How to stand out in the "lemon market"? application of signaling theory in live streaming commerce

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Abstract. Live streaming commerce innovatively combines e-commerce and live streaming, and it is booming. However, like traditional e-commerce, live streaming commerce is facing challenges from “lemon market”. The article applies signaling theory from a perspective of game theory and finds that high-quality sellers can stand out in the market by releasing two kinds of additional signals, which are signals that increase cost and signals that increase risk, and proposes relevant research hypotheses. Then, the researcher designs an experiment to explore how the additional signals affect the audiences’ purchase intention. The data collected shows that additional signals increasing cost can improve audiences’ purchase intension through improving the product quality and sellers’ credibility perceived by the audience while additional signals increasing risk cannot achieve the same effect. At the end, possible explanations for the unproven hypothesis and further research directions are provided.

1 Introduction

Live streaming commerce is a significant component of the current e-commerce economy. This new type of business started in 2016 as a trial from a social platform Mogujie. After rapid growth in these years, it has now become a primary business model for various e-commerce platforms such as Taobao and JD.com. As estimated, the size of China's live streaming commerce market has reached 961 billion yuan in 2020, and it will increase to 1202 billion yuan in 2021 (iiMedia Group, 2020) [9]. Compared with the traditional e-commerce, live streaming commerce provides sellers with more ways, such as real-time interaction, tasting and trial, to introduce products comprehensively. Combing with the use of time-limited tactics, this entertaining and immersive business model can effectively shorten customers’ decision time, thereby greatly increasing the conversion rate. Compared with traditional e-commerce, the conversion rate of live streaming commerce has increased by 10 times, close to 30% (Mckinsey& Company, 2021) [15]. In the later sections, this article

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firstly categorizes additional signals, introduces their ways of influence and proposes hypotheses. The subsequent parts elaborate with the research method and statistical analysis. Finally, it ends with discussion, conclusion, limitations, and potential future research directions.

2 Background

The booming of live-streaming commerce also brings complaints from customers: they bought inferior products due to broadcasters' misleading recommendations (Qi, 2021) [24]. The information asymmetry between broadcasters and customers cause customers cannot reliably distinguish high-quality sellers and low-quality ones; this inability can trigger market failures and lead inferior goods dominate the market, which is the lemon market (Akerlof, 1970) [1]. Akerlof's article analyze lemon market theory by an example of used car market, later research has also applied the lemon market theory in other markets, like insurance market (Chade & Schlee, 2020) [6], office market (Palm, 2015) [16], and pharmaceutical market (Light & Lexchin, 2021) [13]. Similar research has also been conducted in the tradition al e-commerce market, given the huge number of sellers, similar technologies used to create online shops, and lack of face-to-face communications, it is challenging for customers to distinguish high-quality sellers and low-quality sellers, therefore, it causes the lemon market (Tamilla, 2016) [21]. Similar circumstances happen in live streaming commerce market as well, rapidly growing number of sellers, low entry level, and same live streaming platforms hinder customers' ability to tell sellers' quality, as a result, the issue of lemon market is formed.

