

Research on the Customer Satisfaction in Electronic Business Environment based on DEA Method: An Empirical Analysis

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Abstract

With the rapid development of the global economy, information technology has impacted obviously on the way of life. However, trust issues became one of the important obstacles hindering the development when B2C e-commerce vigorous development. In this paper, the author analyzes the key factors affecting the development of electronic commerce, then find out the factors that affect customer satisfaction by using DEA method. The result shows that commodity characteristics, service features and website quality are the main factors that influence the customer satisfaction. At the same time, the variance contribution rate of commodity information is 72.57%, and the variance contribution rate of commodity brand is 66.17%. In service features, the variance contribution rate of logistics service is 81.25%. In website quality, the variance contribution rate of layout is 70.84%, and the variance contribution rate of easy operate is 68.13%. On this basis, we put forward relevant policy suggestions.

Keywords: *Electronic business, customer satisfaction, DEA method, Service characteristics*

1. Introduction

With the rapid development of the global economy, information technology has been more and more impact on the way of life. At the same time, with obvious advantages of e-commerce, rapid emergence in our daily life. When the B2C e-commerce to flourish, trust issues have become one of the obstacles to the current and future development of one of the important obstacles [1]. The integration of the global market continues to increase, the international business competition is becoming increasingly fierce, a variety of new economic forms to meet the needs of the rapid development of customers. High and new technology, the Internet is booming at the same time, but also quickly led to the development of e-commerce. Electronic commerce as a more flexible way of trading is gradually becoming an irreversible economic trend. E-commerce in China although has experienced several ups and downs, in recent years, accompanied by the rapid development of network economy has become the mainstream mode of network economy. China's online shopping users accounted for 50% proportion of the overall Internet users. On the other hand, China's online shopping market transactions increase 67.8% in 2015. In the same year, China's online shopping market transactions accounted for the proportion of total retail sales of social consumer goods was 4.3%, increase 1.4% over last year. All of these data can be clearly reflected in China's e-commerce market is in a period of rapid growth in e-commerce, we put this kind of business to consumer transactions called B2C e-commerce. It is business activities through the Internet and individuals to conduct transactions between individuals [2]. Compared with the traditional marketing model, B2C e-commerce has unparalleled advantages: not subject to time and geographical constraints and influence, timely and efficient information can be real-time online update product information, the types and prices. The new online shopping

environment is in line with the rapidly developing economy and the fast pace of life. But also to bring convenience to consumers while also giving businesses more revenue.

Trust is the key factor that hinders the development of electronic commerce, and it is also concerned by the theorists and the business community. To begin to study the issue of trust in e-commerce is also more and more. Through the theoretical research and empirical study to determine the impact of e-commerce customer trust factors as well as more effective screening e-commerce website customer trust has become more urgent and necessary. Electronic commerce has developed rapidly in foreign countries, but because of the difference between Chinese and Western culture and consumption habits, the development of B2C e-commerce in China is much lower than the development trend of Internet. Therefore the domestic B2C electronic commerce website cannot simply imitate the foreign electronic commerce operation mode, must combine our country consumer's actual consumption custom and the consumer environment to carry on the marketing activity and the marketing countermeasure [3-4]. In this paper, on the basis of previous studies, analysis of factors need to be considered in the evaluation of B2C e-commerce trust, in the study of domestic and foreign scholars analysis and summary, to establish rough index evaluation and divides the input and output parameters were verified and eliminated; and then through the thick index form will receive the interview questionnaire then, the collection of customer trust on the selected electronic commerce website score through questionnaire, data envelopment analysis method is introduced to evaluate B2C e-commerce trust, to overcome the past research in the evaluation method of complex, difficult to confirm the weight problem, solve the B2C e-commerce trust overall efficiency, through the confirmation of the input and output index, analysis on trust efficiency evaluation results, obtain the overall efficiency of comprehensive trust is the optimal results, Suggestions for future decision making for enterprises.

