The influence mechanism of product attributes on product demand in online reviews

Ying Chen
School of Economics and Management, Nanjing University of Science and Technology, Nanjing 210094, China

Li Li
School of Economics and Management, Nanjing University of Science and Technology, Nanjing 210094, China; Jiangsu Collaborative Innovation Center of Social Safety Science and Technology, Nanjing 210094, China, lily691111@njust.edu.cn

Yulan Lin
School of Economics and Management, Nanjing University of Science and Technology, Nanjing 210094, China

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Ying Chen[1], *Li Li*[1,2], *Yulan Lin*[1*]

[1] School of Economics and Management, Nanjing University of Science and Technology, Nanjing 210094, China

[2] Jiangsu Collaborative Innovation Center of Social Safety Science and Technology, Nanjing 210094, China

Abstract: To explore the influence mechanism of product attribute characteristics contained in online reviews on users' purchase decisions can provide decision-making basis for the improvement of products and services of e-commerce enterprises. Based on the previous empirical research and management practice, we put forward the hypothesis that each product attribute in e-commerce online reviews affects product sales, and use the method of panel data modeling to explore the influence mechanism and degree of each product attribute in online reviews on product demand. The results show that there are significant differences in the influence mechanism and degree of different attributes on product demand. In apparel e-commerce, users pay most attention to the size attribute characteristics of products. This study can guide e-commerce enterprises to improve their products and services.

Keyword: Online review, demand forecasting, panel data modeling

1. INTRODUCTION

In recent years, with the rapid development of Internet information technology, online reviews in e-commerce have been developing rapidly. Online users generate a large number of online comments recording consumer experience on the e-commerce platform, and online comments have become an important source of information that affects consumers' attitude and behavior in online shopping[1]. E-commerce online review, as an important part of customer feedback system, is an important way for e-commerce enterprises to understand consumers' needs and wishes, as well as an important way for consumers to understand enterprise goods and services and reduce information asymmetry[2]. Before purchasing goods, consumers often browse online reviews to aid decision-making.

On the whole, e-commerce online review has increasingly become the focus of academic circles and e-commerce enterprises. In the research of e-commerce online review, some scholars focus on the research of online review content, using text mining and algorithms to extract online review content features, then study the usefulness of online review and online review sentiment analysis; in recent years, more and more researchers began to study the impact of online review on consumer purchase decision. Senecal and Sylvain[3] conducted an online experimental study on 487 subjects and found that consumers are more likely to buy products after viewing the comments of other users; Duanetal[4] believed that the number of reviews has the greatest impact on consumers' purchase behavior, which is different from the content of reviews generally considered by people; Chevalier and Mayzlin[5] have studied the impact of consumer reviews on the relative sales of Amazon and bainsannoble books, and found that customer reviews can promote the sales of books, particularly,the impact of negative reviews is greater.At the same time, many domestic scholars have also done such research. Nie Wei and Tian Juanjuan[6] found that the quality and potency of online reviews have a positive impact on consumers' purchase intention through perceived usefulness; Li Haiqin[7] used structural equation model to test the model, and found that the quality of online reviews and the professional ability of recipients have a significant direct

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positive impact on online consumers' purchase intention; Huang Hua and Mao Haifan[8] constructed a transmission mechanism about the influence of the length, quality, quantity and timeliness of negative online reviews on consumers' purchase intention, and put forward suggestions to enterprises and consumers respectively according to the conclusions.

The existing literatures have analyzed the influence of digital reviews(including star levels, scores,etc.), quality and potency of online reviews on consumers' purchase decisions. These studies have enriched the literature content of the influence of online reviews on consumers' purchase decisions,to a certain extent. However, they have not considered the product attributes contained in online reviews. In fact, in the process of purchasing decisions, consumers will refer to various attributes of products[9]. In the e-commerce environment, the websites will provide a large number of online comments, and these online comments often include consumers' comments on product attributes[10], which provides convenience for research and provides data support for researchers to explore the impact mechanism of online comments on users' product needs .

