

# An Empirical Analysis of the Impact of Online Reviews on Product Sales in the Chinese Context

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**Abstract**—Online reviews, as one kind of new marketing methods, are becoming increasingly important in influencing preferences and decision-making of consumers. In view of this, this paper conducts an empirical study on Dangdang Books,<sup>1</sup> constructs a research framework on correlation between product sales and aspects of online reviews, and explores the correction through the panel data econometric model. Compared to former research, our work analyzes real data on product sales instead of the rank of sales. Based on our study results and comparison with others' research results on Amazon (amazon.com), we provide several guiding suggestions for online review systems in the Chinese context. These systems should pay attention to emotional tendency of reviews, reviewer ranking mechanisms, spotlight reviews, review format and review voting mechanisms.

**Index Terms**—Online Review System, Effect on E-Commerce, Empirical Analysis, Information Sharing, Information Search

## I. INTRODUCTION

According to the report by China Internet Network Information Center (CNNIC), the number of Internet users in China has reached 384 million by the end of 2009, a jump of 28.9% over 2008, and the proportion in total number also increased from 22.6% to 28.9% with a steady growth every year. However, there is still much gap between China and other developed countries, while the United States is 74.1%, Japan 75.5% and South Korea 77.3% [1]. The fast development and relatively low popularization of Internet in China fully illustrate that the China's Internet industry has great potential [2]. With the emergence of Internet, more and more people choose online shopping over traditional solid shops. Meanwhile, with the overall promotion of Web2.0 and quick launch of Web3.0, people start to express their views and attitudes of products online, which represent their own subjective feelings. Therefore, the amount of information on the Internet begins growing exponentially.

The emergence of digit network redefines the traditional social information exchange structure dominated by the "word-of-mouth", which allows consumers to easily exchange views and experience toward products with other netizens [3]. Meanwhile, online retailers, such as Amazon and BarnesandNoble.com, expect to expand their product market through their own online review systems. Traditional "word of mouth" marketing is playing weaker and weaker impact on consumers, while online reviews, as one of the new marketing methods,

are increasing the importance in influencing consumer preferences and decision-making of purchases. For instance, Resnick persists that the reviews from buyers could directly affect transactions [4]. Furthermore, Chevalier et al. demonstrate that product reviews would influence book sales in Amazon [5].

Because of the growing importance of online review systems, online retailers pay much more attention on them, and wish to establish a more effective mechanism to influence consumers' products choosing process and strengthen the trust among consumers. For online retailers, an online review system works only when it can really improve product sales, so investigating the correlation between review systems and product sales is necessary for building a more effective mechanism, and is even more indispensable and more significant for expanding online commerce in China. Towards this purpose, our paper establishes a multi-dimensional review-related research framework, and creates a econometric model to explore the correlation between online reviews and product sales from the perspectives of number of reviews, quality of reviews, reputation of reviewers and the emotional tendency of reviews based on dataset collected from the Dangdang Books. The dataset includes basic book information and total review information of 12,609 new books posted on Dangdang within 180 days from October 19, 2009 to April 16, 2010. We explore the impact of online reviews on consumers. The exploration results provide several important guiding suggestions towards effective online review systems in the Chinese context.

## II. RELATED WORK

Former research towards online reviews mostly concentrate on six aspects: connotation, motivation [6], content [7], effect [5], [8], management [6], and individual differences [2], [4]. The above mentioned almost covers all the life cycle of online reviews.

Among the effect research, a considerable part is about the impact exploration of online reviews on products or service sales. However, only a few studies have been conducted in the China context. Hao et al. [9] use movie panel data and emotional tendency of online reviews, and find out that online reviews have different impact on movie box office at the different stages of movies' life cycle, and the impact reaches its peak after three weeks. Furthermore, the emotional tendency of online reviews plays a more significant role on movie box office than quantity of reviews, and the positive influence of

<sup>1</sup><http://book.dangdang.com>, a largest Chinese online bookstore.

five-star reviews has overtaken the negative influence of one-star reviews, while no significant influence of two-star to four-star reviews.

The majority research on online reviews has been conducted by researchers in other countries. However, there is no unified result towards the effect of online reviews on product sales. For example, Duan et al. [10] discuss the effect of online reviews on movie box office from the perspectives of pervasive effect and awareness effect. The result turns out to be that online reviews cannot influence sales directly. Meanwhile, scholars use sorts of methods to explore the correlation between product sales and different aspects of reviews. Chevalier and Mayzlin [5] declare that online reviews have positive effect on book sales of both Amazon and Barnesandnoble.com. High quality of reviews can improve sales, and reviews of one star have more significantly effect on product sales than reviews of five stars, which is opposite to the study of Hao et al. [9]. Based on the Transaction Cost Theory and Uncertainty Reduction Theory, Hu et al. [11] use a combinative analysis to exploit the effect of online reviews on sales of Amazon videos and books. Ghose and Ipeirotis [12] use an econometric approach, text mining and technology of model predictive control to discuss the correlation between product sales and characteristics of reviews including average helpfulness of historical reviews, information richness and readability. They find that reviews mixed with objective sentences and subjective sentences have less impact on product sales than reviews containing only objective sentences or subjective sentences. Besides, Dellarocas et al. [13] try to figure out how to predict movie box office based on historical reviews.

