

Moderating Roles of Review Credibility and Author Popularity on Book Sales

Completed Research Paper

Keehyung Kim

Wisconsin School of Business
University of Wisconsin-Madison
975 University Ave, Madison, WI 53706
kkim@bus.wisc.edu

Xiao Ma

Wisconsin School of Business
University of Wisconsin-Madison
975 University Ave, Madison, WI 53706
xma@bus.wisc.edu

Sung S. Kim

Wisconsin School of Business
University of Wisconsin-Madison
975 University Ave, Madison, WI 53706
skim@bus.wisc.edu

ABSTRACT

User reviews have become a popular source to assess the quality of products in consumers' purchasing decision. New insights into the effect of user reviews on product sales can be derived from examining *review credibility* and *author popularity* in our example of book sales from Amazon.com. We found that (1) average rating of reviews and diversity of ratings positively affect book sales, but (2) high diversity weakens the effect to sales, showing a quadratic effect of diversity on sales. In addition, our results suggest evidence that (3) review credibility and author popularity moderate the positive association of average rating of reviews and diversity of ratings on sales. Finally, (4) consumers seem to pay more attention to reviews for digital books than for paper books.

Keywords

Online reviews, review credibility, author popularity, digital book, e-commerce.

INTRODUCTION

For consumers, online product reviews (or user reviews) are the main source of information, providing indirect experience for unfamiliar products. Because user reviews often contain product information (e.g. product faults and low quality of products) unfavorable to sellers, it can be considered more objective and less biased, compared to product descriptions provided by sellers. The importance and dynamics of online reviews attracted attention from both academics and managers. Previous research shows that a mere presence of reviews in an online shopping mall leads to sales increase (Kumar and Benbasat, 2006).

Review ratings play an important role on consumers' purchase decision. Review sites, such as Amazon.com and Yelp.com, let reviewers rate products' score. Research (Chevalier and Mayzlin, 2006; Luca, 2011) shows a positive link between average rating and product sales. Firms also recognize that good reviews are one of the most important resources in marketing activity. For example, hotels and restaurants often use their user reviews in advertisements. Sometimes, firms even try to filter negative reviews. In 2012, one reviewer is accused of \$750,000 defamation because of her negative review.¹

However, are all reviews trustable to the same extent? Enthusiastic fans and invited reviewers often provide positively biased feedbacks. Sellers often post false reviews to manipulate their products' average ratings (Dellarocas, 2006; Mayzlin, 2006). Furthermore, they even bribe customers to leave favorable comments about themselves and unfavorable comments about competitors.² To alleviate this problem, online review sites developed several mechanisms. Amazon.com shows *verified purchase* badge next to each review if a reviewer purchased a product from its website. Similarly, Yelp.com, the restaurant review sites, shows so-called *check-in* badge if a review is written at the restaurant via smartphone.

¹TechCrunch article. <http://techcrunch.com/2012/12/07/yelp-reviewer-gets-slapped-with-750k-lawsuit-and-takedown-order/>

²NYTimes article. <http://www.nytimes.com/2012/10/18/technology/yelp-tries-to-halt-deceptive-reviews.html>

In addition to credibility of reviews, a number of aspects, such as brand image and diversity (or inconsistency) of reviews, affect consumers' purchase decision. Brand image is a resource that a firm has built on customers' satisfaction (Keller, 1993). Consumers see brand image as a signal of product quality. Diversity of reviews refers to variation in consumers' experiences with a certain product, thus questioning the product's quality. However, consumers may consider this inconsistent phenomenon favorable if a product is highly differentiated (Clemson, Gao and Hitt, 2006). Since customers are heterogeneous, highly differentiated products enjoy high sales from specific consumers while they also suffer from low ratings by others. Extending the direct effects of average rating and diversity, we examine the moderating roles of review credibility and author popularity (e.g. brand image in book market) on book sales. Furthermore, the difference between paper and digital books is investigated.

CONCEPTUAL BACKGROUND

In information systems (IS), marketing, and economics literature, *information asymmetry* refers to the phenomenon when one party has more or better information than the other party in regard to business transactions. The information-rich party can decide to share part of information to the information-poor party. The information-poor party may infer the quality of uncertain products from the provided information. However, under information asymmetry, *adverse selection* may occur when the information-rich party provides false information or exaggerates its level of skills. In marketing, sellers may claim high quality of products, although they do not possess, when consumers are uncertain.

