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Shun Cai
Xiamen University, caishun@xmu.edu.cn

Qinfang Luo
Xiamen University, qinfangluo.xmu@gmail.com

Xin Fu
Xiamen University, xfu@xmu.edu.cn

Guowei Ding
Xiamen University, Wiki_Ding@outlook.com

PAYING FOR LIVE BROADCAST: PREDICTING INTERNET KNOWLEDGE PRODUCT SHARING

Shun Cai
Xiamen University
caishun@xmu.edu.cn

Xin Fu
Xiamen University
xfu@xmu.edu.cn

Qinfang Luo
Xiamen University
qinfangluo.xmu@gmail.com

Guowei Ding
Xiamen University
Wiki_Ding@outlook.com

Abstract:

Despite researcher's attempts on examining knowledge sharing behavior, the impact of purchasing behavior on sales of knowledge products remains largely unknown in the existing literature. To fill this void, using the data collected from Zhihu.com, we develop a two-phase framework to assess the impact of factors of live (i.e., price), factors of other audiences (i.e., review scores) and factors of speaker (i.e., reputation) on sales. Moreover, with start date of a live as a dividing point, our study examines the difference of impact of these factors on sales between two sales stages (before a live start VS. after a live starts). Results and implications are analyzed and discussed.

Keywords:

Knowledge sharing; signaling theory; knowledge products

1. Introduction

Sharing economy has recently drawn a great deal of attention among practitioners and academics. Platforms such as Uber, Airbnb and Zhihu has been experiencing explosive growth. According to the statistics from Jeremiah Owyang and VB (Venture Beat) Profiles, there are now 17 billion-dollar companies with 60,000 employees and $15 billion in funding in the sharing or collaborative economy[1]. Broadly defined, sharing economy can be divided into four main categories: recirculation of goods (e.g., eBay), increased utilization of durable assets (e.g., Uber and Airbnb), exchange of services (e.g., Time Banks), and sharing of productive asset (e.g., Skillshare and Zhihu) (Schor, J,2016). In sharing economy, platforms enable owners of resources to make their idle personal assets available to those who need them relying on the online community (Hamari, J,et al.,2016, Täuscher, K&Kietzmann, J,2017).

Among all these different activities of sharing economy, knowledge sharing in professional virtual communities is one of the most rapid growing phenomenon during these two years (e.g., Zhihu and Guoke). With the explosion of knowledge and the growth of users' scale, some

[1] Report from Venture Beat: http://vbprofiles.com

platforms previously offering free knowledge sharing service are now charging audience who subscript or "listen" to live broadcast. This mechanism would presumably increase the platform's revenue and encourage more people to make a live broadcast and share their knowledge because typical the platform would share their revenue with those speakers.

In China, knowledge sharing service made a big splash in 2016. Seven new products including Zhihu Live (www.zhihu.com/lives) and Fenda (www.fd.zaih.com) were launched and rapidly got great market-penetration levels[2]. The volume of users who are willing to pay for knowledge-based products soared 3 times in 2016. According to the report from Chinese Internet Consulting Data Center, the estimated economy scale of paid knowledge sharing service is about 10-15 billion RMB and this number reaches 30-50 billion RMB in 2017[3].

Zhihu Live is a real-time Q&A product based on Zhihu community, whose registered users has exceeded one hundred million in September 2017. On Zhihu Live platform, a user can be a speaker to broadcast lives towards audiences and (s)he also can also be an audience to purchase lives from other speakers. Similar to pre-ordering, a live is on sale a few days before the live starts. When a live start, audiences can interact with speakers and comment on lives.

Paying for knowledge is not a novel phenomenon, but knowledge-based products in sharing economy is different from traditional knowledge and virtual/digital goods. On one hand, traditional paid knowledge products such as online training courses have limited contents and forms. While paid knowledge sharing products have more various contents containing other topics not only education and various forms including audio, video, instant-message and so on. This variety is more freely for receivers to learn and is in line with the development of mobile Internet. On the other hand, paid knowledge sharing products relies on the professional virtual communities (PVCs), which means receivers can interact with givers during knowledge sharing process and create value together. For example, audiences can propose questions or suggestion to the speaker of the live which they have bought, and then the speaker can respond audiences accordingly. This interacting behavior results in the difference between paid knowledge sharing products and virtual or digital goods. Consumers usually are not able to participate in the creating of a song with the singer but are able to create value of a live together with the speaker.