Overall, the research on this topic, no matter in China or other countries, on one hand, involves many inconsistent results and cannot reach a steady conclusion due to the overlapped study points. On the other hand, the study data is mainly concentrated on videos, digit products and books sold on Amazon, while little research has been carried out in the Chinese context. Therefore, these research results have only limited realistic value to guide e-commerce market in China. This motivates our work of compressively studying the impact of online reviews on product sales in the Chinese context.

### III. METHODOLOGY

In order to scientifically achieve our research objects, we construct our research by combing with approaches of literature study, econometrics methods, empirical approach and methodology of comparison. The whole research ideas are described in detail as follows.

Firstly, we propose our research hypotheses through a well study of the literature related to our topic, in which the Literature Study approach is applied. For the purpose of comprehensively exploring the effect of online book reviews on book sales in Dangdang, we collect lots of research results and establish a relatively complete research framework. In addition, we compare our results of Dangdang with other studies conducted towards Amazon and then provide suggestions for guiding online review system design in the Chinese context.

Secondly, a panel data model is constructed on the basis of econometric methods and strictly grounded on its basic

procedures. We define product sales as a dependent variable and review related variables together with other correlated variables as independent variables, and then use the Pooled Ordinary Least Squared (POLS), Hausman test and Heteroscedasticity test consequently to verify the effectiveness of our research dataset and model.

Thirdly, by using empirical approaches, our empirical study is launched to explore the correlation between online reviews and product sales on the data collected from Dangdang Books. The data is crawled directly from Dangdang.com and covers all the new books posted from October 19, 2009 to April 16, 2010 within 180 days. Then, with the assistance of Stata 10.0, we apply the econometric model on dataset to test the proposed hypotheses and analyze the regression results.

Lastly, the methodology of comparison is used to contrast our results on Dangdang with previous research results on Amazon. Several guiding suggestions for Chinese online review systems are derived by our study.

### IV. HYPOTHESES

Online sales are affected by many factors, and all these are explored by researchers in psychology, behavioral science, economics and other fields. Consumers' purchasing decision making process is very complex, and influenced by many external and internal factors most of which have already been studied. From demographic, cognitive and psychological aspects, Wang [14] tries to figure out which sort of potential consumers would actually purchase online. It turns out to be that online consumers' attitude and intention were greatly influenced by cognitive and psychological characteristics, while the connection with demographic features was trivial. Therefore, we give our study premise: products' demographic characteristics have little effect on products' sales and can be ignored.

At present, many typical B2C websites, such as Amazon and Dangdang, have established their online review systems and make them available for online consumers to express their comments toward the products they have purchased. Online reviews are very necessary for subjective products like books, music and movies, since majority of reviews posted by online consumers can influence other potential consumers' decisions about whether to purchase the same products. We study the correlation between online reviews and product sales in B2C market from the dimensions elaborated in the following.

Online consumers can view details on the number of reviews about one particular product. As discussed in Section II, a lot of empirical analysis have proved the positive impact of the number of reviews on product sales. Generally speaking, the larger number of reviews for the same product, the more information about the product can be acquired by potential consumers, and this can be more beneficial for consumers to know about the product. Godes and Mayzlin [15] point out that the more discussions of a product, the more likely for it to receive intensive attention which could lead to more purchase of this product. Hence, we propose our first hypothesis:

**H1:** *The number of reviews has a positive impact on product sales for the same kind of product.*

A lot of online review communities would provide reviews of different ranks, for instance, reviews are ranked one to five stars in Dangdang. The different ranks represent feeling of likes or dislikes toward the particular product or service, and they also reflect different levels of persuasive effect. No matter positive reviews or negative reviews, they are all from the users' angle to describe their experience of using the product, and the reviews can include the content and quality characteristics of the products. Then based on provided information, the review receivers evaluate the product, compare with their expectations and then decide whether to purchase. Learning from the research of Chevalier and Mayzilin [5], we suppose that positive reviews can have positive effect towards potential consumers, while negative reviews can have negative effect, and the negative effect of negative reviews overtakes the positive effect of positive reviews, while the reviews including less emotional tendency (two-star to four star) have little effect on potential product consumers. Meantime, according to Pavlou and Dimoka's research [16], people generally just read the first two pages of reviews. We combine this with Hao et al's research [9], and propose our second hypothesis and several relative derived hypotheses:<sup>2</sup>