To resolve this problem (e.g. adverse selection), signaling approach is used. The information-rich party with required skills sends a signal of its level of skills to the information-poor party to prevent that a low-skilled party is selected. In marketing, sellers often send a *signal of quality* (or quality signal) about their products, signal including brand image, price, warranty, and advertising (Dawar and Parker, 1994; Kirmani and Rao, 2000). For example, firms producing high-quality products have incentives to build brand equity (one of signals of quality) to claim their high-quality. Once consumers recognize the high quality of a certain brand, the firm can gain future sales (by repeated purchases) that cover previous investment for brand equity. But, firms producing low-quality products do not have this incentive because repeated purchases will not occur after the low quality is revealed (Kirmani and Rao, 2000). Thus, a signal of quality (e.g. brand image) is a useful mechanism from the perspective of both consumers and (high-quality) sellers.

Derived from theories discussed above, we extend the framework of *signals of quality* and develops an idea of testing *quality of signals*. When the information-rich party sends a signal to the information-poor party, the quality of the signal (whether strong or weak) varies under different circumstances. In our context of online shopping, potential consumers lack information about product quality and, thus, they use information (or signals) provided by reviewers and sellers to infer the quality of products. The average rating is regarded as a signal of quality of the product, leading to positive association with product sales. Along with average rating, we believe the diversity of reviews will be another signal of quality, strongly associated with sales. We propose review credibility and author popularity as moderating roles (e.g. quality of signals) that improves signals. Zhu and Zhang (2010) argue that consumers' purchase decisions are adjusted by consumers' reliance on reviews. Thus, credibility of reviews might affect strength of signals. Dawar and Parker (1994) showed that consumers use brand image as a signal of product quality, leading to product sales if author popularity is considered brand image. In summary, the focus of this study is testing the direct effect of "signals of quality" as well as testing the idea of "quality of signals" by using the moderation of review credibility and author popularity.

Literature Review

A number of studies investigated the effect of user reviews on product sales as well as helpfulness. Chevalier and Mayzlin (2006) and Luca (2011) showed a positive relationship between average review rating and sales. Chen and Xie (2005) suggested firms with negative average rating to use advertising instead of price discount to recover product sales. Luca (2011) found that one rating increase (out of five) for a restaurant leads to 5-10% increase in revenue. However, Clemson et al. (2006) found that variation of ratings reflects product sales. Polarity (extreme value) of ratings is investigated as well. Chevalier and Mayzlin (2006) showed that fraction of one-star ratings affects product sales significantly. Zhu and Zhang (2010) found that product type moderates the effect of average rating on product sales. When the product type is online, average rating has stronger effect. Ghose and Iperirotis (2011) found the positive effect of average helpful votes on sales.

Beyond linking reviews with sales, other studies (Cao, Duan and Gan 2011; Danescu-Niculescu-Mizil, Kossinets, Kleinberg and Lee, 2009; Mudambi and Schuff 2010; Tan, Swee, Lim, Detenber and Alsagoff, 2008; Willemsen, Neijens, Bronner and Ridder, 2011) discovered what makes reviews helpful. Cao et al. (2011) and Danescu-Niculescu-Mizil et al. (2009) reported that extreme ratings and contents are perceived helpful. However, Mudambi and Schuff (2010) found that extreme ratings are less helpful.

Although many studies have studied the effect of ratings on product sales, several studies (Chaevalier and Mayzlin, 2006; Mudambi and Schuff, 2010) mentioned that consumers also rely on review contents rather than average ratings while Poston and Speier (2005) found that review rating offers a cue for the review content. Some (Cao et al., 2010; Ghose and Iperirotis, 2011; Willemsen et al., 2011) even considered review content characteristics. Qiu, Pang, and Lim (2012) found that conflict of ratings decreases perceived reliability of reviews.

THEORY AND HYPOTHESES

Signals of Quality: Average Rating and Diversity of Ratings

Empirical studies have found evidence of positive association between average rating of reviews and product sales. There are conflict findings in the strength of the relationship, but, generally, average rating is considered a signal of product sales. We propose the following hypothesis:

H1: The higher average rating of reviews for a given product, the higher is the product sales.