Over the past decade, a number of researchers have been focusing on the factors affecting users' knowledge sharing behavior (Koh, J&Kim, YG,2004, Hsu, MH,et al.,2007, Lin, MJJ,et al.,2009, Chen, CJ&Hung, SW,2010, Fang, YH&Chiu, CM,2010, Chang, HH&Chuang, SS,2011, Chia-Shen, C,et al.,2012). However, research on studying factors influencing purchasing behavior of knowledge sharing products is limited. To fill in this gap, the current study proposed a two-phase framework to investigate important factors affecting the sales volume of live broadcast with data collecting from Zhihu Live platform. Specifically, this study mainly seeks to answer the following research questions:

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[2] Report from Jiguang: http://www.yixieshi.com/79870.html

[3] Report from 199IT Chinese Internet Consulting Data Center: http://www.199it.com/archives/590711.html

1) What factors affect the amount of sales of a live?
2) What are the differential factors affecting the sales volume before (pre-order) and after a live starts?

2. Literature review and theoretical background

2.1 Factors affecting purchasing behavior in knowledge sharing

Researchers in knowledge sharing filed focused on defining factors that affect an individual's willingness to share knowledge: costs and benefits, incentive systems, extrinsic and intrinsic motivation, social capital, social and personal cognition and organization climate (Koh, J&Kim, YG,2004, Hsu, MH,et al.,2007, Lin, MJJ,et al.,2009, Chen, CJ&Hung, SW,2010, Fang, YH&Chiu, CM,2010, Chang, HH&Chuang, SS,2011, Chia-Shen, C,et al.,2012, Bock, GW&Kim, YG,2002, Bock, GW,et al.,2005). However, as paid knowledge sharing business model becoming more and more popular, the study of examining factors that influencing purchasing behavior of paid knowledge product remains nearly blank.

The prior researches of information product is worth reference. For example, perceived benefit of online music products has a positive impact on purchasing behavior of a consumer(Chu, CW&Lu, HP,2007). Besides, consumers' willingness to pay for online content is positively related to their perception of convenience, essentiality, added-value, and service quality (Wang, CL,et al.,2005). For personal characteristic, a consumer's willingness to pay for digital content is related to age and gender (Punj, G,2015).

2.2 Signaling theory

When focusing purchasing behavior, like any other business models, one of the most critical problems in paid knowledge sharing is information asymmetry. When decision makers are faced with information asymmetry, Spence (1973) postulated signaling theory, which explains that observable entity attributes can serve as a signal of quality. In his formulation of signaling theory, Spence (1973) utilized the labor market to model the signaling function of education. Potential employers lack information about the quality of job candidates. The candidates, therefore, obtain education to signal their quality and reduce information asymmetry.

The signaling theory has been applied to a wide range of management studies, including electronic commerce research (Mavlanovaa, T&Koufaris, M,2012, Xu, Y,et al.,2013), online trust building(Yunjie,et al.), venture capital financing, electronic word-of- mouth (eWOM) (Aggarwal, R,et al.,2012), investor decisions (Davila, A,et al.,2003, Higgins, MC&Gulati, R,2006), and P2P lending (Cai, S,et al.,2016). A review and assessment of the extant literature on the application of the signaling theory suggest that there are three primary focuses: signaler, signal, and the receiver (Connelly, BL,et al.,2015). In our study, the signaler in paid knowledge sharing could be the speaker, live, or other audiences, and the receiver might be the potential audience. The credibility of the source of information (i.e., the signaler) would affect the trustworthiness of the signals it sends out. From the receiver side, some receivers interpret signals differently from others. In many cases, receivers may apply weights to different signals in accordance with preconceived notions of their importance or cognitively distort signals

(Perkins, SJ&Hendry, C,2010). Prior research has identified a variety of signals of quality. Not all signals are equally efficacious. Some signals may be strong or weak (Gulati, R&Higgins, MC,2003). Two important traits for efficacious signals are observability and cost (Spence, M,1973, Aggarwal, R,et al.,2012, Connelly, BL,et al.,2015). While observability is a necessary characteristic of a signal, it is not sufficient for detecting quality. Signal cost is so central to the signaling theory that some refer to it as the "theory of costly signaling"(Bird, RB&Smith, EA,2005). Some signals are costly to produce but more efficacious. For instance, the introduction of live chat software on online shopping sites might signal the quality to the consumer but might be expensive and time-consuming to employ.

