

The Impact of Online Pre-Sales Customer Service on Purchase Conversion

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Abstract. In the context of the booming e-commerce industry, the competition among e-commerce enterprises is not simply about category or logistics, but about service quality, which is the key to the development of enterprises. In this paper, we established a model from two perspectives of online customer service usage and purchase conversion, then took into account the self-selection problem due to users' conscious non-use of customer service. By building a treatment effect model, we explored the impact of online pre-sales customer service on purchase conversion from the perspective of the actual business of enterprises. The study finds these factors, e.g. urgency, uncertainty, demand, are positively correlated with the possibility of using pre-sales customer service system, and knowledge factor is negatively correlated with the possibility using pre-sales customer service system. At the same time, the use of online pre-sales customer service has a positive effect on purchase conversion. These results are helpful for enterprises to improve the utilization rate of online customer service and purchase conversation.

1. Introduction

With the continuous development of the e-commerce industry, the transaction scale of China's e-commerce market is increasing year by year, and the focus of enterprise marketing also begins to shift from the commodity-centered service model to the user-centered service model^[1]. In this context, service quality becomes the key factor to determine the development of enterprises^[2]. As a type of service, customer service refers to the ability to provide products or services to customers accurately and quickly under the conditions of meeting customer needs. In the traditional retail store, the seller and the buyer can communicate face to face, but the fact is that it is difficult for the buyer and the seller to meet and communicate in real life in the shopping environment of the e-commerce platform^[3]. As a bridge of communication between buyers and sellers, online customer service can increase consumers' participation and reduce the uncertainty consumers face in e-shopping. In the practical application of the e-commerce platform, customer service is generally divided into three types, named pre-sales customer service, sales customer service, and after-sales customer service. Among them, pre-sales customer service is the first window of network marketing. It extends the traditional business mode and service means, also becomes an important factor to help consumers obtain information of product and facilitate e-commerce transactions. Since pre-sales customer service has a great impact on whether users want to buy or not, its efficiency, attitude and quality will directly affect the order turnover rate. Pre-sales customer service plays an unsubstitutable role in network marketing, explore the influencing factors of consumers' use of pre-sales customer service and measure the relationship between pre-sales customer service's usage and consumers' purchase conversion has become an urgent problem to be solved in research and practice.

Existing studies mostly use structural equations modeling and regression analysis methods to measure the effect of customer service. They collect data through questionnaires and other ways for

consumers who have used customer service^[4]. Under these methods, the use of customer service was considered a random event, and the researchers studied only a sample of people who had used customer service. However, according to the theory of sample deviation, we believe that only specific consumers with consultation intention will use the customer service system. In other words, consumers may have the problem of self-selection when using the customer service system, that is, the sample selection bias caused by the conscious or self-selection of samples^[5]. So, in the existing research, the research object of the effect of online customer service is not all consumers, but only consumers who use online customer service. If only consumers who use online customer service are analyzed and studied, there may be a certain missing value between samples, which will lead to inaccuracy of research results and selection bias.

In order to explore the "impact of online pre-sales customer service on purchase conversion" and solve the self-selection problem, we use the treatment effect model to modify the sample distribution by constructing whether consumers use online pre-sales customer service, so as to solve the problem of selective bias. The model and method proposed in this paper can provide decision support for the evaluation and improvement of customer service usage in e-commerce enterprises.

2. Related Literature

2.1. Online Customer Service System

Most researchers in the field of e-commerce have studied the online customer service system of enterprises to improve the shopping experience of consumers. Compared with the customer service in the traditional market, due to the unique characteristics of the electronic market, online customer service pays more attention to technical support^[6], response speed^[7], page interaction effect^[8], and a series of methods that can improve the customer service quality. Although many e-commerce platforms have begun to focus on online customer service quality in recent years, little is known about what motivates users to use online customer service. As one of the important ways for consumers to search for information, online customer service is an important means for consumers to obtain information when information is not equal in the transaction process^[9]. The research on information search based on information behavior theory holds that consumers are the main body of information search. Many researchers have explored the impact of consumers on information search behavior from the perspectives of individual characteristics, situation, emotion, trust, environment, and other dimensions. Based on previous studies, we extracted several indicators from the dimensions of urgency, uncertainty, demand and knowledge, and combined them with the log data and transaction data of e-commerce to carry out feature extraction, as the influencing factors of the selection model.

