merchants will be R' if the platform adopts weak supervision. $R_1 > R' > R_2$, because of the lemon market. Consumers can only know product information online through pictures, advertisements, and videos rather than physical objects. They cannot judge the quality of the goods through only information. Therefore, users aware of the risk of buying fake and inferior products will only offer the average price in the market. So the merchant's revenue will be lower than R_1 and greater than R_2 .

Assumption 5: According to “Game Analysis on Supervision of Quality Problems of Live Goods with Short Video Platform Participation” (Liu Han et al., 2022). The cost of supervision for the platform is C_3 , and we assume that the weak supervision costs zero. Besides, the fine of low-quality merchants was found to be f [4-7].

Assumption 6: The department kicked off the low-quality goods, the average quality of goods has improved, and more consumers have come in. So commodity's click rate has increased, bringing more profit for platforms. So the contribution of effort to profit for a platform is E (extra profit).

$$E = (\text{high/low}) \times n(\text{the number of consumers}) \times \text{click rate}$$

Table 1 : Merchants and platform game payoff matrix.

	Strict supervision	Weak supervision
High quality, high effort p	$R_1 - C_1, -C_3 + E$	$R' - C_1, 0$
Low quality, low effort 1-p	$R_2 - C_2 - f, f - C_3 + E$	$R' - C_2, 0$

3.1. Model Establishment

According to these six model assumptions, We can calculate the benefits of each strategy.

For merchants, when the merchant selects to produce high-quality goods, the benefit obtained by the merchant is $R_1 - C_1$ under strict supervision. Conversely, the benefit of merchants who sell high-quality products is $R' - C_1$ under weak supervision.

When merchants produce low-quality goods, the platform chooses strict supervision. Then the benefit obtained by the merchant is $R_2 - C_2 - f$. On the other hand, if the platform selects weak supervision, low-quality merchants' profit is $R' - C_2$.

For the Tiktok platform, If the platform implements strict supervision, but only high-quality goods are sampled, and they do not find the low-quality goods, then the benefit of the platform is $-C_3 + E$. In the case of strict supervision, if the platform successfully samples low-quality products, the platform's profit is $f - C_3 + E$. In contrast, in the case of weak supervision. The benefit gained by the platform is 0. Because the cost of weak supervision is 0, the platform cannot check the quality of products successfully.

Therefore, using these data. We can see that merchants should produce high-quality products under strict supervision because of $R_1 - C_1 > R_2 - C_2 - f$. Besides, merchants should produce low-quality products rather than high-quality products because of $R' - C_1 < R' - C_2$. Then, we can

calculate the maximized profit of both merchants and the Tiktok platform. The probability of merchants producing high quality is p , and the probability of merchants producing low quality is $1-p$. The probability of strict supervision is q , and the probability of weak supervision is $1-q$.

For merchants:

$$\Pi(\text{high})=q(R1-C1)+(1-q)(R'-C1)$$

$$\Pi(\text{low})=q(R2-C2-f)+(1-q)(R'-C2)$$

$$\Pi(\text{high})=\Pi(\text{low})$$

Finally, we can find out that $q=(C1-C2)/(R1-R2+f)$, $1-q=(R1-R2+f+C2-C1)/R1-R2+f$.

Therefore, one of the mixed strategies of nash equilibrium is:

$$((C1 - C2)/(R1 - R2 + f), (R1 - R2 + f + C2 - C1)/R1 - R2 + f)$$

For Tiktok platform:

$$\Pi(\text{strict}) = p(-C3 + E) + (1 - p)(f - C3 + E)$$

$$\Pi(\text{weak}) = 0$$

$$\Pi(\text{strict}) = \Pi(\text{weak})$$

Finally, we can find out that $P = (E - C3)/f$, $1 - p = (C3 - E)/f$

So, another mix strategy nash equilibrium is:

$$((E - C3)/f, (C3 - E)/f)$$

In summary, the mix strategy nash equilibrium is:

$$((C1 - C2)/(R1 - R2 + f), (R1 - R2 + f + C2 - C1)/R1 - R2 + f) \text{ and } ((E - C3)/f, (C3 - E)/f)$$

3.2. Model Analysis

We use a partial differential equation to analyze how each factor influences the profit.

Proposition1: the probability P of the merchant selling high-quality goods is related to the cost of supervision and production. The higher the cost, the lower the P . However, the higher the cost of producing low-quality goods and the higher contribution of effort to profit for the platform is E (extra profit), the higher the probability of providing high-quality goods. So strict regulation will encourage merchants to use high-quality products because it will reduce costs and bring additional revenue.