**H2:** *The emotional tendency of online reviews has significant effect on product sales. Generally speaking, the higher overall rank of product reviews, the more product sales would be.*

**H2a:** *The recent accumulation of one-star reviews has significantly negative effect on product sales.*

**H2b:** *The recent accumulation of five-star reviews has significantly positive effect on product sales.*

**H2c:** *The negative effect of recent accumulated one-star reviews overtakes the positive effect of recent accumulated five-star reviews.*

**H2d:** *The recent accumulation of two-star to four-star reviews has little effect on product sales.*

Reputation is a mutual trust relationship which is formed in the process of people communicating, company contacting, or product transacting. In an online review community, connection between information senders and receivers is very weak, which is completely different from traditional face-to-face communication. Therefore, in order to eliminate the negative factors caused by the new form of online communication in product transactions, e-commerce website designers attempt to introduce the concept of the reviewers' rank, which is determined by several pre-set factors. Then, consumers can decide whom should be trusted or distrusted by viewing the rank of every reviewer. On the basis of the number of review medals, Dangdang divides its reviewers into five classes: Primary, Intermediate, Advanced, Premium and Expert. Review medals can be obtained either by posting a review more than fifty words or when posted reviews have been chosen as spotlight reviews on the websites. The former research has elaborated that reviews posted by reviewer of high rank can greatly affect book sales. Guadagno and Cialdini [17] point out that authority is far more important in the process of online decision-making than in traditional face-to-face interaction and online product

reviews are in the form of indirect communication. Therefore, we propose our third hypothesis: the higher rank of a reviewer, the much more important effect of her review on product sales: **H3:** *The reputation of a reviewer is significantly and positively correlated with product sales.*

Quality of a review refers to its authenticity, reliability, relevance of its content with the product and whether it provides helpful information for potential consumers. We test the effect of review's quality on product sales from the aspects of review votes, length and whether it is a spotlight review.

In an e-market, on one hand, due to the anonymity of the online review systems, sellers or authors can register online and pretend to be consumers to post fake or untruthful reviews, which could lead customers to make bad decisions and threaten benevolence of consumers. On the other hand, reviewers, limited by their own knowledge, can post low quality of reviews, which is useless for potential consumers. Therefore, effect of a review is greatly determined by its quality and the objectivity of its content. Namely, reviews of high or low quality affect differently on product sales. In Dangdang's review system, people can comment on existing reviews and vote whether the reviews are helpful. So we can use votes of a review as indication to evaluate the quality of this review. Chen et al. [8] point out that for votes in a range of either "helpless" or "helpful", reviews with the votes of "helpful" can promote product sales while reviews with the votes of "helpless" may reduce product sales. Therefore, we propose our fourth hypothesis and several derived hypotheses: **H4:** *The votes of "helpful" for reviews are significantly and positively correlated with product sales.*

**H4a:** *A review receiving a large number of "helpful" votes has positive effect on product sales, while a review receiving a large number of "helpless" votes has little significant effect on product sales.*

**H4b:** *A review with a lot of "helpful" votes can well promote product sales.*

**H4c:** *A review with a lot of "helpless" votes can reduce product sales in some degree.*

Review length, as a part of review's readability and quantitative indication, can be treated as another dimension to evaluate the quality of a review. Generally speaking, the longer is a review, the more possibility for consumers to get helpful information. That is to say, long reviews can be more information persuasive, and then greatly influence purchase decision making of potential consumers. Based on this point, we propose our fifth hypothesis:

**H5:** *Review length is positively correlated with product sales.*

As we known, information search cost of consumers is a key factor influencing online product sales. The spotlight review mechanism of Dangdang is similar to that of Amazon. The spotlight reviews are selected by the editors of Dangdang. When they think that a review has unique perspectives, insightful content, personalized text and more importantly has a lot of "helpful" votes, they would mark it as a spotlight review during a particular period. The high availability of spotlight reviews means low information search cost, so they would have much effect on potential decision-making of consumers. A lot of research towards e-market demonstrates that majority

<sup>2</sup>But in this research, we only use panel data to test the main hypothesis. By considering the lagged effect of the past reviews on the present product sales, we can use dynamic panel data model to test derived hypotheses.

of consumers think that the information processing cost online is relatively high and ordered information has a disproportionately strong influence on consumer decision-making [18]. All these show that consumers are more willing to browse reviews which are more visible in the list, more location significant and more time-saving. Therefore, we propose our sixth hypothesis: **H6: Spotlight reviews have more positive impact on product sales than other reviews do.**