Signaling theory is the concept that one party credibly conveys some information about itself to another party (Spence, 1973) [20]. Past research proved that signals play an important role regarding to reduce information asymmetry (Kirmani & Rao, 2000) [11]. As an efficient tool to reduce information asymmetry, signaling theory has been applied in many fields, for example, stock market (Amin, 2017) [22], mortgage market (Adelino, Geradi & Hartman-Glaser, 2019) [2], and job market (Jeong, 2019) [10]. Signaling theory has also been well applied in traditional e-commerce. Interestingly, as the e-commerce market relatively lacks information sources and tangible signals compared with the offline retailers, consumers tend to rely more on the signals released by sellers (Biswas & Biswas, 2004; Pan & Zinkhan, 2006) [4, 17]. Subsequent research proves that a relatively flexible refund policy is an effective signal. Although a flexible refund policy can increase the refund requirements, high-quality sellers can compensate this cost through increasing revenue. However, it is infeasible for low-quality sellers, because the low quality of their goods can lead to many refunds and hence the cost of setting a flexible refund policy is much higher than the income it provides (Heiman, McWilliams, & Zilberman, 2001) [8]. Additionally, brand, privacy policy, and third-party verification seals are also effective signals to reduce information asymmetry (Lee, Ang, & Dubelaar, 2005; Tamilla, 2016) [12,21]. In addition to e-commerce, live streaming commerce provides merchants with opportunities to release additional signals to buyers. Also, live streaming commerce can increase customers' purchase intention through reducing customers' perceived uncertainty of product quality and fit and increasing customers' perceived trust (Lu & Chen, 2021) [23]. Based on former research, this article proposes that customers' perceived product quality and perceived sellers' credibility can effectively affect customers' purchase intention, and also categorizes additional signals raised from live streaming commerce and test their effectiveness and corresponding ways of influence.

3 Additional signals categorization

From the game theory perspective, after releasing an effective signal, high-quality sellers should be still capable to make profits whereas the low-quality sellers make a loss. Under this circumstance, there is no incentive for low-quality sellers to continue releasing the signal. Assuming the revenue of high-quality sellers is $\boldsymbol{R_h}$; the revenue of low-quality sellers is $\boldsymbol{R_l}$; the cost of releasing signals is $\boldsymbol{C_s}$, then, if the signal is effective, it needs to satisfy conditions:

$$R_h - C_s > 0 \text{ And } R_l - C_s < 0 \Rightarrow R_l < C_s < R_h \tag{1}$$

It is worthwhile to notice that $\boldsymbol{R_l}$ need to be strictly less than $\boldsymbol{C_s}$ to avoid the semi-separating equilibrium: some low-quality sellers still release the signal for imitating high-quality sellers even though it is not profitable. The challenge of lemon market can be understood as the situation that the cost of the signal is lower than revenues of both high-quality and low-quality sellers, and thereby customers cannot tell products quality based on the signal:

$$\mathrm{C_s} < \mathrm{R_l} < \mathrm{R_h} \tag{2}$$

Additional signals from live streaming commerce can be categorized into two types. The first one is the signals that can increase cost, which means the cost of signals increases to the level that is between revenues of different quality sellers. Assume the cost of new signal is $\boldsymbol{C_N}$, then:

$$\mathbf{C_s} < \mathbf{R_l} < \mathbf{R_h} \quad \Rightarrow \quad \mathbf{C_s} \rightarrow \mathbf{C_N} \quad \Rightarrow \quad \mathbf{R_l} < \mathbf{C_N} < \mathbf{R_h} \tag{3}$$

Nevertheless, in the real-world market, the revenues difference between different quality sellers is complicated. Therefore, how distinguished a seller can achieve depends on how much cost of the signals it releases. For example, celebrity endorsements are much more effective than simple decorations in the broadcast room. In the following research, this article sets live streaming in the field as a representative signal for signals that increase cost to test its effectiveness. Hence, we propose the first hypothesis:

H1: Releasing additional signals that increase cost can improve customers' purchase intention.

The second type is additional signals that increase risk. In the lemon market, if an additional signal can appropriately decrease both revenues of high-quality sellers and low-quality sellers, it can also be effective. Assuming after releasing the additional signal, the new revenues of high-quality sellers and low-quality sellers are R_{hN} and R_{lN}, respectively. Then:

$$C_s < R_l < R_h \quad \Rightarrow \quad R_l \rightarrow R_{lN} \ \& \ R_h \rightarrow R_{hN} \quad \Rightarrow \quad R_{lN} < C_s < R_{hN} \tag{4}$$