Therefore, we explore the influence mechanism of product attributes on product demand in e-commerce online reviews. Under the background of big data, the content of online reviews can be recorded accurately, which provides a new idea for the study of the influence mechanism of various attribute characteristics on product demand. In this paper, we use panel data model to analyze the influence mechanism of online reviews on product demand, which has guiding significance for the improvement of products and services of e-commerce enterprises.

We make a supplement to the existing literature from three aspects: the first aspect is the data sources, most of the existing research data sources are questionnaire survey data. However,our research data comes from an e-commerce fashion women's clothing website, which is more objective; The second one is research content, although the existing literature involves the impact of Online reviews on consumers' purchase decisions, there is a lack of specific research on online reviews. The last is the research method,the existing literatures mostly use multiple regression analysis, structural equation and other data analysis methods, while we use panel data modeling method, which has a certain degree of innovation.

2. HYPOTHESIS

In the process of obtaining product information, users will often browse the comments of other users who have purchased the products or services, which will affect their purchase decision and then has effect on the sales volume of the products. The attributes of products are various, by summarizing the views of some scholars, Mark Perry proposed that product attributes mainly include the internal attributes and external attributes. The internal attributes refer to the physical composition of the products, such as material; the external attributes refer to the attributes that can be recognized when the product is not used, such as product service[11]. For clothing product attributes, after filtering out useless variables through data preprocessing, the proposed product attribute features include size, material, breakage, loose / off button, off-line, wool dropping, threads, zipper (bad), odor, discoloration, dirtiness, and these attributes can be divided into product specification attributes, quality attributes, users' perception attributes.Then,we will explore the impact of these three types of product attributes on product sales respectively.

Product specification attributes mainly include product size, volume and other attributes. Yu Yishuang takes Taobao clothing products as the research object and empirically analyzes the impact of online reviews on clothing sales.This paper studies the influence of clothing size, color difference and other attributes on sales, and the results show that color difference and size have no significant impact on sales[12]. However, this paper fails to specifically analyze whether there is multicollinearity between product size, color difference and other comment features. Generally speaking, when a user found that the size of a garment is wrong after purchasing a

product, he / she will write down his / her intuitive feelings on the e-commerce website. Other customers who want to buy the product will browse these comments of the product. After seeing other user's poor comments on the size, they maybe change their purchase decision. Therefore, the following hypotheses can be put forward.

H1: product size in online reviews has a significant impact on sales.

There will be differences in users' concerns about different products, such as the price and ease of use of cameras. Zhang Meng[13] and others have found that if words such as service and transportation convenience appear in hotel reviews,they can show more real situation of the hotel. Archak[14] and other scholars believe that the quality of product design may be an important determinant of consumers' purchase decisions. The material of clothes is often one of the product attributes that consumers most concerned.Generally speaking, the better the material of clothes, the more consumers like them. When users find that the clothes are damaged after receiving the products, it will greatly affect their views on this kind of products. The quality attributes of products also include some attributes that reflect the poor quality of products, such as loose / off buttons, off-line, hair falling and defective products. The increase in the number of these comments will often make other users who want to buy such products give up the idea of buying, thus affecting their purchase decisions. Therefore, the following hypotheses can be put forward.

H2a: the product material in online reviews has a significant impact on sales;

H2b: product breakage in online reviews has a significant impact on sales;

H2c: the product button loose / off in online reviews has a significant impact on sales;

H2d: product off-threads in online reviews has a significant impact on sales;

H2e: the product wool dropping in online reviews has a significant impact on sales;

H2f: product threads in online reviews has a significant impact on sales;

H2g: zipper in online reviews have a significant impact on sales.

Facing different types of products, consumers are eager to get different product information[15]. For exterior products such as fashion women's wear, users want to know more about the external information related to the product, such as the color and other attributes of the product[16]. The users' perception attributes of products include odor, discoloration and dirtiness. After receiving the product, whether the product has peculiar smell will directly affect the user's purchase experience, and thus affect the perceived value of other users and their purchase decision. Therefore, the following hypotheses can be put forward.