Beside online reviews, consumers can use other channels, such as television, newspaper, popular catalog and consumers clubs, to get acquainted with already popular books. So, it is possible for consumers to get some prior knowledge of popular products before surfing online, while for unpopular products, consumers rely more heavily on online reviews to get to know these products. In this sense, we propose our seventh hypothesis:

**H7: Online reviews have greater effect on sales of unpopular products than that on popular products.**

**H7a: A review with many "helpful" votes has greater effect on sales of unpopular products than that on popular products.**

Meanwhile, for the same product, people can get its prior knowledge from historical online reviews. It means that reviews posted much latter has less marginal effect on sales than reviews posted much earlier. In other words, reviews have greater effect at the primary stage of product sell life cycle than at the latter stage. Therefore, we propose our eighth hypothesis to test timeliness of reviews.

**H8: Online reviews have greater marginal effect on product sales at the earlier stage of a product's sell life cycle than the latter stages.**

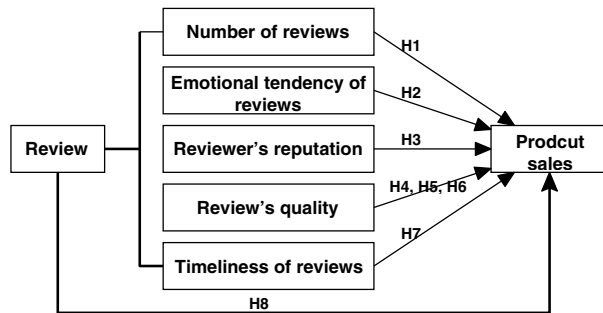


Fig. 1. Research Framework of the Effect of Online Reviews

Based on the above mentioned research hypotheses, we build our research framework as shown in Figure 1. The seventh hypothesis and the eighth hypothesis would not be tested in our research, and the object of being discussed here is for the integrity of our research framework and guiding future research on this topic.

## V. EMPIRICAL ANALYSIS AND RESULTS

In this section, we systematically analyze real data of online reviews and product sales, and present our study results.

### A. Research Object

The data of our research is collected from Dangdang Books and we choose Dangdang based on the following three reasons.

First, Dangdang is the largest online Chinese bookstore in the world. Dangdang, as a typical and successful Chinese B2C website, is usually compared with Amazon both in academic and in business circles [19]. Our research tries to compare our study results towards Dangdang with former studies based on Amazon from the perspective of online book reviews to explore our results more comprehensively in the Chinese context. We then use these results to guide online review system building of Chinese e-commerce websites. Second, Dangdang has a comprehensive book review system. In Dangdang, consumers may not only read the reviews posted by others, but also comment on these existing reviews and vote for their quality. Furthermore, reviewers are also ranked. All these aspects are necessary for our research. Third, we can get the exact book sales data in Dangdang. Through our prior study of Dangdang, we find that it will conserve its daily sales data over a half year period and all these sales data can be collected by our own designed crawler. This is a special part of our research compared with former studies on Amazon. Because Amazon can only conserve its book sales ranking data, researchers [5], [8], [10], [20] basically treat sales ranking as an alternative variable of sales when exploring correlation between product sales and online reviews, which is following the research of Schnapp and Allwinel [21]. They published their results in UCB/SIMS 2001 that relation between book sales and sales ranking in Amazon approximately conformed to Pareto distribution, meaning that the logarithm of book sales was linear correlation with logarithm of sales ranking. However, since Pareto distribution is just approximate and that research was based on the data collected before 2001, book sales and sales ranking could not be treated as the same thing and using this relationship might influence the accuracy of research results.

### B. Data Collection

We collect our data from Dangdang covering all the new books posted from October 19, 2009 to April 16, 2010 within 180 days. In all, the dataset has 12,609 books, which includes basic information, daily sales and reviews related data of books. There are two reasons for studying new books. On one hand, consumers have not formed complete views towards new books yet, which means that online reviews can have a much greater effect on influencing book purchase. On the other hand, the reviews of new books are significantly increasing and it is one of the sources of data changing of our research.

With regard to each book, we use our own crawler to retrieve their basic information, including book category, identification, fixed price, sales price, publication data, publisher information and its daily sales since posted online. Besides, we also collect concrete review data of each book, including posted date, the number of stars of the review, reviewers' ID, reviewer's rank, review length and whether it is a spotlight review.

In the end, we sort, clear, integrate and standardize our data and pre-process it assisted by Stata, to make sure that it is in the form needed by our research.