Sellers' revenues can be calculated by expected value, assuming there are n kinds of sales situation (e.g., sell well and unsalable), the i-th sale situation's probability is P_i, and its corresponding revenue is R_i, then:

$$R = \sum_{i=1}^{n} P_i R_i \tag{5}$$

Therefore, an effective signal should increase the risk that low-quality sellers experience sales difficulties and hence decrease their revenues, meanwhile it would not cause significant damages to high-quality sellers. This research applies the signal that live streaming host trials the product as a representative signal. Real-time trial can expose the shortcomings of low-quality products and cannot be compensated by editing, but it will not cause high-quality sellers too much risk due to their products' high-quality. In terms of testing its effectiveness, the following research hypothesis is proposed:

H2: Releasing additional signals that increase risk can improve the customers' purchase intention.

4 Ways of influence

This research proposes that there are two ways for additional signals to influence audiences' purchase intention, which are by customers' perceived products quality and by customers' perceived sellers' credibility. Product quality is undoubtedly an important consideration for consumers. The credibility of the seller is another decisive factor. Under the situation that the quality of some products tends to be homogenized, the credibility of the seller is very important. The live streaming provides the seller with the opportunity to interact with consumers in real time and release signals that allows consumers to feel trustworthy to the seller. The signals can not only facilitate the current transaction, but also cultivate customer loyalty and increase the repurchase rate. Therefore, the researcher proposes the following hypotheses:

H3: Customers' perceived product quality is positively correlated to their purchase intention.

H4: Customers' perceived sellers' credibility is positively correlated to their purchase intention.

Combining with the discussion in signals categorization, the research also proposes hypotheses:

H5: Releasing additional signals that increase cost can improve customers' perceived product quality.

H6: Releasing additional signals that increase cost can improve customers' perceived sellers' credibility.

H7: Releasing additional signals that increase risk can improve customers' perceived product quality.

H8: Releasing additional signals that increase risk can improve customers' perceived sellers' credibility.

5 Experiment and analysis

To analyze from a mature market perspective, this study selects China's live streaming commerce users as the sampling frame. The questionnaire asks whether respondents have watched live streaming e-commerce and only the responses of respondents who have watched the live e-commerce will be used for subsequent analysis. This research selects food as the target product and provides a screenshot of an ordinary live streaming room, which the host is only giving an oral introduction, as a reference. Next, the two representative additional signals: live streaming in the field and real-time trial are also displayed in the form of screenshots. Additionally, the live streaming in the field screenshots consists of two screenshots respectively aimed at improving the audience's perception of product quality (live streaming in the production orchard) and aimed at improving the audience's perceived sellers' credibility (live streaming in overseas markets to choose products based on audiences' interaction). For eliminating the interference from other factors, all interference information in the screenshots, such as the brand of food, the facial information of the host, are processed by mosaic. Respondents are asked to rate their perceived product quality, sellers' credibility, and purchase intention from 1 to 10 for each screenshot.

Before issuing the formal questionnaires, the researcher sent pre-test questionnaires to investigate whether respondents could perceive the cost difference between the live streaming in the field and the reference live streaming, and the risk difference between the trial live streaming and the reference live streaming. Respondents are required to score the cost and risk perceived in each screenshot from 1-5. The results are as follows:

Table 1. Perceived cost and risk of screenshot in pre-test questionnaires.

Live streaming screenshot	Test item	Mean	Standard deviation	T-test for the difference with the reference live streaming screenshot
Reference	Cost	2.079	1.208	
	Risk	1.944	1.209	
In the field 1 (Product quality)	Cost	2.494	1.391	0.017 (***)
	Risk	2.056	1.256	0.272
In the field 2 (Sellers' credibility)	Cost	2.584	1.413	0.005(***)
	Risk	2.157	1.429	0.141
Real-time trial	Cost	2.169	1.367	0.321
	Risk	2.393	1.459	0.013(***)

The coefficients that are statistically significant at the 1% significance level are marked as ***; the coefficients that are significant at the 5% significance level are marked as **; and the coefficients that are significant at the 10% significance level are marked as *.