3. Research model and hypothesis

The objective of this study is to examine the factors influencing sales of knowledge-based products in sharing economy. We proposed the following two models for the scenarios of purchasing before a live starts (Model 1) and purchasing after a live starts (Model 2). Model 1 refers to the scenario when audiences bought lives in pre-sale phase. Model 2 corresponds to the scenario when audiences purchase lives when the live is over.

We distinguished two phases for three major reasons. First, from information disclosure perspective, the information that audiences can receive in two phases are different. Before a live starts, users can only get very limited information such as live price, start time and some personal information of the speaker. While when a live is over, users can get more additional information about live such as reviews from other audiences, the number of live attachments and so on. Thus, purchasing behaviors in two phases are affected by different factors.

Second, audience who bought a live before it starts can interact with the speaker during the live time, which means the user can ask the speaker any questions and have a chance to discuss with the speaker. However, if a user bought a live when it is over, this audience does not have the chance to ask speaker and discuss with speaker. However, a user will take more risks in pre-sale phase to buy a live because of limited information. Thus, even for the common variables like live price and speaker reputation, they may be diversely affect users' purchasing behaviors because the benefits and risks they present are different in these two phases.

Variable	Description
SalesBefore	sale of a live from the live created to started
SalesAfter	sale of a live in the following 15 days from the live started
Price	the price of a live before it started
SpkrRept	an index reflecting the reputation of a speaker in Zhihu community, which equals to the average value of these five factors of speakers: the number of followers, the number of gratitude from other users, the number of likes from other users, the number of times speaker's answers are collected and the number of times speakers' answers are shared.
AudDuration	the audio duration of a live from its speaker
ReplyNum	the number of reply messages of a live from the speaker to audiences

AtchmntNum	the number of attachments which the speaker uploaded in a live
LikedNum	the number of users who like a live
RvwScrs	average scores of a live in the following 5 days from the live started

Table 1: Description of Key Variables

Taking all these reasons into consideration, we suggest that examining the factors affecting live's sales should be divided into two phases. Thus, for Model 1, we identified two factors as the antecedents of the sales, including live price and speaker reputation. We added more factors of lives and other audiences in Model 2 and the detail models are illustrated on Fig. 1. Two models shared the three factors as control variables including speaker gender, whether a live starts on weekend, and the tag popularity. A description of variables is presented in Table 1.