2. Literature Review

2.1. E-Commerce

As rapid development of the Internet, e-commerce has become a new economic form of Internet users and the market is popular. But there is no standard definition of the concept of electronic commerce. Various international organizations, enterprises and institutions, governments, scholars have different opinions, according to their own environment and economic conditions, from their own point of view. From a narrow sense, the scholars in the literature to define the electronic commerce as the electronic means, the use of communication network technology to engage in business activities and management of business activities [5]. The United Nations Economic Cooperation and Development Organization (DECD), the Economic Commission for Europe and other organization believes that the concept of electronic commerce is by including the use of electronic payment, fax, online ordering system, digital switching, email and other nonphysical directly contact the, there in the enterprise and between enterprises, the exchange between the enterprise and the consumer goods or services such as commercial trade activity behavior. In the transaction process involving digital sound, text and other data processing and transfer process, but also related to the certification and enterprise capital flow and other information flow.

While the general e-commerce is defined as the whole process of economic activities, e-commerce can be seen as a modern business model. It is in meet the government organization and the manufacturers, consumer demand at the same time, the improvement of product and service delivery speed to achieve the maximization of resources and interests. Grant (2014) analyze the electronic commerce definition is reflected in the communication and business processes, services and online

marketing[6]. They think that electronic commerce is the application of computer network or other electronic forms for business and workflow automation is the use of a tool to complete the manufacturers, consumer's online trading services. The concept of electronic commerce Electronic Commerce Association of Canada proposed for all kinds of goods and services transactions are conducted through digital communication and funds the transfer is completed, which includes a variety of electronic data between companies and the company's internal used switch (EDI) equipment, fax machine, e-mail, Email, remote computer networking and video conferencing can realize the financial settlement, marketing and business negotiation and all other functions[7]. Global Information Infrastructure Committee (GIIC) electronic commerce work committee report referred to through the use of electronic communications in this way propaganda, on the economic value of products and services with the purchase and settlement is the concept of electronic commerce. It is emphasized that different social organizations or citizens are free to participate in economic activities, which are not limited by geographical position, how much money or retail channels.

In summary, the narrow e-commerce we can defined for the use of electronic means of the economic behavior of trading activities; general e-commerce is information through electronic means of transactions at the same time also includes the relationship between the parties in the transaction process, involving the procurement, production, logistics, transportation and other aspects of economic activity[8]. In addition to the impact of the electronic platform based on the study, but also to consider the impact of various aspects of the transaction process for the e-commerce trust.

- 1) **B2C model:** this form of e-commerce is mainly consumer's use the Internet to participate directly in the form of online marketing activities, and it mainly exists between business organizations and individuals and representatives of the business model is the Amazon e-commerce.
- 2) **B2B model:** B2B e-commerce refers to those e-commerce transactions is the object of business between enterprises. Mainly through the Internet to integrate enterprise chain on the lower level, to complete the transaction process.
- 3) **C2C model:** E-commerce between consumers and consumers is to build a fairer, free and secure environment in a platform built on third parties to achieve the user's trading activities.
- 4) **C2B model:** E-commerce between consumers and enterprises, which is based on the original model of B2C based on the. By integrating more similar purchasing requirements of consumers to use the scale efficiency to the enterprise for a greater discount model.

2.2 E-commerce Satisfaction

Satisfaction in e-commerce is mainly reflected in the customer trust degree of electric products. In this paper, the definition of trust in e-commerce is under changing network transactions and social environment and expectation formation of subjective trust and the trust object in the transaction process, the subjective dependence of commitment both trading, and thus to the trusted party take the behavior of judgment[9]. As consumers in B2C e-commerce transactions belonging to vulnerable groups, the trust mainly refers to the consumers through the trading environment and social environment, all the factors of expectations for the trading site, through constraints on the individual to achieve control of transaction risk and uncertainty and reduced. Through the collation of the literature, we can find that

although there is no definition of e-commerce in the definition of a standard, but no matter from which point of view which subject, there are some common characteristics and characteristics. First, trust exists in a risky environment. Consumers only in the perception of the risk of the transaction environment will be very much on the trust of the requirements and expectations. Under the electronic commerce environment, mainly has the following risks: transaction risk, the risk of exposure of private information, the accuracy of the information provided by risk. Secondly, trust is a trust relationship between the object and the subject of the trust. Djelassi (2013) proposed in the company and website information, commodity information and marketing information can be seen as the object of trust[10]. If the agent is the intermediary businesses agent all kinds of goods and channel information can be seen as a trust object. In addition, the definition of trust subject includes not only the consumers, also includes various stakeholders, such as suppliers, distributors, shareholders, employees. Again, trust based on the expectation of trust. The definition of trust, this expectation is based on future execution behavior and behavior expectation degree.