Diversity (or inconsistency) of reviews refers to the degree of variation in ratings. Clemons, Gao, and Hitt (2006) explains why ratings dispersion (measured by variance of ratings) predicts as well as influences product sales. A highly differentiated product targeted to specific consumers' taste should have a moderately positive average rating with highly dispersed reviews. Such products experience the greatest sales growth in empirical analysis of beer market. This suggests that diversity is a cue for the product sales. However, another finding (Qiu et al., 2012), that conflict of ratings decreases perceived reliability of reviews, gives a concern that a high level of diversity may weaken the positive effect on product sales. Thus, we propose the following hypothesis:

H2: The higher diversity of ratings for a given product, the higher is the product sales. The quadratic form of diversity weakens this positive association.

Quality of Signals: Review Credibility and Author Popularity

Previous research (Forman et al. 2008; Ghose and Iperirotis 2011; Zhu and Zhang 2010) shows that consumers rely on a number of credibility measures (e.g. reviewer identity disclosure, subjectivity of review content) in purchasing decision, high credibility resulting in positive increase or moderation effect in product sales. Thus, review credibility may strengthen signals to product sales by enhancing consumers' reliance on user reviews. We propose the following hypothesis:

H3: The higher review credibility, the stronger (1) the positive association between average rating and product sales, and (2) the positive association between diversity of reviews and product sales.

Brand image is a powerful component that affects product sales. On book market, author's popularity is regarded as brand image of a product. Based on brand image literature (Dawar and Parker, 1994), consumers often expect famous and popular authors to have high quality in all the books, other than best-sellers. As a result, books written by popular authors may enjoy much higher sales if positive signal (e.g. average rating) is presented. This means author popularity enhances quality of signals to product sales. In this research, author popularity is divided into two parts based on source of measurement: author popularity, measured by sellers, and author favorability, measured by users. We propose the following two hypotheses:

H4: The higher author popularity of a given product, the stronger (1) the positive association between average rating and product sales, and (2) the positive association between diversity of reviews and product sales.

H5: The higher author favorability of a given product, the stronger (1) the positive association between average rating and product sales, and (2) the positive association between diversity of reviews and product sales.

Product Type: Paper and Digital Books

Product type is an important factor differentiating customer groups. In Amazon.com, books are categorized into two main types: paperback (paper book) and kindle editions (digital books). We hypothesize that consumers buying digital books rely more on user reviews than consumers buying paper books. There are two possible reasons. At first, the former group (consumers buying digital books) is more technology-oriented, leading to higher chance of acquiring information from the internet (e.g. review sites). At second, many digital books are self-published by unfamiliar authors (or without publishers) while paper books enjoy a certain level of quality guarantee from popular authors and verified publishers. This motivates consumers to seek information of digital books from user reviews. Thus we propose the following hypothesis:

H6: User reviews in digital books have more significant and stronger effect on product sales than those in paper books.