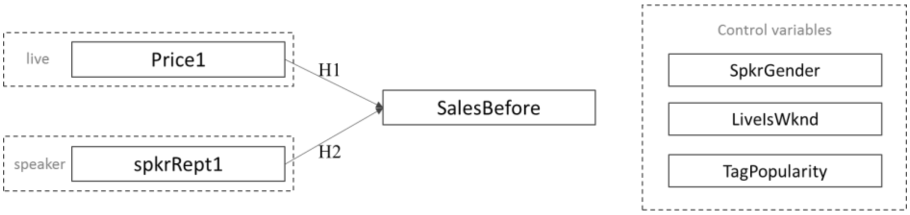

Fig 1: Model 1

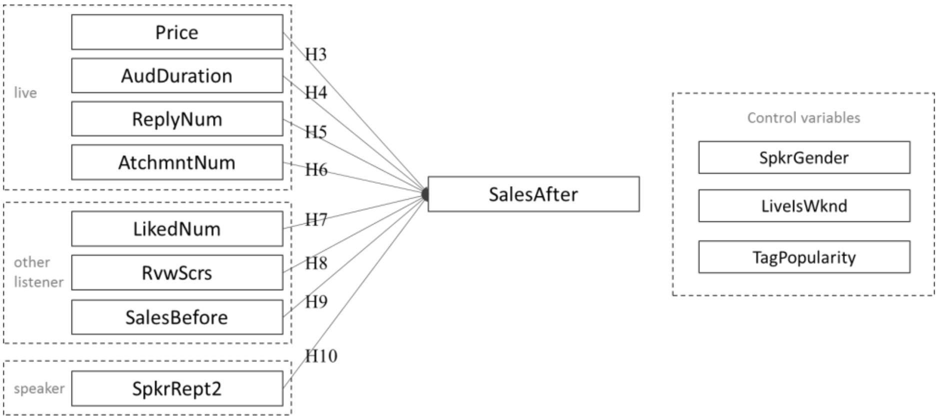

Fig 2: Model 2

Figure 1 depicts our research models. Dependent variable are sales before starting and sales after starting respectively in two models. When a live is on pre-sale, potential audiences can only get the information of price and speaker reputation. In traditional economic theory, price has a negative impact on consumers' budgets (Rao, AR&Monroe, KB,1988). Thus, the higher the price is the grater the perceived monetary cost is, which impedes purchasing behaviors of consumers. Therefore:

H1: live price negatively affects sales volume of a live before a live start. (first phase)

When making a decision, consumers evaluate not only cost but also benefit. The cost-benefit model of microeconomics holds that when a person is confronted with a set of possible actions each of which can lead to some set of outcomes, the person should convert the benefits and costs of all possible outcomes to a single scale, and adjust them for the probabilities that the outcomes will occur (Meade, JE&Mishan, EJ,1972). In the purchasing scenario in our study, the benefit for a audience to buy a live is the knowledge in this live. Thus the extent of the benefit relies a lot on the quality of lives. Based on signaling theory, a positive reputation over time is a strong signal of underlying quality (Coff, RW,2002). In Zhihu Live community, the reputation of a speaker mainly shows in two aspect: 1) the number of a speaker's followers; 2) the approval of a speaker's answers to other users' questions, including the number of gratitude, the number of likes, the number of times that answers are collected and the number of times that answers are shared. We expect reputation of a speaker has a positive effect on sales. Therefore:

H2: The speaker's reputation is positively associated with the sales volume of a live in the pre-order phase.

When a live is over, the information that can be viewed as signals are more. Theses information can be divided into three categories according to diverse signalers: live, speaker and other audiences. The first kind factors are the information related to live directly including live price. Similarly, price is considered as monetary cost of consumers and has a negative impact on sales even after a live starting.

H3: live price is negatively associated with the sales volume of a live after the live starts. (second phase)

Besides price, more information about live are available when a live is over. A speaker gives a live via audio messages. Meanwhile the speaker can upload files like handout pictures to assist audiences understanding. During the live, audiences who have bought the live can ask any questions and the speaker will answer. Thus, when a live is over, a potential audience can see three important numbers of the live: the audio duration, the number of reply messages to the questions proposed by audiences and the number of attachments. The longer the audio duration is, the larger the probability that an audience can get more useful knowledge is. The more the reply message is, the larger the probability that an audience can get more useful knowledge is as it is more possible to find the same questions from other users. Likewise, the number of attachments would have the similar effect on the the probability that an audience can get more knowledge. Thus these three factors can be regarded as quality signals and we suggest:

H4: the audio duration is positively associated with the sales volume of a live. (second phase)

H5: the number of reply messages from the speaker is positively associated with the sales volume of a live. (second phase)

H6: the number of attachments of a live is positively associated with the sales volume of a live. (second phase)

The second kind factors are concerned with the signals from other audiences. In Zhihu Live, each live can be marked with "like" and potential audiences can see the number of people who have liked this live when they browse the home page of this live. Besides, users can see all lives that they have liked in personal "liked list". For a potential audience, there are two possible motivation to "like" a live. On one hand, the audience is interested in a specific topic and he or she may “like” several lives in this specific topic, in order to make a further purchasing choice with the help of “liked list”. In this way the function of “like list” is quite similar with shopping carts of online shopping. On the other hand, the audience has already listened this live and indeed like this live so he marks this live. Thus, the number of people who like a live may indicate the quality of this live to some extent. Therefore, we suggest the following:

H7: the number of “like” expressed by audiences in the pre-order phase is positively associated with the sales volume of a live in the second phase.