The results demonstrate that, at the significant level of 0.05, the audience do feel the cost difference between live streaming in the field and reference live streaming and the risk difference between real-time trial and the reference streaming. Meanwhile, respondents also feel that there is no risk difference between live streaming in the field and reference live streaming and no cost difference between real-time trial live streaming and the reference streaming, which meets the requirements of controlled variables. Therefore, it is concluded that the screenshots correctly represent the cost and risk difference, and also control the variables.

A total of 290 responses received for the formal questionnaires. Excluding incomplete questionnaires and questionnaires with unusual short completion time, there 215 responses were regarded as valid and used for subsequent analysis. The effective response rate of this questionnaire is 74.14%. According to the demographic characteristics of the respondents, female respondents (66.51%) are more than male (33.49%), and most respondents watch live streaming commerce 3-5 times a mouth (46.5%). The respondents are mainly younger generations (25-34 years old accounted for 53.95%) and with evenly distributed salaries between 3000 to 19999. The demographic distribution is generally in line with the portraits of consumers in live streaming commerce (China Commercial Industry Research Institute, 2020) [7].

Subsequent study calculated the mean and standard deviation of the respondents' perception of product quality, sellers' credibility, and purchase intention from the four screenshots, which from 1 to 10, and used the data to perform one-tailed T tests under the same variance assumption to determine whether the additional signals can effectively affect customers' perceived product quality, sellers' credibility and purchase intention.

From the mean value, both signals that increase cost and signals that increase risk improve customers' perceived product quality, sellers' credibility, and purchase intention. The results of one-tailed t test illustrate that, at the significant level of 0.01, signals that increase cost can effectively increase customers' perceived product quality, sellers' credibility, and purchase intention, which supports the hypotheses H1, H5, and H6. At the significant level of 0.05, signals that increase risk can effectively increase customers' perceived product quality, which support the hypothesis H7. Nevertheless, the result also demonstrates that H2 and H8 are not supported. Though additional signals that increase risk increase customers' perceived sellers' credibility and customers' purchase intention from the perspective of mean value, the increases are not statistically significant. To verify the remaining hypotheses, subsequent study separately measured the correlation coefficients of the audience's perceived product quality (PPQ), the perceived sellers' credibility (PSC), and purchase intention (PI) in the four screenshots.

Table 2. Effectiveness test of additional signals in formal questionnaires.

Test item for each live streaming	Mean	Standard Deviation	P value of one-tailed T test with the reference live streaming
Reference - Product quality	5.749	1.885	
Reference - Sellers' credibility	5.912	2.061	
Reference - Purchase intention	5.502	2.255	
In the field 1 - Sellers' credibility	6.6	2.107	0.0003(***)
In the field 1 - Purchase intention	6.130	2.096	0.0015(***)
In the field 2 - Product quality	6.777	2.006	3.7×10^{-8}(***)
In the field 2 - Purchase intention	6.516	2.148	1.2×10^{-6}(***)
Real-time trial - Product quality	6.065	2.024	0.047(**)
Real-time trial - Sellers' credibility	6.047	2.053	0.248
Real-time trial - Purchase intention	5.730	2.234	0.147

Table 3. Correlation coefficients test of screenshots in formal questionnaires.

Reference	PPQ	PSC	PI
PPQ	1		
PSC	0.564(***)	1	
PI	0.515(***)	0.590(***)	1

In the field 2	PPQ	PI
PPQ	1	
PI	0.600(***)	1

In the field 1	PSC	PI
PSC	1	
PI	0.539(***)	1

Real-time trial	PPQ	PSC	PI
PPQ	1		
PSC	0.663(***)	1	
PI	0.627(***)	0.639(***)	1

The researcher then calculated the correlation coefficients between customers' perceived product quality, customers' perceived sellers' credibility and their purchase intention. For all screenshots, there are strong positive correlations between customers' perceived product quality and purchase intention as well as between customers' perceived sellers' credibility and purchase intention. Student's t-distribution test also shows that the above correlation coefficients are statistically significant at the significance level of 0.01 (Rahman, 1968) [18]. Therefore, at a significance level of 0.01, Hypothesis H3 and H4 are verified.