H3a: product odor in online reviews has a significant impact on sales;

H3b: product discoloration in online reviews has a significant impact on sales;

H3c: product dirtiness in online reviews have a significant impact on sales.

3. RESEARCH METHOD

In order to explore the impact of online review product attribute characteristics on product sales, we adopt the method of panel data modeling. Panel data refers to the sample's data that takes multiple sections in the time series and selects the sample's observation value on the section. The variables used in the panel data model include the duality of time series and cross section.

We use panel data modeling method to build a panel data model. Compared with cross-sectional data, panel data can provide individual dynamic behavior information, and the sample's size is larger. Because the time dimension of the panel data used in this study is small, it is a short panel data, and we adopt the short panel data modeling method. In the process of building the model, quarter is taken as the time variable to study the influence mechanism of product attribute characteristics in online reviews of different commodities on product demand in different quarters. Finally, the panel data model established in this paper is shown in formula (1).

$$y_{it} = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3 + \alpha_4 x_4 + \alpha_5 x_5 + \alpha_6 x_6 + \alpha_7 x_7 + \alpha_8 x_8 + \alpha_9 x_9 + \alpha_{10} x_{10} + \alpha_{11} x_{11} + \alpha_{12} x_{12} + u_{it} \tag{1}$$

Among them, y_{it} is the explained variable, which represents the product sales volume of the i-th commodity in the t period; the explanatory variable adopts the characteristics of each attribute of the product in online reviews. At the same time, in addition to the attributes of the product itself, there are other factors that may also affect the sales volume. Li Jian points out that the fluctuation of commodity price affects the purchase decision of users to a certain extent through summarizing previous literature[17]. Therefore, we will take the product price as the control variable of the model. The explanation of each variable of the model is shown in Table 1.

Table 1.   Variable description of panel data model

Variable type	Variable name	Variable explanation
explained variable	sales	Average daily sales volume of the i-th commodity in quarter t
	size	The proportion of size reviews of the i-th commodity in quarter t
	material	The proportion of material reviews of the i-th commodity in quarter t
	breakage	The proportion of breakage reviews of the i-th commodity in quarter t
	button loose / off	The proportion of button loose / off reviews of the i-th commodity in quarter t
exlanatory variable	wool dropping	The proportion of wool dropping reviews of the i-th commodity in quarter t
	off-threads	The proportion of off-threads reviews of the i-th commodity in quarter t
	threads	The proportion of threads reviews of the i-th commodity in quarter t
	zipper	The proportion of zipper reviews of the i-th commodity in quarter t
	odor	The proportion of odor reviews of the i-th commodity in quarter t
	discoloration	The proportion of discoloration reviews of the i-th commodity in quarter t
	dirtiness	The proportion of dirtiness reviews of the i-th commodity in quarter t
control variable	price	The proportion of price reviews of the i-th commodity in quarter t

4.   EMPIRICAL RESEARCH

4.1 The data

The data in this paper comes from an e-commerce fashion women's clothing website, where consumers can buy and comment on all kinds of products. The data mainly includes online review data and order data. Due to the complexity of corpus data, data preprocessing is needed. In the model, the main data include the control variable(price),the explained variable ,including product sales, and the explained variable,which contains the product attribute characteristics. We select 3470 kinds of products in 2017 as the sample.

We extract the product attribute features reflected in online reviews, including product specification attributes, product quality attributes and users' perception attributes, and calculating the proportion of various attribute features in the total reviews in a certain period as the explanatory variables of the product; because the product demand can not be measured, but the sales volume of the product can be obtained, and the product demand can be reflected from the side, therefore. The explanatory variable of this paper is the average daily sales volume of the product,its calculation method is the ratio of the total sales volume of the product and the corresponding date in the order data table. The control variable of the product is the price of the product. Because the product is the fashionable women's clothing, the price value is relatively large. Therefore, the price variable is obtained by taking the logarithm of the product price, and the bottom is the natural logarithm E. The logarithm processing can make the data more stable and weaken the collinearity and heteroscedasticity of the model. The individual data of panel data is the commodity code of each commodity, with quarter as the time data, January to March as the first quarter, and then every three months as the next quarter. Finally, the panel data for the study are shown in Table 2.