### C. Research Model

For each book  $i$  sold on Dangdang, we take its book sales as the dependent variable and set it as the logarithm form, for the reason that the book sales conform to scale effect, and logarithm of book sales can well reflect the effect of independent variables on dependent variables. Scale effect is equivalent to that the majority of consumers might view popular books on sales while just a few consumers might view unpopular books. Therefore, the number of consumers conducting actual purchase actions can be treated as the function related to online reviews. By following the research of Chevalier and Mayzlin [5] and Chen et al. [8] and considering the real situation of Dangdang, we establish our econometric model shown as follows:

$$\ln S_i^t = v_i + \alpha \ln P_i^t + \beta_1 \ln R_{ni}^t + \beta_2 R_{si}^t + \beta_3 R_{ri}^t + \beta_4 R_{li}^t + \varepsilon_i^t$$

In the model,  $S_i^t$  is the sales of book  $i$  on time  $t$ ;  $P_i^t$  is the price of book  $i$  on time  $t$ ;  $v_i$  is the individual effect of book  $i$ .  $v_i$  does not change with time and is generally related to factors which cannot be directly observed or easily quantified;  $R$  is a vector related to online reviews, while  $R_{ni}^t$ ,  $R_{si}^t$ ,  $R_{ri}^t$ ,  $R_{li}^t$  respectively represent number of reviews, average review stars, average reviewer's rank and average length of reviews towards book  $i$ , and  $\beta_1, \beta_2, \beta_3, \beta_4$  are just the mapping to their correlation coefficient;  $\varepsilon_i^t$  is the residual;  $t$  is the posting time of book  $i$ , while in our research it is quantified based on our time observation points. In the data processing stage, all the variables have been standardized to ensure them in the same order of magnitude. It should be noted that although there are four shipping methods available on Dangdang, consumers may not be significantly different on shipping methods, which is caused by shopping habits of Chinese people. So, in this model we would not consider the effect of shipping time on book sales. We may adjust our model in our future research if needed according to actual situations.

Our panel data econometric model includes a large number of cross-sectional units compared to just twelve time observation points. The panel data model is chosen based on the following three reasons. For one thing, the dummy variables can be set to control individual differences. For the other thing, by combining the different values at different observation points of different cross-sectional units, we can increase the degree of freedom (DOF) and reduce the effect of collinearity among explanatory variables to improve the effectiveness of estimating results. Moreover, by repeatedly observing the same unit, we can better research dynamic changes of economic behaviors. Then, we are going to conduct Pooled Ordinary Least Squared (POLS), Hausman test and Heteroscedasticity test consequently to verify the effectiveness of our research dataset and model.

Firstly, the POLS approach is used to verify the quality of our panel dataset. By firstly assuming panel data as normal cross-sectional data and then doing regression analysis, assisted by Stata 10.0, we find that the R-square value is 0.9023. It means that the dependent variable can be over 90 percent explained by independent variables, which indicates the high quality of our panel dataset and our good model that well

coordinates the overall relationship of the dependent variable with independent variables.

Secondly, Hausman test is applied to determine which form of panel model is more appropriate for our research: fixed effect model or random effect model. The Hausman test value is 8212.69, and by referring to critical chi-square distribution table, we find that the Null hypothesis is not supported, so the fixed effect model is much more suitable for our research. The result can be explained as that, generally speaking, a particular kind of book is produced in high volume before actually entering the market and its sales are mainly determined by its downstream retailers, but its marginal price set by retailers is little related to its sales. Therefore, we can assume that its supply is fixed and not influenced by other external factors such as price set by retailers. Moreover, inherent difference exists in each book and is not time-dependent because of the difference among readers and topics.

Conducting Heteroscedasticity test is the last model testing step and we find that our model has the cross-sectional heteroscedasticity. Related to our research object, heteroscedasticity can be explained from two aspects. On one hand, books vary about their category and are subjective products, which leads to great disparity of their topics and readers. Therefore, differences among observation values of dependent variables are deemed to increase deeply. On the other hand, heteroscedasticity is known to mostly exist in cross-sectional units. As we mentioned before, our dataset includes 12,609 samples and just 12 time observation points, which significantly increases heteroscedasticity of the model. In our research, the Heteroscedasticity Robust and BOOTSTRAP approaches will be used to adjust standard error, heteroscedasticity and serial correlation.