6 Discussion

The data analysis proves the hypotheses H1, H3, H4, H5, H6 and H7. The verification of hypotheses H1, H5 and H6 demonstrates that additional signal that increase cost can effectively increase customers’ perceived product quality, perceived sellers’ credibility and their purchase intention. Therefore, in real-world sales, it is desirable for sellers to release the “high cost” additional signals, like live streaming in the field, well-decorated live streaming backgrounds and hiring well-known broadcasters. The proof of H3 and H4 shows that both the customers’ perceived product quality and the perceived credibility of the seller are positively correlated with the purchase intention. It indicates that these two ways are effectual to impact customers’ purchase intention, which reminds that improving sellers and products’ reputation are key marketing directions that sellers need to pay attention to.

However, research results show that additional signals that increase risk can only effectively improve the quality of products perceived by viewers but not viewers’ perceived sellers’ credibility and their purchase intention. There are two possible reasons for this result. The first is that the application of signal theory is relatively complicated in the reality. Increasing different levels of risk can separate sellers of different quality. The results of the pre-test survey show that the respondents can indeed tell that the real-time trial does increase the risk of live streaming, however, the later formal survey indicates that such a risk is not enough to make the respondents trust the seller significantly more than other similar merchants. Also, compared with signals that increase costs, most signals that increase risk may be more concealed, and each viewer has a different perception and tolerance of risk, thereby the effects of risk-increasing signals is quite subjective, resulting in greater variance, and hence it may cause the statistically insignificance. The second reason comes from the influence of the “eating and live streaming scam” in recent years. Eating and live streaming means an eating show through the form of live streaming. In 2020, some eating and live streaming broadcasters were exposed to using cheating methods during live streaming, such as vomiting and secretly editing (Liu & Wang, 2020) [14]. The scandals can negatively impact the credibility of the sellers who use real-time trial, and further affect the consumer's willingness to buy. From the perspective of research results, this research suggests that high-quality sellers can give priority to releasing additional signals that increase cost, and consumers can also pay more attention to the additional signals released by sellers as an important reference for product quality identification.

7 Conclusion

This study categorizes additional signals from live streaming commerce into cost-increasing and risk-increasing from a perspective of game theory and demonstrates that additional signals can affect the purchase intention by affecting the quality of the products and the credibility of the seller perceived by customers. The research results show that additional signals that increase costs can improve customers’ perceived product quality, customers’ perceived sellers’ credibility and their purchase intention. In contrast, additional signals that increase risk can only significantly improve the quality of products perceived by the audience. This may be due to the risk being more subjective and difficult to perceive, or it may be due to the representative signal selected in this study being affected by relevant negative news. Caused by interference, future research can consider proposing new representative signals that increase risk and conducting repeated experiments to eliminate interference from specific signal selection.

In addition, this research suffers from some limitations. Future research can improve the universality of the research. Firstly, this research takes food as the research target. Future research can explore the effectiveness of additional signals about more targets. Secondly, the research object of this study is China's live streaming commerce market. However, due to cultural differences and the different development levels of live streaming, audiences in different countries have different levels of signals acceptance. Future research can combine these differences to further test the effectiveness of additional signals in other countries.