In e-commerce transactions to complete the transaction service products or process is the process of behavior intention formation also ultimately affect the behavior of the. In this process, the belief as ability, integrity, good cognition; attitude is the network legal system, trading rules, the third party trust view. So the theory of reasoned action can be used to study the influence factors of e-commerce trust formation, and used to guide the transaction process, enhance trust, and promote trade. As the propensity to trust the reputation and quality of the site for the establishment of trust plays a pivotal role in. For consumers, e-commerce there is uncertain and insecure, for the reputation of the requirements is particularly prominent. A good reputation will bring consumers more credible perception, for a successful conclusion of the transaction has a key role. Also on the one hand, e-commerce based on the Internet platform, so the quality of the site, including page design, layout, and speed will to the potential consumer awareness, good quality of the site will give consumers a high trust perception.

3. DEA Model

3.1. Decision Making Unit

Data envelopment analysis relative to the analysis of the effectiveness of the traditional input-output analysis and is very suitable for processing multi input multi output problem. Customer trust in B2C e-commerce sites evaluation of our research is a need from multiple inputs and outputs to the overall balance and consideration. Many influential factors of affecting trust, website of investment, the ultimate embodiment of trust can have several different, and between these factors if using the traditional evaluation method was used to evaluate the need confirmation in advance between each factor weight and function relations, for complex problems lack operation, and data envelopment analysis (DEA) fusion advantages of linear programming optimization model, for complex evaluation by multi input and multi output process, effectively reduce the human factors science and accuracy. And data envelopment analysis (DEA) can be evaluated from many aspects, for site in terms of trust investment scale effective technical and effectiveness, and input and output redundancy can get effective analysis and evaluation, for future site operation has certain guiding significance. Therefore the study data envelopment technology applied to the field of trust evaluation for electronic commerce.

We study a production activities or economic activities, are all factors of production put a certain amount of a unit in a certain range and from the output to a certain amount of activity. We must hope that this decision into the activities as

small as possible, output as much as possible, is also hoping to maximize the benefit. Maybe we are facing economic activities are not the same, but we are getting a "output through a certain decision". So, we call them as the decision making unit (DMU). Each decision making unit (though not the same on behalf of the meaning, but has certain economic meaning. They all have a certain input and output characteristics of this, in the process of implementation decisions and effective will be input into output. In the course of the study, we tend to be more similar to the decision making unit to study together. With such a clear definition, it is easy to see that the mode of production and engineering project is not the same kind of decision-making units; in the course of the study, with a decision making unit performance in different time we can as a similar decision making units. For example, we can put several different e-commerce sites with a comparative study, can also be a different period of the electronic commerce website for analysis of the data, they can be seen as a decision making unit of the same.

3.2. DEA Method

Decision making units use the same units of measurement, so the linear programming is not affected by the input and output units of measurement. And DEA can not only deal with the ratio data, but also can deal with the non-ratio data, and there is certain flexibility in the application of the data and the absolute scale of the processing ratio. Because the data envelopment analysis method does not need to estimate parameters in advance, and it does not need to determine the weight in advance, it makes both parametric and non-parametric methods by this non parametric statistical method. And the solution of the linear programming problem can be determined in the study of the weight of the decision-making factors, so that the parameters and weights are not subject to subjective influence, more just. We can use the following vector expression in the study of M similar ($i=1,2,\dots, M$), as well as in the decision-making activities involved in the N kinds of input and s kinds of output.

$$X_j = (x_{1j}, x_{2j}, \dots, x_{mj})^T \quad (1)$$

Each decision unit has the same s output, and the output vector is:

$$Y_j = (y_{1j}, y_{2j}, \dots, y_{sj})^T \quad (2)$$

For input, we want to ($i=1,2,\dots, M$) Can achieve the output at a certain time, the minimum input value, but also to make this input value is less than the original input values.