TABLE I  
REGRESSION RESULTS OF FIXED EFFECT MODEL

Fixed-effects (within) regression		Number of observations = 151308			
Group variable: bookid		Number of groups = 12609			
R-sq: within = 0.8802		Observations per group: min = 12			
between = 0.9484		avg = 12.0			
overall = 0.8981		max = 12			
		F(5,138694) = 203722.90			
corr( $u_i, X_b$ ) = 0.3625		Prob > F = 0.0000			
$S_i^t$	Coefficient	Standard Error	$t$	P>   $t$	[95% Conf. Interval]
$P_i^t$	<b>0.9857472</b>	0.0010385	949.19	0.000	.9837117 .9877827
$R_{ni}^t$	<b>0.4273748</b>	0.0045244	94.46	0.000	.418507 .4362426
$R_{si}^t$	<b>-0.1302111</b>	0.0061536	-21.16	0.000	-.142272 -.1181502
$R_{ri}^t$	<b>0.0396388</b>	0.0014393	27.54	0.000	.0368178 .0424598
$R_{li}^t$	<b>-0.0312003</b>	0.0007497	-41.624	0.000	-.0326697 -.0297308
$v_i$	0.0494393	0.0016667	29.66	0.000	.0461726 .052706
sigma_u	0.33396631				
sigma_e	0.4968875				
rho	0.31117174 (fraction of variance due to $u_i$ )				
F test that all $u_i=0$ :		F(12608,138694) = 4.05		Prob > F = 0.0000	

### D. Data Analysis and Results Explanation

According to our proposed fixed effect model, we conduct the regression analysis of our sample data by using Stata 10.0 and the result is shown in Table I. By viewing the corresponding  $P$  value, we find that all control independent variables are respectively significantly correlated with dependent variable. One point that should be emphasized is that

the positive effect of the price on book sales, namely, among all the factors that affecting book sales, price is in a very prominent position, which can also be seen from Table II. This is inconsistent with Amazon’s result, which is told that the coefficient between book sales and price is from -0.5249 to -0.8132 [5]. The differentiated results might be caused by that only new books are sold in Dangdang and lowest price strategy is used to cumulate loyal consumers, while in Amazon both new version and old version books are sold, which may increase the individual differences among books.

Meanwhile, reviews’ stars and number of reviews are positively correlated with book sales, while length of reviews and reviewer rank are negatively correlated with book sales. We try to discuss our results based on the above mentioned hypotheses in the following paragraphs.

TABLE II  
REGRESSION RESULTS OF EXTENDED MODEL

Random-effects GLS regression		Number of observations = 49319			
Group variable: bookid		Number of groups = 5309			
R-sq: within = 0.0287		Observations per group: min = 1			
between =0.1982		avg = 9.3			
overall =0.2131		max = 177			
Random effects u-1 Gaussian		wald chi2 (7) = 2047.58			
corr( $u_i$ , Xb) = 0 (assumed)		Prob > chi2 = 0.0000			
$S_i^t$	Coefficient	Standard Error	z	P>  z	[95% Conf. Interval]
$P_i^t$	<b>-0.0877339</b>	0.0179895	-4.88	0.000	-.1229927 -.0524751
$R_{ni}^t$	<b>0.3957532</b>	0.0091027	43.48	0.000	.3779123 .4135941
$R_{ui}^t$	<b>0.0000673</b>	0.0021012	0.03	0.974	-.004051 .0041855
$R_{wi}^t$	<b>0.0092465</b>	0.0023506	3.93	0.000	.3779123 .4135941
$R_{si}^t$	<b>0.0281511</b>	0.0024203	11.63	0.000	.0234073 .03289935
$R_{li}^t$	<b>-0.0067945</b>	0.0047524	-1.43	0.153	-.0161089 .00252
$R_{ri}^t$	<b>-0.0103086</b>	0.0098482	-1.05	0.295	-.0296107 .0089935
$v_i$	1.874451	0.0593817	31.57	0.000	1.758065 1.990837
sigma_u	0.46467211				
sigma_e	0.64914187				
rho	0.33880176 (fraction of variance due to $u_i$ )				

1) *Number of Reviews vs. Book Sales:* According to our research, the first hypothesis is supported (see  $R_{ni}^t$  in Tables I and II), namely, the number of reviews has a significantly positive effect on book sales. Books are subjective products and as the number of reviews increases, it will be much more possible for consumers to get helpful information on the products they want to know, and then promote more sales. This can be explained by Matthew Effect and Population Effect in Behavior Science that relatively more attention will lead to more and more attention, and then initiates Eyeball Effect.

2) *Emotional Tendency of Reviews vs. Book Sales:* As shown in Table I, review stars  $R_{si}^t$  are positively correlated with product sales and its correlation coefficient is 0.04. Our second hypothesis is verified that the emotional tendency of online reviews has significant effect on product sales. Generally speaking, the higher the overall rank of product reviews is, the more product sales would be. The reviews differing from one-star to five-star in Dangdang all reflect emotional tendency of readers towards particular books and describe the content and plot of books. Moreover, they may comment the books from several concrete aspects of books such as styles and novelty. The potential consumers can decide whether books have met their expectation and whether to buy by viewing reviews posted by others. Oppositely, the second hypothesis

is not supported in majority of former research, and this can illustrate that emotional tendency of reviews, either positive or negative, is highly valued by Chinese consumers especially for subjective products and can greatly affect purchase decision making process of potential consumers.