2.2. Sample Bias and Self-selection Theory

The individual's behavior of conscious selection or self-selection results in no randomness in the selection of samples, which results in the deviation of statistical evaluation results, then it is the sample selection bias. In most cases, the sample bias is so closely related to people's self-selection behavior that it cannot be eliminated by designing sampling methods alone. James Heckman^[5] played an important role in reducing the sample selection bias caused by self-selection by using the "specification error" research method, which was called Heckman two-stage model. Additionally, the treatment effect model constructed by using the "counterfactual framework" proposed by Rubin^[10] can also well solve the sample deviation problem.

Since the two-stage method was proposed, many researchers have taken a series of attempts on it in different fields. Lee et al.^[11] found consumers' selection bias for computer banking through surveys and two-stage estimation. Pontines^[12] used a two-stage treatment effect model to evaluate the effectiveness of official foreign exchange intervention on exchange rate movements. According to previous literature, due to the scarcity of available data in the first stage of e-commerce websites, researchers cannot directly observe the behavior of consumers before the first stage of selection, so there are few studies in the field of e-commerce to discuss the issue of consumer self-selection.

Based on the user data in the e-commerce platform database and the problems studied, we use two-stage data to correct the sample selection bias in the e-commerce platform.

3. Hypothesis

This paper includes solving the self-selection problem in the use of customer service. In the first stage, the influence variables of the use of online customer service are mainly explored from the perspective of information search; in the second stage, the influence variables of the use of customer service on the final purchase conversion of consumers are discussed.

In the first stage, the research model of Dutta^[13] and Li Yulu^[14] was integrated and improved by sorting out literature in the field of information search, and user characteristics were extracted from the following aspects. Urgency refers to the time distance between the generation of consumer demand and the acquisition of products. The shorter the time distance, the stronger the urgency of consumers, which affects consumers' cognition and decision-making, and improves the probability of consumers using customer service^[15]. The Uncertainty is mainly reflected in the gap between the existing information and the information mastered by consumers. The increase of uncertainty will promote consumers to search for external information, which will positively affect consumers' use of customer service^[16]. Demand refers to users' demand for service, Kuhlthau^[17] pointed out that the intervention of service providers (i.e. online customer service personnel) may help users to search for information, so users' demand for service will positively affect users' use of online customer service system. Knowledge in this article refers to the user's familiarity with the product category and website. In general, Users who lack commodity knowledge often rely more on further information support, such as using an online customer service system for information search^[18]. According to the above indexes, this paper extracts relevant variables based on user access behavior data, as shown in Table 1. And then, in the first stage, the following hypotheses can be made about the influencing factors of customer service' s usage:

H1: Urgency factors are positively correlated with users' online customer service behavior

H2: Uncertainty factors are positively correlated with users' online customer service behavior

H3: Demand factors are positively correlated with users' online customer service behavior

H4: Knowledge factors are negatively correlated with users' online customer service behaviors

Combining with previous studies, we believe that online pre-sales customer service is helpful to increase users' social presence and interaction. The high presence will increase users' trust in websites^[19], thus eliminating the uncertainty of products^[20] and increasing users' purchases. Therefore, we assume the following relationship between the use of online customer service and the purchase conversion:

H5: The use of online pre-sales customer service helps to promote the purchase conversion of users

The specific variables and hypotheses mentioned above are shown in Table 1. In addition, we also extract the gender and age of users as the demographic control variables to measure whether consumers use pre-sales customer service consultation.

Table 1. Characteristics meaning.

Indicator	Characteristic	Meaning of characteristics	Hypothesis
Demo	gender	User's gender	
	age	User's age	
Urgency	visit_time_m	Maximum page browsing time	H1a
	visit_qq_num	Number of times to browse "quick quote page"	H1b
	visit_qp_num	Number of times to browse "quick purchase page"	H1c
Uncertainty	visit_cate_num	Browse the number of product categories	H2a
	visit_compare_num	Number of times to browse " product comparison page"	H2b

	visit_prod_num	Number of times to browse " insurance products page"	H2c
Attitude	visit_cs_num	Number of times to browse " online service page"	H3a
	visit_help_num	Number of times to browse " help center page"	H3b
	search_num	Number of searches	H3c
Knowledge	growth	Growth value of users	H4a
	visit_dict_num	Number of times to browse " insurance dictionary page"	H4b
	visit_huati_num	Number of times to browse " insurance topics page"	H4c
	login_num	Login times	H4d
Usage	USE_CS	Using online customer service or not	H5

4. Research Method

The purpose of this section is to quantitatively analyze the impact of customer service use on customers' purchasing behavior. Assuming that user purchasing behavior Y_i is a linear function of explanatory variable X_i and CS_i (whether customer service has been used), the regression equation can be set as follows:

$$Purchase_i = \beta X_i + \gamma USE_CS_i + \varepsilon_i \quad (1)$$

Among them, the explained variable $Purchase_i$ said user Purchase behavior, X_i is an explanatory variable, to measure personal characteristics (such as gender, age), access behavior characteristics (e.g., visits, access time, etc.), purchasing experience characteristics (such as historical times, Purchase amount, etc.), CS_i is a characterization of the user use customer service behavior of binary classification variable, β and γ are estimated coefficient vector, ε_i is a random error term.