$$\max h_j = \frac{\sum_{r=1}^s u_r y_{rj}}{\sum_{i=1}^M v_i x_{ij}} \quad (3)$$

$$s.t. \begin{cases} \sum_{r=1}^s u_r y_{rj} / \sum_{i=1}^M v_i x_{ij} \leq 1 \\ v = (v_1, v_2, \dots, v_M)^T \geq 0 \\ u = (u_1, u_2, \dots, u_s)^T \geq 0 \end{cases} \quad (4)$$

This is a fractional programming model. In order to solve it, it must be changed into a linear programming model. Therefore assume:

$$t = \frac{1}{\sum_{i=1}^m v_i x_{ij}} \quad (5)$$

Transform the model to:

$$\max h_j = \mu^T Y_0 \quad (6)$$

$$s.t. \begin{cases} \mu^T Y_0 - w^T X_j \leq 0 \\ w^T X_0 = 1 \\ w \geq 0, u \geq 0 \end{cases} \quad (7)$$

4. Empirical Analysis

4.1 Evaluation Index Construction

For B2C e-commerce website customer evaluation to determine evaluation index is a very important link, the evaluation index system establishment will influence and determine the electronic commerce website customer trust evaluation for the authenticity and accuracy. Evaluation index system is not composed of a single index, but through a scientific and rigorous analysis of a whole, used to describe the impact of the factors in the evaluation process. The mainly based on the chapter for constructing the evaluation index system by research to the domestic and foreign electronic commerce trust theory and influence factors analysis and summary, the technology acceptance model as the basis, and in accordance with the technology accepted model theory can see individuals in the electronic commerce trust research for attitude and behavior and the final intention and behavior will be affected by the attitude for technology. ,

Scientific and complete combination, through the review of the literature at home and abroad, in the mature trust theory based on the summary of the factors that influence of B2C e-commerce website customer trust, and different factors affecting classification and segmentation, in order to establish the initial index system. Strict discipline in the follow, the logical method is closely combined with the characteristics of the industry, a comprehensive analysis of the problem, so that the indicators can not only meet the scientific and complete reflection of the problem. System and independent combination in the establishment of the index system to starting from the system point of view, from the point of view of open system analysis was evaluated in terms of the sub problems, to be involved in all aspects of the system, the processes of internal and external environmental factors. Maintain the consistency of the whole system. However, when considering the problem, we should keep the relative independence of each factor, and the index should have a relatively small correlation, not affect each other.

Operability and comparability of the combination of the index system to operate, to facilitate access, with a measurable, there is a clear physical meaning, meaning clear, easy to express. And the use of similar cases can be comparable, can be relatively consistent use and promotion, making the index system has a guiding and practical significant. After getting the evaluation of the rough indicators, through the form of a questionnaire to some of the B2C e-commerce website managers and

e-commerce research related scholars to obtain the relevant research data to prepare for research. Communicate with them prior to the release of the questionnaire in order to investigate more smoothly. The main use of e-mail in the form of questionnaire, total of 500 copies were issued, 485 questionnaires were recovered, and the recovery rate was 97%.

4.2 Reliability Analysis

The release and collection of the questionnaires are just the beginning of the questionnaire. After getting the original data, we need to test the reliability of the questionnaire. The reliability of the questionnaire mainly includes two aspects: internal reliability and external reliability. It is in order to ensure that the results of the questionnaire are consistent with the same way to the same object to expand the number of measurements to ensure that the quality of the data is good. Internal reliability is judged by the analysis of the same item; the degree of consistency is determined by the analysis of the non identical time of the same test item. The data used in this paper, cross section data, no external reliability of the measurement, only need to carry out the internal reliability of the survey. Through the questionnaire reliability analysis, we can see the reliability of each component are both greater than 0.7, indicating the reliability of the subscales of the various factors of the questionnaire is credible; total reliability is greater than 0.7, indicating the reliability of the total scale is adopted.