Table 2.   Panel data

Prodcode	quarter	Size	……	dirtiness	sales
00c741a448848f680dc7a2cc2ff84c00	1	0.05	……	0.17	4.94
00c741a448848f680dc7a2cc2ff84c00	2	0.05	……	0.62	6.18
……	……	……	……	……	……
00d8dcb63f3e47cb0c6728c7d4dd79de	3	0.2	……	0.67	4.12
00d8dcb63f3e47cb0c6728c7d4dd79de	4	0.2	……	0.39	2.63

We take the product attributes and average daily sales volume of different products in different quarters of online reviews as the research object. Before the panel data analysis, we make a correlation analysis between explanatory variables to avoid the problem of multiple collinearity of explanatory variables. From the correlation analysis between variables, except the correlation coefficient between threads and off-threads attributes is $0.792 > 0.7$,the correlation coefficient between other variables is small, and the correlation between most of the independent variables is significant. Therefore, in the follow-up experiments, we will eliminate the off-threads variable and reject the hypothesis of H2d.

4.2 Result

The Table 3 is the descriptive statistics of variables. Through the descriptive statistical analysis of variables, it can be found that users are most concerned about the size and material of clothing, and less about the problem of clothing wool dropping. The reason for this phenomenon may be that the wool dropping of clothing needs to be found after using the product for a period of time, and the impact on the user's experience is not as big as other factors.

Table 3.   Variable descriptive statistical analysis results

Variable	Obs	Means	Std. Dev.	Min	Max
Size	3470	0.606	0.299	0.000	1.000
material	3470	0.557	0.205	0.000	1.000
breakage	3470	0.093	0.151	0.000	1.000
button loose / off	3470	0.024	0.062	0.000	0.500
wool dropping	3470	0.022	0.076	0.000	1.000
threads	3470	0.379	0.083	0.000	1.000
zipper	3470	0.405	0.144	0.000	0.802
odor	3470	0.099	0.051	0.000	0.250
discoloration	3470	0.245	0.036	0.000	0.447
dirtiness	3470	0.207	0.266	0.001	0.907
price	3470	5.078	0.509	3.378	6.907
sales	3470	4.245	1.411	0.693	9.458

Because the time dimension of the panel data used in this study is small, it is a short panel data, and we adopt the short panel data modeling method.Through the panel data modeling, adding time dimension for analysis,the explanatory variable is the product attribute characteristics of different products in different quarters,the price is taken as the control variable,and the explained variable is the average daily sales volume of different products in different quarters. The data is imported into Stata for analysis and the analysis results of the panel model are shown in Table 4.

Table 4.   Panel model analysis results

sales	Coef.	Std. Err.	t	P>|t|
Size	-.759	.131	-5.80	.000
material	-.844	.111	-7.59	.000
breakage	-.822	.166	-4.96	.000
button loose / off	-.129	.364	-3.10	.002
wool dropping	-.574	.295	-1.94	.052
threads	-.411	.451	-5.35	.000
zipper	-.619	.200	-4.79	.000
odor	-.359	.799	-2.95	.003
discoloration	-.711	.707	-0.31	.000
dirtiness	-.049	.085	-2.38	.000
price	.139	.045	3.10	.002
constant item	4.759	0.535	8.89	3.710

R2=0.181
Prob>F=0.000

From the test results of the model, the F test p value of all the coefficients of the model is 0, which is less than 0.05, so the fitting result of the model is good; the goodness of fit r of the model is 0.181, which shows that the fitting effect is also good. According to the weight of regression coefficient, size, material and breakage attributes are the main indicators that affect the sales volume of products, and the most important one is the product material attribute, which indicates that users are very concerned about the product material. The more comments about the product material attribute, the less users are likely to buy the product. From the results of the model, it can be seen that the test p value of the influence of wool dropping on product sales is 0.052, indicating that the influence is not significant, and the hypothesis of H2e is rejected.