As a behavioral choice, as mentioned above, whether users use customer service is affected by many factors, rather than random selection:

$$USE_CS_i = Z_i \delta + u_i \quad (2)$$

Where, Z_i is the variable set that affects whether the user uses customer service or not, including the above indicators of urgency, uncertainty, knowledge, etc., δ is the parameter to be estimated, and u_i is the error term.

The error term a in equation 1 and the error term in equation 2 may affect the final purchase at the same time, so there may be a correlation between the two error terms, namely, $\text{corr}(u_i, \varepsilon_i) \neq 0$. In this case, the estimated coefficients that you get are biased if you estimate the model directly. Therefore, we use a treatment effect model (TEM) to analyze the impact of online pre-sales customer service usage on purchasing behavior.

Furthermore, the TEM estimation coefficient can be used to calculate the average treatment effect (ATE) of the impact of online pre-sales customer service intention on purchasing behavior. ATE can be calculated by the following equation:

$$ATE = E(Y_i|CS_i = 1) - E(Y_i|CS_i = 0) \quad (3)$$

In the above equation, $E(Y_i|CS_i = 1)$ represents the purchase decision of the user when using the online pre-sales service platform, $Y = 1$ represents that the user has made a purchase after using online customer service, $Y = 0$ represents no purchase. $E(Y_i|CS_i = 0)$ represents the purchase when the user is not using online pre-sales customer service. With ATE, the impact of online pre-sales customer service usage on users' purchasing behavior can be investigated from the perspective of the overall sample and subsamples of different categories.

5. Empirical Research

5.1. The Data

The empirical data in this paper are from an online insurance agent platform in Nanjing. Based on the user log data of this website, we study the impact of online pre-sales customer service on purchase conversion. The log data records the user behavior data, including user IP, customer service chats data, user access data, user transaction data, etc. In view of the importance and impact of customer service, we rely on the customer service system of this platform and collect all user log data from January 1, 2017 to March 31, 2019. At the same time, according to the research practice, this paper conducted the following processing on the initial samples : (1) Eliminating redundant data, cleaning up invalid and abnormal data; (2) User identification by user ID and IP; (3) The time interval segmentation method is used to segment the session at a time interval of 30 minutes. We ended up with 76,859 users.

5.2. Variable

We studied the impact of online pre-sales customer service on purchasing behavior, so the explained variable of the research model in this section is the purchase decision of users. In the processing effect model, the selection of control variables is more based on the selection equation. Therefore, we take the variables affecting customer service usage as the control variables of the purchasing behavior model. It includes urgency, uncertainty, demand, and knowledge.

In this study, it is considered that users' knowledge will affect whether they use online pre-sales customer service for consultation, but users' knowledge will not directly affect users' purchasing behavior. Therefore, we choose "Knowledge" as the instrumental variable in the behavioral indicator.

5.3. Result

The dependent variable of this empirical study is the user's purchase. Considering the time interval between the user's consultation with customer service and the purchase decision, we extended the deadline of the purchase decision characteristics by one month and extracted the user's purchase conversion records from January 1, 2017 to April 30, 2019.

Table 2. Model estimation results.