Proposition2: For the probability of strict supervision, if the cost of producing high-quality goods increases, strict supervision is needed, as the merchants are incentivized to use low-quality goods to lower the cost so that the profit will increase. The platform does not need strict supervision if the cost of providing low-quality goods is high or the extra revenue is high. Offering a low-quality product is less profitable for the business than offering a high-quality product, and there may be a penalty to pay. So they are more willing to provide high-quality goods. The platform can reduce supervision and reduce the cost of the platform accordingly.

Proposition3: For platforms, The higher the good, the higher the profit. Most of the platform's profits come from fines. However, regulation costs also affect profits, and high costs reduce profits. However, strict supervision can increase the platform's profit because the strict supervision makes the merchants provide good products, and more and more consumers are willing to buy the products on the platform. Therefore, the platform's influence becomes more extensive, and the profit increases.

According to the "General Rules for the Management of E-commerce Creators" and "Specifications for the Creation of E-commerce content" released, the "quality grading standard for e-commerce content" was launched. The data of 60 days online showed that the short video quality content increased by 15.38% month-on-month, and the live broadcast quality content increased by 11.86% month-on-month [8]. Over the year, the platform punished 971,000 creators for violations, and 11,000 were permanently shut down, according to the report [8]. Sixty-seven thousand low-

quality content creators, 1.52 million low-quality short videos, and 80,000 low-quality live-streaming studios were identified and suppressed by the system. On the other hand, favorability ratings rose 8.4 percent [8].

At the same time, the platform invested more than 80 million yuan in random inspection funds. In addition, it cooperated with 11 authoritative third-party institutions, such as the Swiss General Surveyor (SGS), to conduct random spot inspections on the platform's commodities. The report disclosed that the year sampled 2.23 million goods, intercepted 30,000 problematic products, and punished more than 10,000 merchants for violations [8].

According to the report, the platform has rigorous control over livelihood goods and seasonal goods. For example, after the campaign, the return rate of crayfish dropped by 23.8 percent, the return rate of strawberries dropped by 55.9 percent, more than 6,000 substandard bamboo shoots, beef, and mutton chops, preserved duck, and chicken were cleaned up, and more than 300 illegal businesses were closed down. As a result, customer satisfaction increased by 16% [8]. All of this justifies the conclusions of our model.

4. Limitation

Through simplification, our model only considers the game between merchants and platforms, ignoring the influence of consumer behavior on the strategies of merchants and platforms, the competition between short video platforms, and the regulation of short video platforms by government departments. Consumers' behavior has the most direct impact on their quality of life. Enhance consumer vigilance, and strengthen consumer awareness. Rights protection can effectively reduce the probability of selling fake and infringing on live streaming. In addition, relevant policies also have a significant impact on live streaming. Whether the government adopts strict supervision and preferential policies, the delivery of goods can significantly increase the probability of merchants selling qualified goods. Our model also simplifies many aspects, including the regulatory approach, the platform's execution, and whether there is a mix of high-quality and low-quality goods. These are all factors we need to consider in future research.

After that, we will continue looking at merchant strategies and consider more factors to further research.

5. Conclusion

This paper takes the most popular Douyin platform as the background. It uses a mixed-strategy game model to construct the revenue matrix of the Douyin platform and its merchants [4]. More importantly, we added a market for lemons to our model. Based on other previous studies, this paper considers and calculates the Nash equilibrium of mixed strategies of the Tiktok platform and merchants in the market with lemon. Moreover, the relationship between each factor and the probability of strict supervision and product quality was analyzed. It is found that if The cost of high-quality products increases, merchants' profits will be relatively low; at this time, the platform should strengthen management because, in the case of the lemon market, Merchants selling high-quality products have to reduce the price to sell their products. The worst result is that such businesses may finally leave the platform. To prevent this from happening, the platform needs to strengthen supervision.

Conversely, when the cost of low-quality products increases, merchants will realize that the profit from producing low-quality products is lower, so they will choose to produce high-quality products more. At this time, the platform does not need strict supervision. Moreover, consumers prefer high-quality goods. Therefore, the platform must strengthen supervision, take strict penalties for violations, and provide a high-quality platform for consumers. Businesses should also regulate

the quality of their products and operate their stores according to the platform's regulations so as not to cheat consumers.

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