When a live is over, audiences who have purchased the live have accesses to give a score and comment on the live. The review score is from one to five. The influence of user reviews is particularly important for experience goods (Klein, LR,1998), because their quality is often unknown before consumption (Nelson, P,1970). In the past decades, studies have shown online reviews significantly affect the sales of products like movies, books and hotel rooms (Chevalier, JA&Mayzlin, D,2006, Qiang, Y,et al.,2009, Reinstein, DA&Snyder, CM,2005). Moreover, a higher review score usually shows higher quality of a live, which means review scores can be regarded as a quality signal. Therefore,

H8: the review score of a live is positively associated with the sales volume of a live.

On the home page of a live, potential audiences can see the number of people who have already bought the live before it starts, which may arouse herding effect on potential audiences’ decision making. A stream of research has documented evidence of herding effect. For example, music consumers seek frequently downloaded songs (Salganik, MJ,et al.,2006); web visitors will be attracted to popular vendors according to click count that displayed on webpages(Tucker, C&Zhang, J,2011); customers prefer popular dishes when they consume in a restaurant (Cai, H,et al.,2009). In this study, we expect that the volume of pre-order of a live will affect sales positively. Therefore,

H9: the more the people who preorder a live, the more the sales of this live will be after the live starts.

Last but not least, the reputation of the speaker also has a positive impact on sales as it shows the ability of a speaker. The greater the speaker’s ability is, the greater the probability that the live is superior is. Therefore, we propose:

H10: the greater the speaker’s reputation is, the more the sale will be after the live starts.

4. Data

The data used in this study were retrieved from Zhihu Live (URL: www.zhihu.com/lives), which is one of the largest paid knowledge sharing platforms in China. Zhihu Live is a real-time Q&A product based on Zhihu community, whose registered users has exceeded one hundred million in September 2017. There are 17 topic tags such as art, education, etc. in Zhihu Live platform and each live has only one topic tag.

We obtained data by crawling the Zhihu Live website from June 2017 to September 2017. Through the website, 634 lives were returned as search results. Some of these were still on presale and some records had incomplete values. After removing such “noisy” records, we retained 490 lives and 362 speakers, including 38,936 purchase records before live starting and 80,841 purchase records after live starting, and 275 speakers of them are male. To obtain observable data, the live was used as the unit of analysis.
Table 2 presents the summary statistics for all listings.

Variable	Mean	Std.dev.	Min	Max
control variable				
LiveIsWknd (1=yes)	0.51	0.50	0.00	1.00
TagPopularity	758.95	391.67	88.00	1313.00
live is on pre-sale				
SalesBefore	164.98	459.35	1.00	6946.00
Price	18.43	25.45	4.00	499.00
SpkrRept	16369.40	93561.97	0.00	1443810.20
live is over				
SalesAfter	79.46	288.61	1.00	4146.00
Price	18.43	25.45	4.00	499.00
AudDuration	66.09	37.51	0.00	265.00
ReplyNum	17.20	28.35	0.00	204.00
AtchmntNum	18.18	21.34	0.00	163.00
LikedNum	599.34	1509.31	0.00	23215.00
RvwScrs	4.21	1.55	0.00	5.00
SpkrRept	16369.40	93561.97	0.00	1443810.20

Number of Valid Records (lives): 490

Table 2: Descriptive Analysis for Model 2 Data Set

5. Empirical Model and Results

Logistic regression is chosen for the data analysis to verify our research models. In model 1, we include three control variables and two independent variables in the research model. In model 2, we include the common control variables and eight independent variables. The following two log-linear models for sales of live i was developed to examine Model 1 and Model two respectively:

$$\log(SalesBefore) = \beta_0 + \beta_1 Price_i + \beta_2 SpkrRept_i + \beta_3 SpkrGender_i + \beta_4 LiveIsWknd_i + \beta_5 TagPopularity_i + \varepsilon_i \quad (1)$$

$$\log(SalesAfter) = \beta_0 + \beta_1 Price_i + \beta_2 AudDuration_i + \beta_3 ReplyNum_i + \beta_4 AtchmntNum_i + \beta_5 LikedNum_i + \beta_6 RvwScrs_i + \beta_7 SalesBefore_i + \beta_8 SpkrRept_i + \beta_9 SpkrGender_i + \beta_{10} LiveIsWknd_i + \beta_{11} TagPopularity_i + \varepsilon_i \quad (2)$$

All data for independent variables were normalized before conducting the regression analysis. Before estimating our models, we conducted a collinearity test for two models. The variance inflation factors (VIF) associated with all variables were below 10, indicating that there was no evidence of the existence of multicollinearity(O'brien, RM,2007). The empirical results of two models are summarized in Table 3.