3) *Reputation of Reviewers vs. Book Sales:* By considering both registration time and active degree of online participation of reviewers, Dangdang divides its reviewers into five classes, which are from primary reviewers to expert reviewers. Our empirical study shows that reviewer rank is negatively correlated with book sales (see  $R_{ri}^t$  in Table I and II). Thus, the third hypothesis is not supported, which can be partly explained by the following reasons. In real world, people are more willing to trust the authorities in a particular domain. For example, people would highly trust gourmet about good restaurants and food. However, a reviewer with relatively high rank does not mean that he is an expert in the online community of Dangdang. The longer online time and the much more active participation make higher rank for a reviewer, but it does not assure the quality of the reviews the reviewer posted online. More importantly, this kind of motivation may only reduce the degree of persuasive effect of his reviews on purchase decision making of potential consumers.

4) *Quality of Reviews vs. Book Sales:* To have more comprehensive exploration between quality of reviews and book sales, we add two independent variables, the number of “helpful” votes for reviews ( $R_{ui}^t$ ) and spotlight reviews ( $R_{wi}^t$ ) to our econometric model and the new regression analysis results are shown in Table II.

Length of review: According to  $R_{li}^t$  in Tables I and II, we find that our fifth hypothesis is not supported that length of reviews is negatively correlated with book sales, although the absolute value of correlation coefficients is low. The results can be explained by the following three reasons. First, conceptually, potential consumers can get much more useful information from longer reviews, but in fact, long reviews sort of scale up emotional tendency of potential consumers from either aspect of positive or negative, and this will lead to a relatively moderate result on the effect of long reviews on product sales. Second, the longer a review is, the more time potential consumers will take to view it and get useful information. This is inconsistent with the objective of low information search cost. Third, a long review might have more redundant information than others. Therefore, the value of it should be underestimated if website designers or managers have not regularized reviews.

Spotlight reviews: Spotlight review mechanism in Dangdang is similar to that in Amazon, and they are selected by content editors of Dangdang. As shown in Table II, our sixth hypothesis is supported that spotlight reviews is positively correlated with book sales. This agrees with our expectation, mainly for the reason that spotlight reviews are more visible to potential consumers, which would take them less information search cost and then play much greater impact on purchase decision-making. Potential consumers are more willing to view reviews which are more visible, location significant and time-saving.

“Helpful” votes of reviews: “Helpful” votes of reviews are not significantly correlated with book sales, which can be

concluded from Table II, so our fourth hypothesis is not supported. It means that the review voting mechanism does not play its true value in Dangdang's online review system. Although this mechanism is also similar to that in Amazon, it is not actually active and useful due to the lack of effective guidance. Through browsing the online review community of Dangdang and viewing our sample data, we find that few people have voted for the quality of reviews, and commenting on existing reviews is even much rarer.

## VI. DISCUSSION

Based on our empirical study and literature review, we propose several suggestions grouped into four parts towards future development of online review systems for e-commerce in the Chinese context.

### A. Evaluating Rank of Reviewers

The empirical study of Chen et al. on Amazon [8] shows that reviewer rank is not significantly correlated with product sales, while our study demonstrates that reviewer rank is negatively correlated with product sales in Dangdang. These two results all demonstrate that reviewer rank does not reflect their expertise, because the rank of reviewers is mainly based on their online time and number of reviews they ever posted. The content of their reviews is rarely considered.<sup>3</sup> For Chinese online review systems, the content of reviews should be considered more seriously and take more weights in determining reviewer rank. And, it can be valued from several dimensions, such as whether reviews are professional and helpful. Through this approach, rank of reviewers can play greater persuasive effect on decision making of potential consumers. Meanwhile, in the view of a website, as the decreasing of controversy about reviewer rank evaluation mechanism, goals of the website building would be more easily achieved and this is also consistent with the objective of e-commerce.

### B. Guiding Emotional Tendency of Reviews

Ye et al [7] point out that emotional tendency of online reviews will have a significant effect on movie box office. Similarly, the reviews toward books, also a kind of subjective products, reflect subjective feelings of readers, which can influence purchase decision making of other potential consumers in the form of seeking sympathy and recognition from others of the same interest. The review readers will decide whether this book conforms to their expectation and then make their final decisions. As mentioned before, this kind of behavior is particularly prevalent in Chinese online bookstores. Therefore, an effective review mechanism is very necessary for inducing readers to express their real feelings of particular books, which can encourage more potential consumers to respond and pay attention, and to expand consumer group from the dimensions of both depth and breadth. Most importantly, negative reviews should be highly estimated and be processed legally, and they also should not be distorted in a reasonable range.

<sup>3</sup>It is worth mentioning that recently Amazon has in certain degree improved its mechanism of this problem, from which Dangdang should learn.