References

1. G.A. Akerlof, (1970). The market for “Lemons”: Quality uncertainty and the market mechanism. *The Quarterly Journal of Economics*, 84(3), 488-500.
2. M. Adelino, K. Gerardi, & B. Hartman-Glaser (2019). Are lemons sold first? dynamic signaling in the mortgage market. *Journal of Financial Economics*, 132(1), 1-25.
3. M. D. Bacharach, 2002. Trust in signs. In K. S. Cook. *Trust in society*, pp. 148-184. Russell Sage Foundation.
4. D. Biswas & A. Biswas, 2004. The diagnostic role of signals in the context of perceived risks in online shopping: Do signals matter more on the Web?. *Journal of interactive marketing*, 18(2), pp. 30-45.
5. C. Bonifield, C. Cole & R. L. Schultz, 2010. Product returns on the Internet: A case of mixed signals?. *Journal of business research*, 63(9), pp. 1058-1065.
6. H. Chade, & E. E. Schlee, (2020). Insurance as a lemons market: Coverage denials and pooling. *Journal of Economic Theory*, 189, 105085.
7. China Business Industry Research Institute, 2020. *Report on the Current Market Status and Development Trends of the Live E-commerce Industry in 2020*. https://www.sohu.com/a/403509863_350221.
8. A. Heiman, B. McWilliams, & D. Zilberman, (2001). Demonstrations and money-back guarantees: Market mechanisms to reduce uncertainty. *Journal of Business Research*, 54(1), 71-84.
9. iiMedia Group., 2020. *China's live e-commerce market research report in the first half of 2020.* https://www.iimedia.cn/c400/74827.html.
10. D. Jeong, (2019). Job market signaling with imperfect competition among employers. *International Journal of Game Theory*, 48(4), 1139-1167.
11. A. Kirmani, & A. R. Rao, 2000. No pain, no gain: A critical review of the literature on signaling unobservable product quality. *Journal of Marketing*, 64(2), pp. 66-79.
12. B. Lee, L. Ang, & C. Dubelaar, (2005). Lemons on the web: A signalling approach to the problem of trust in internet commerce. *Journal of Economic Psychology*, 26(5), 607-623.
13. D. W. Light, & J. R. Lexchin, (2021). Pharmaceuticals as a market for “lemons”: Theory and practice. *Social Science & Medicine (1982)*, 268, 113368.
14. Mingyang, Liu & Ruiwen. Wang, *debunking the "big stomach king" eating and broadcasting scam.* https://epaper.gmw.cn/wzb/html/2020-08/22/nw.D110000wzb_20200822_1-01.htm.
15. Mckinsey& Company, 2020. It’s showtime! How live commerce is transforming the shopping experience. https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/its-showtime-how-live-commerce-is-transforming-the-shopping-experience
16. P. Palm, (2015). The office market: A lemon market? A study of the malmö CBD office market. *Journal of Property Investment & Finance, 33*(2), 140-155.

17. Y. Pan, & G. M. Zinkhan, 2006. Determinants of Retail Patronage: A Meta-Analytical Perspective. *Journal of Retailing*, 82(3), p. 229–243.
18. N. A. Rahman, 1968. *A Course in Theoretical Statistics.* s.l.:Griffin books on statistics and mathematics.
19. A. Rahimipour, (2017). Investigating the validity of signaling theory in the tehran stock exchange: Using real earnings management, accrual-based earnings management and firm growth. *Journal of Economic & Management Perspectives*, 11(3), 925-936
20. M. Spence, 1973. Job Market Signaling. *Quarterly Journal of Economics*, 87(3), pp. 355-374.
21. M. R.-F. G. Tamilla, 2016. *Decision Support Systems*, 11 5, pp. 59-68.
22. O. Farooq, & A. Amin, (2017). National culture, information environment, and sensitivity of investment to stock prices: Evidence from emerging markets. Research in International Business and Finance, 39, 41-46.
23. Lu, B., & Chen, Z. (2021). Live streaming commerce and consumers' purchase intention: An uncertainty reduction perspective. Information & Management, 58(7), 103509.
24. Xijia. Qi, 2021. *Efforts made to regulate the livestreaming market in China.* https://www.globaltimes.cn/page/202106/1225696.shtml