For Model 1, the results indicate that when a live is on pre-sale, the price of the live (β = -0.475, p = 0.000) has a negative impact on the amount of sales, which support the first hypothesis in our study. Speaker reputation (β = 0.181, p = 0.000) is positively associated with the amount of sales, which is consistent with the second hypothesis.

For Model 2, as indicated in Table 3, there is a significant relationship between the independent variables and dependent variable with an R-square of 79.8%. The results show that for potential audiences who bought a live when it was over, the price of a live (β = -0.208, p = 0.000) also has a negative impact on the amount of sales as the result in Model 1. Besides, the sales before a live starts (β = 0.535, p = 0.000), audio duration of a live (β = 0.081, p = 0.035), the amount of reply messages (β = 0.063, p = 0.021), the number of people who likes a live (β = 0.392, p = 0.000) have significantly positive impacts on the amount of sales. However, the effect of the number of attachments (β = -0.010, p = 0.700), review scores (β = 0.009, p = 0.865) and speaker reputation (β = -0.018, p = 0.136) on the amount of sales are not significant, which are not consistent with our hypotheses.

For the relationship between number of attachments and sales, a possible reason is that attachments of a live are usually pictures. These attachments are aim to assist audiences understanding the live and the core knowledge is in audio messages. From this point of view, potential audiences focus more on the duration and interaction of a live and may not care about the attachments.

For the results of the relationship between review scores and sales, a potential reason is that some audiences lack trust on these online reviews due to the absence of source cues on the Internet (Qiang, Y,et al.,2009, Smith, D,et al.,2005). Thus, the effect of review scores on sales needs to be further tested in this context.

	Model 1 (R^2=0.153)	Model 2 (R^2=0.*798*)
spkr_gender (1=male)	-0.130	-0.043
live_isweekend (1=yes)	-0.171	-0.018
tag_popularity	0.056	0.203***
live is on pre-sale		
live_price	-0.475***	
speaker_reputation	0.181***	
live is over		
live_price		-0.208***
sales_before_stars		0.535***
audio_duration		0.081*
reply_messages #		0.063*
Attachment #		-0.01
Liked_people #		0.392***
review_scores		0.009
speaker_reputation		-0.018

* P<0.05; ** P<0.01; *** P<0.001

Table 3: Logistics Regression Result

It is interesting to see that the relationship between speaker reputation and sales after a live starts is not significant, which is inconsistent with the relationship when a live is on pre-sale. A possible reason is that before a live starts, quality signals of the live can be received by potential audiences are very limited, thus information of speaker reputation is valuable for potential buyers. However, when a live is over, audiences can judge the live by information about live such audio duration. Compared with signals from speaker (e.g., speaker reputation), signals from live (e.g., audio duration) are more directly useful. Therefore, a common signal speaker reputation plays different roles on the amount of sales in the two phases of a live.

6. Conclusions

This study contributes the knowledge sharing research by revealing the factors that affecting the sales of knowledge products in sharing economy. We addressed this issue by examining which factors are powerful signals that make potential buyers more likely purchase a live in Zhihu Live platform. More importantly, we examined the influence of different factors on sales of live in two separately phases due to the business model of Zhihu lives. Our study shows that 1) price of a live is viewed as a cost signal no matter in which phase thus live price affect sales negatively; 2) reputation of speaker have different impacts on sales in two phases. When a live is on pre-sale, speaker reputation is regarded as a quality signal to help potential buyers make purchasing decisions while it will be replaced by other information about live when a live is over; 3) herding effect exists in purchasing behavior of knowledge sharing products. Both the amount of people who like a live and the amount of people who have bought a live have a positive impact on the amount of sales.

However, there are still some limitations to the current research. Firstly, there are some endogeneity that is neglected in our model. Future research should be conducted by including more undiscovered factors and timestamp. Secondly, we collected only data from one knowledge sharing platform (Zhihu Live) that may have unique caracteristics, limiting the generalizability of the proposed model. Finally, the R^2 of Model 1 is much lower than Model 2, which may suggest that there are other important factors for this model that have not been considered.

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