### C. Quality of Reviews

First, standardize format of reviews. Reviews with standardized format are more convenient for readers to get their needed information in a low cost. Therefore, in the premise of free speech environment, the reviews should be maximally standardized, and this can be achieved by pre-research, which needs scholars to conduct related research on review readability to make sure that reviews will be standardized both scientifically and effectively.

Second, strengthen and promote review voting mechanism. From the study of Chen et al. [2], we know that in Amazon, reviews with a larger number of "helpful" votes can have more significant effect on purchase decision making of potential consumers, while the same mechanism does not work in Dangdang. Therefore, Chinese online bookstores should take more efforts to study behavioral habits, psychological aspect and participating motivation of Chinese people for the purpose of effectively encouraging readers to vote for reviews, together with particular incentive mechanism to increase voting participation and feedback provision, and then the review voting mechanism can actually promote product sales.

Third, further perfect the spotlight reviews. Our research shows that spotlight reviews have positive effect on product sales, and much more than other reviews. With regard to Chinese online bookstores, based on the present spotlight review mechanism in Dangdang, spotlight review mechanism should be deepened both from connotation and extension. Besides editor recommending, review voting mechanism and reviewer rank mechanism both can be considered to produce spotlight reviews and then improve the quality of spotlight reviews. Thus, not only the cost of information search can be decreased, but also the preference of e-commerce site will be enhanced, which then maximally promotes product sales. This is applicable both in the Chinese context and English context.

### D. Activeness of Reviewers

Our study proves that number of reviews is positively correlated with product sales, which is consistent with former empirical studies toward Amazon and other e-markets. Therefore, for e-commerce websites, we should emphasize on encouraging consumers to participate in online communities and post their experience online, together with considering reviewer rank and quality of reviews, and then we can differentiate our mechanism with other e-commerce websites. Only through this way can we take a firm place in this e-commerce market featured with low entry threshold and being easily imitated.

In conclusion, the purpose of improving online review system is to enhance the invisible information effect of online reviews. Hence from both macro and micro perspective and by considering shopping habits and user behavior together, how to effectively maximize the effect of online review systems should be well explored. Moreover, standardizing virtual communities and improving the credibility of online review system should be constantly and well thought by all the Chinese online stores.

## VII. CONCLUSION

Online review systems and virtual communities are playing a growing important role in the process of seeking product information needed by consumers. In our research, we establish a panel data econometric model and apply it to test the dataset collected from Dangdang Books, the largest Chinese bookstores in the world, and explore the effect of Dangdang's online review system on product sales. More specifically, we first propose several hypotheses related to online reviews and build our research framework on correlations between product sales and online reviews, including number of reviews, reputation of reviewers, emotional tendency of reviews, quality of reviews and timeliness of reviews, within which the former four aspects are tested towards Dangdang. We find that number of reviews, emotional tendency of reviews and spotlight reviews are all positively correlated with product sales, while reviewer rank and length of reviews have negative effect on product sales. Besides, the review voting mechanism of Dangdang is not significantly correlated with product sales.

Based on our empirical studies and comparison with former research results towards Amazon, we then propose several guiding suggestions for online review systems in the Chinese context, such as that they should rank reviewers more scientifically and effectively, make consumers to express their emotional tendency and pay attention to negative reviews, and standardize the format of reviews. In addition, e-commerce websites designers should not only enhance the effectiveness of review voting mechanisms, but also further improve the quality of spotlight reviews to reduce information search cost of online potential consumers by ensuring that they can get their needed information quickly. Furthermore, more real experience of consumers should be encouraged to be shared online, and be well combined with reviewer rank evaluation, review voting mechanisms and spotlight reviewers selection.

The innovation of this study comes as follows: (1) by using and modeling large, good and real panel data, our research explores the dynamic impact of online reviews on product sales; (2) by firstly employing the data of book sales in this kind of research, we promise more precise results; (3) we design a more comprehensive framework towards the relationship between online reviews and product sales, and then explore the empirical study on panel data collected from Dangdang and apply empirical results to guide websites designing of Chinese online review systems.

However, our research does not consider the lagged effect of reviews on sales and the endogenous effect of variables. These limitations should be improved in the future research. Besides, future research on this topic can be conducted towards more objects from both vertical and horizontal aspects. To be specific, we can not only study other subjective products, but also discuss how other forms of online word-of-mouth, such as blogs, online forums or other social networks, influence decision making of potential consumers, and conduct a comparative study. In addition, the same product both in different selling conditions and different e-markets could be studied separately. It is told that an online review mechanism has a much more significant effect on sales of products in a tail

position of the whole market. Thus, comparative studies could be conducted between effect of online reviews on popular products and unpopular products.

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