Table 1. Questionnaire Reliability Analysis

Index classification	Index subdivision	Cronbach α
Commodity characteristics	Commodity information	0.706
	Commodity brand	0.724
	Commodity price	0.768
	Commodity type	0.789
Service features	logistics	0.902
	Return	0.813
	After-sales service	0.825
Website quality	layout	0.781
	Easy to operate	0.729
	Response speed	0.824
	Community construction	0.816
Operating efficiency index	Purchase frequency	0.715
	Recommended times	0.769
	Single purchase amount	0.752

4.3 Validity Analysis

The validity analysis is to evaluate the validity of the questionnaire; it is true of the characteristics of the difference between the measurements reflected, rather than random error or system error. The validity analysis mainly includes two aspects: the content validity and structure validity. Content validity refers to judge from a subjective point of view we use the scale in the expression of its excellent degree of specific intent to show when the. It is used to evaluate the performance of the scale suitability and logic in content and measurement objectives. The questionnaire related items not only from foreign classical literature, is the use of many domestic and foreign scholars in the study of electronic commerce, and in the initial stage of the study questionnaire design and consulting and research a lot of classmates and teachers, after many discussions, the questionnaire of recognition than higher.

Therefore, from the perspective of content validity can be identified as outstanding performance.

In this paper, the structure validity of the scale using exploratory factor analysis (EFA) to measure. Factor analysis need to meet certain conditions, namely kmo is greater than 0.5, data are fit using factor analysis. The kmo were not less than 0.5 and Bartlett hemisphere inspection of the corresponding probability. Verify that the research can be conducted factor analysis.

Table 2. Analysis of Commodity Characteristics Scale Exploratory Factor

Item	Commodity information	Commodity brand	Commodity price	Commodity type	Variance contribution rate%
D1	0.753				72.570
D2	0.757				
KMO Sample measure 0.695;Barlett Ball test;Approx.Chi-Square 75.852;df3;Sig.000					
E1		0.587			66.174
E2		0.623			
KMO Sample measure 0.638;Barlett Ball test;Approx.Chi-Square 71.072;df6;Sig.000					
F1			0.633		56.347
F2			0.653		
KMO Sample measure 0.621;Barlett Ball test;Approx.Chi-Square 96.781;df6;Sig.000					
G1				0.763	69.142
G2				0.671	
KMO Sample measure 0.712;Barlett Ball test;Approx.Chi-Square 95.726;df6;Sig.000					

Table 3. Exploratory Factor Analysis of Service Characteristic Scale

Item	Logistics	Return	layout	Variance contribution rate%
H1	0.812			81.251
H2	0.781			
H3	0.783			
KMO Sample measure 0.782;Barlett Ball test :Approx.Chi-Square 164.183;df3; Sig.000				
I1		0.706		62.726
I2		0.725		
I3		0.663		
KMO Sample measure 0.683;Barlett Ball test;Approx.Chi-Square 102.831;df6;Sig.000				
J1			0.711	57.381
J2			0.726	
KMO Sample measure 0.701;Barlett Ball test;Approx.Chi-Square 91.661;df6;Sig.000				

Table 4. Exploratory Factor Analysis of Website Quality Scale

Item	layout	Operational simplicity	Community construction	response speed	Variance contribution rate%
K1	0.675				70.841
K2	0.710				
KMO Sample measure 0.624;Barlett Ball test;Approx.Chi-Square 79.821;df6;Sig.000					
L1		0.649			68.132

L2		0.724			
KMO Sample measure 0.693;Barlett Ball test;Approx.Chi-Square 83.163;df6;Sig.000					
M1			0.762		65.475
M2			0.732		
KMO Sample measure 0.694;Barlett Ball test;Approx.Chi-Square 95.822;df6;Sig.000					
N1				0.723	62.172
N2				0.792	
KMO Sample measure 0.621;Barlett Ball test;Approx.Chi-Square 105.322;df6;Sig.000					

Is to explore the results of factor analysis, from the table, we get the conclusion is this scale has the reasonable distribution and each factor has clear structure, each item of the load were more than 0.5, the variance contribution rate reached more than 50%. Therefore, it is proved that the scale has good construct validity.

4.4 DEA Model

The process of completing the transaction products or services in e-commerce transactions is the process of the formation of behavior intention and ultimately affects the occurrence of behavior. In this process, it can be regarded as a belief in the ability, integrity, good faith; attitude is the network of legal system, trading rules, the third party and so on whether the point of view of trust. So the theory of rational behavior can be used to study the factors that affect the formation of trust in electronic commerce, and it is used to guide the trading process, improve the trust and promote the occurrence of the transaction. The reputation of trust and the quality of website have a key role in the establishment of trust. For consumers, e-commerce has been a problem of uncertainty and insecurity, the reputation of the requirements are particularly prominent. A good reputation will give consumers more confidence in the perception of the smooth reach of the transaction has a key role. Also on the one hand, e-commerce based on the Internet platform, so the quality of the site, including page design, layout, speed will to the potential consumer awareness, good quality of the site will give consumers a high trust perception.