It can be seen from the analysis results of panel model that, for the product specification attribute characteristics, the influence coefficient of size on the product sales is negative, and the test p value is 0.000, which indicates that the influence of product size on the sales is significant, and the hypothesis H1 is accepted; for the product quality attribute characteristics, the influence coefficient of breakage, material, button loose / off, threads, etc. on the product sales is significant, and the influence coefficient is negative, which means that the more comments about product quality problems, the less sales of products, so accept the hypothesis H2a, H2b, H2c, h2f. For the users' perception attributes, the three hypotheses of hypothesis H3 all been verified, that is, odor, discoloration, dirtiness and other product attributes have a significant impact on product sales. The control variable price has a significant impact on product sales, and the coefficient is greater than 0, which indicates that the higher the product price, the more products users buy. Because the product is positioned as a luxury fashion for women, and its users pursue higher spiritual enjoyment,high price often means high quality and fashion sense of the product.

The research results of this paper have guiding significance for the product improvement direction of e-commerce enterprises. Based on the above discussion results of the influence mechanism of online reviews on product demand, most of the product attributes have significant influence on product demand. For e-commerce enterprises, we can use the research results of this paper for reference to make some improvements to the products.

Users are very concerned about the quality attributes of products. E-commerce enterprises selling clothing can pay attention to the attributes of product materials and zippers in the user's online comments, and make

certain improvements on the product materials. The material attributes of products have the greatest impact on the product sales. Therefore, e-commerce enterprises must strictly control the raw materials of products and pay attention to the product materials when making products. E-commerce enterprises should strengthen communication with users to avoid the problem of different sizes of clothes, users' perception of products also has a significant impact on product sales, from our study, we can see that the odor, discoloration, dirtiness and other problems of clothing will have a significant negative impact on product sales. Therefore, e-commerce enterprises should pay attention to the preservation of products, so as to avoid problems such as odor, discoloration and so on.

5. CONCLUSIONS

We study the influence mechanism of e-commerce review features on product demand. Different from previous studies, the data in our paper comes from the order data and review data of an e-commerce website. Taking the specific text content of online reviews as the research object, The product attribute features in online reviews are extracted, and the influence of product attribute features on product sales is discussed through panel data modeling.

Through the analysis of the panel data model, it is found that many product attributes in online reviews do have a significant impact on product sales. The specific conclusions are as follows:

(1) Product specification attributes, such as size, are one of the most concerned product attributes when users purchase, which has a significant impact on product sales, and it is consistent with the situation in real life. When buying clothing and other products, users often try to see if they fit firstly.

(2) The quality attribute of products is also an important factor affecting the sales of products. The material of clothing products has the greatest correlation with product sales, which indicates that users are very concerned about the comfort of products; product attributes such as breakage, threads, loose / off buttons have a significant impact on product sales; the impact of wool dropping on product sales is not significant. To a certain extent, e-commerce enterprises can learn from the research results of this paper to improve the properties of clothing, such as material, button, zipper and so on.

(3) The users' perception attributes include whether the product has odor, dirtiness and discoloration. Through the analysis of the panel model, we can find that the products with odor, dirtiness and discoloration have significant effects on the product sales;

At the same time, in the process of our study, we found that there are still some limitations, some problems still need to be further explored, mainly including the following:

(1) Research object: the research object of our paper is only limited to clothing products, which has no universal significance, and can only provide certain reference for e-commerce enterprises operating clothing products; in the follow-up research, we hope to analyze more commodity types and explore the influence mechanism of online reviews on product demand;

(2) Due to the lack of some order data, the study only uses the order data and review data in 2017, the sample size of the study can be larger. The follow-up research hopes to use several years of order data and review data as samples to explore the influence mechanism of online review product attribute characteristics on product demand.

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