Characteristic	TEM				OLS	
	Selection equation		Purchase equation		coefficient	SE
	coefficient	SE	coefficient	SE		
gender	-0.101576***	0.0233967	-0.0540792***	0.005281	-0.0397796***	0.0033385
age	-0.0031005**	0.0012742	0.0046568***	0.0002783	0.0054199***	0.000176
visit_time_m	-0.0247676	0.0191165	-0.0111534***	0.0025129	-0.0088851***	0.0015922
visit_qq_num	0.058521***	0.0070226	0.0243631***	0.0025912	0.0037045**	0.0016058
visit_qp_num	0.113552***	0.0092707	-0.009888***	0.0028108	-0.0379109***	0.0017188
visit_cate_num	0.013797	0.010364	-0.0423239***	0.0025482	-0.045803***	0.001614
visit_compare_num	0.0094339	0.0124201	-0.0158813***	0.0031093	-0.0183812***	0.0019714
visit_prod_num	0.075883***	0.0147799	0.1207342***	0.0034999	0.1095769***	0.0022106
visit_cs_num	0.028283***	0.0060702	0.0372552***	0.0029103	0.0164128***	0.0018113
visit_help_num	0.0176641**	0.0074722	0.0013924	0.0024997	-0.0032275**	0.0015823
search_num	0.0166019**	0.0073795	0.0108091***	0.0025116	0.0053035***	0.0015956
visit_dict_num	-0.0450279**	0.017696	-0.032309***	0.0041346	-0.0150876***	0.0026053
visit_huati_num	-0.0369916**	0.0155142	-0.0627392***	0.0025282	-0.0606592***	0.001602
growth	-0.071777***	0.0218131	-	-	-	-
login_num	-0.0275307*	0.0145692	-	-	-	-
USE_CS	-	-	4.022324***	0.1071195	0.0249078***	0.011814
Constant term	0.050722***	0.006895	0.0505227***	0.002624	0.0314945***	0.0016323
hazard lambda	-	-	1.662557***	0.0437406	-	-
Wald test of indep. eqns.	-	-	758.99***	-	-	-
Log likelihood	-	-	-6476.3648	-	-	-
Number of samples	76859	76859	76859	76859	76859	76859

Notes: ***, **, * denote significant at the levels of 0.01, 0.05, 0.1

According to the results of the model, the self-selection problem of samples is judged at first. According to the estimated results, the hazard lambda and Wald test of Indep. Eqns. values of the model are 1.662557 and 758.99 respectively, which are significant at 1% level, then the two-stage equation independent results are rejected, and there is a sample self-selection problem. By comparing the results of TEM and OLS estimates with the sample bias balance, it can be seen that when the subjectivity of users using the online pre-sales service system is balanced, the estimated coefficient of the model on consumers' use of the online pre-sales service system (USE_CS) increases significantly. The results show that the role of the online customer service system in user's purchase is greatly underestimated when the user's self-selection behavior is not taken into account.

In terms of Urgency, the number of times users visited these two pages (visit_qq_num, visit_qp_num) was positively correlated with customer service behavior at the 1% level., hypotheses H1b and H1c pass the test. In terms of Uncertainty, visit_prod_num is positively correlated with customer service behavior. The more times users compare products, the more likely will use online pre-sales customer service, hypothesis H2c pass the test. In terms of Demand, the number of users who browse the online services page (visit_cs_num) and help center page views (visit_help_num) at the 5% significant level use behavior was positively related with online customer service, hypotheses H3a and H3b pass the test. The number of user searches (search_num) is also positively correlated with customer service usage behavior. The more users search, the more likely they will use customer service. Hypothesis H3c passes the test. In terms of Knowledge, the number of times users visited the knowledge introduction page (visit_dict_num, vисти_huati_num) was negatively correlated with customer service usage behavior at a 1% significance level. Therefore, H4a, H4b pass the test. the growth value of users (growth), number of logins (login_num) are also negatively correlated with customer service usage behavior. Hypotheses H4c, H4d are supported.

In the TEM model, the results of the estimation of customer service' s usage behavior (USE_CS) show that other things being equal, users who use online pre-sales customer service have stronger purchasing behavior, which is significant at 1% level, compared with users who do not use online pre-sales customer service. This indicates that the use of online pre-sales customer service has a positive impact on purchasing behavior, so hypothesis H5 passes the test. Based on TEM estimation, the average processing effect of online pre-sales customer service can be further calculated, and the results are shown in the following table:

Table3. Results of ATE.

	Online pre-sales customer		ATE	t value	variation (%)
	use	not used			
Purchase probability	0.653	0.536	0.116***	8.60	17.9

Note: * * indicates that the estimated results are significant at the level of 0.01;

Change = marginal probability = (average purchase probability with customer service - average purchase probability without customer service) / average purchase probability with customer service × 100%

The results showed that the ATE of online pre-sales customer service's usage on the purchase conversion was 0.116 and significant at 1% level. From the perspective of purchase probability change, under the condition of controlling observable and unobservable factors, the use of online pre-sales customer service will lead to a 17.9% increase in purchase probability.

6. Conclusion

This study explores the sample selection bias in the online customer service study. The problem of sample selection is universal in the actual situation, and the existing research often ignores the problem of sample selection of data. Based on empirical data, we verify the existence of conscious choice or self-selection behavior of users when using an online pre-sales customer service system. Also, we extend the research of the two-stage choice model in the field of e-commerce. While enriching the research on online customer service, this study can also help enterprises to evaluate

the effect of pre-sales customer service, provide favorable theoretical guidance for enterprises to improve their service quality and improve their online customer service quality.

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