Through the analysis, evaluation of the three B2C e-commerce website only JD mall overall efficiency is 1, the overall efficiency of Tianmao and Vipshop are less than 1. The efficiency of the scale, if the scale efficiency is close to 1, the overall efficiency of the electronic commerce website trust more appropriate. In this study, the JD mall scale efficiency is 1, the website is in constant returns to scale, which is the optimal state returns to scale. It means that the JD mall has done in the construction and the optimization of customer trust, the overall high degree of trust. While the Tianmao and Vipsho scale efficiency is less than 1, in the non-effective scale stage, and in a state of increasing returns to scale. This is illustrated in the aspects of trust investment; increase the output proportion of the increase will be greater than the proportion of investment. When the comprehensive efficiency is less than 1, we need to consider is due to the influence of returns to scale of, or the technical efficiency of the impact, so we model continued analysis can be found through research and although is the size of the non-effective, is pure technology effectively. The note for the technical efficiency of the two e-commerce website and there is no need to reduce investment, their combined efficiency reason did not reach the optimal, not due to the redundant input or lack of output, but is because their size and input and output does not match. And increasing returns to scale, so you can maintain the existing proportion of the allocation of resources under the premise of the appropriate expansion of the scale, so that the overall size of the

Tianmao and Vipshop effective. Through the analysis, the evaluation of the three B2C e-commerce sites in the overall efficiency

Table 5. The Computing Results of DEA

Index	Index classification	Index subdivision	JD	Tianmao	Vipshop
Input index	Commodity characteristics	Commodity information	8.72	5.54	5.27
		Commodity brand	7.97	5.27	6.68
		Commodity price	7.19	6.12	5.98
		Commodity type	7.11	7.5	7.18
	Service features	Logistics	8.24	5.12	6.18
		Return	7.6	5.37	6.29
		After sales follow up	7.0	6.1	5.12
	Website quality	Layout	7.16	6.56	5.12
		Easy to operate	7.81	5.98	5.19
		response speed	6.72	4.98	5.37
		Community construction	8.21	6.13	7.21
	Output index	operating efficiency	Purchase frequency	8.91	3.21
Recommended times			7.37	3.67	3.28
Purchase amount			6.21	3.21	3.26

5. Conclusions

The rapid development of Internet has led to the development of electronic commerce. Electronic commerce as a more flexible way of trading is gradually becoming an irreversible economic trend. E-commerce transaction model, although there are incomparable advantages of the transaction, but also has a hidden trouble of its uncertainty, due to the network shopping market more and more fraud and security issues, resulting in decline in consumer confidence, and one of the main obstacles that hinder the rapid development of online shopping market. In this paper, based on the electronic commerce trust theory to obtain the factors that affect the customer trust of B2C e-commerce website, combined with the DEA method used in this paper to establish evaluation index system, and through empirical research to analyze. Through the research and summary of existing domestic and foreign literature on technology acceptance theory based on the analysis of factors that influence of B2C e-commerce website customer trust extract rough evaluation index, and the data were analyzed by means of questionnaire and interview, evaluation index for optimization, excluding the high correlation and influence degree index. Set up the evaluation index system for the B2C e-commerce website customer trust research has certain guiding significance.

For the results of the analysis, scale efficiency, if the scale efficiency is closer, it shows that the overall efficiency of the e-commerce website trust is more appropriate. JD mall scale efficiency is 1, in a fixed scale return state, that is, the optimal state of the scale of remuneration, also shows that the JD mall in the building of customer trust and the results of the optimization of the configuration, the overall high degree of trust. And through the study can be found, although it is

not the size of the effective, but it is pure technology effective. The note for the technical efficiency of the two e-commerce website and there is no need to reduce investment and their combined efficiency reason did not reach the optimal, because of their size and input and output mismatch. Can maintain the existing allocation of resources under the premise of the appropriate expansion of the scale, so that the overall size of the effective.

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