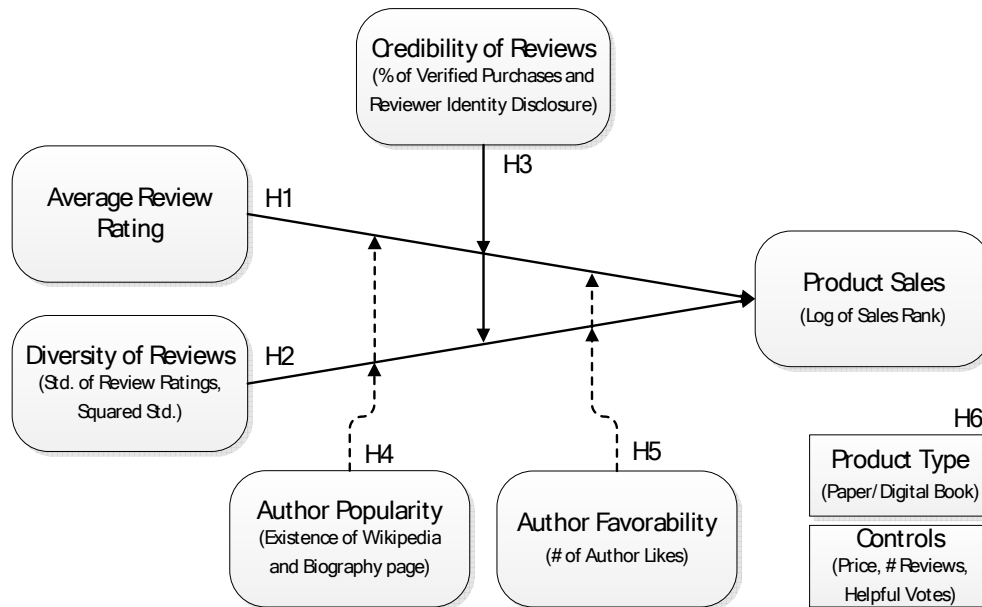


Figure 1. Conceptual Diagram

Figure 1 shows the conceptual diagram of the proposed hypotheses. Average rating and diversity of reviews are signals to product sales while credibility of reviews, author popularity, and author favorability moderate the quality of those signals.

EMPIRICAL STUDY

Data, Variables, and Measures

Category	Variable Name		Measure
Average Rating	Avg. Rating		Average of review ratings
Diversity of Reviews	Std. Rating		Standard deviation of review ratings
Review Credibility	Credibility	Verified	Proportion of verified purchases among reviews
		Realname	Proportion of reviewer identity disclosure among reviews
Author Popularity	Popularity	Wiki	Existence of Wikipedia page
		Bio	Existence of biography page on Amazon.com
Author Favorability	Favorability		Number of likes
Product Sales	Rank		Book sales rank ³
Control Variables	Price		Price of book
	Reviews		Number of reviews
	Helpful		Average helpful votes of reviews

Table 1. Variables and Measures

Data is collected from Amazon.com, the largest online bookstore in US. On December 10, 2012, Amazon.com has about 25 million paperback books and about 0.9 million kindle digital books. Among all books, around 2 million books have at least one user review. Almost 80% of average customer reviews have more than 4 stars out of 5 stars, showing that reviews are highly positive-biased. Our sample consists of 874 books, including 433 paper and 441 digital editions. These books in the

³ Schnapp and Allwine (2001) showed that a close linear relationship exists between log of sales rank and log of sales volume. In this paper, sales rank is used as an approximate measure of sales volume.

sample are randomly selected from all books published between August 25 and November 23, 2012.⁴ Product information and user reviews are collected weekly for two months. Table 1 shows the list of variables and measures.

The value of each variable is measured as shown in Table 1. Review credibility (Credibility) is calculated by sum of two proportional variables. Proportion of verified purchases (Verified) and reviewer identity disclosure (Realname) are considered due to objectivity of these measures. Average helpful votes (Helpful) is not included in credibility due to subjectivity (the level of helpfulness depends on readers). Author popularity (seller-side) is measured by sum of two indicator variables. Existence of Wikipedia page (Wiki) and of biography page (Bio) are seller-side popularity measures because Wikipedia and Amazon.com have motivation to create a web-page for authors advertised or sponsored by publishers. Author favorability (user-side) is measured by the number of likes, the number of fans who added an author into their favorite lists. Since Amazon.com does not provide sales level, sales rank (Rank) is collected instead. Sales rank is an approximate measure for the product sales because the rank is adjusted based on cumulative sales and the recent change of sales in Amazon.com.

	count	mean	sd	min	Max
Rank	3271	382846.61	699788.46	10.00	6155049.00
Avg.Rating	3367	4.39	0.76	1.00	5.00
Std.Rating	3367	0.51	0.51	0.00	2.00
Verified	3367	12.64	35.15	0.00	519.00
Realname	3367	5.53	16.37	0.00	237.00
Wiki	3367	0.09	0.29	0.00	1.00
Bio	3367	0.00	0.05	0.00	1.00
Favorability	3367	6.58	19.85	0.00	213.00
Price	3323	11.46	13.14	0.00	175.00
Reviews	3367	22.73	67.39	1.00	905.00
Helpful	3367	1.83	2.60	0.00	22.21

Table 2. Descriptive Statistics of Measures

	(1) Paper book		(2) Digital book	
	mean	sd	mean	sd
Rank	626513.00	964935.44	190975.97	242571.36
Avg.Rating	4.41	0.75	4.37	0.76
Std.Rating	0.48	0.50	0.53	0.52
Verified	7.64	15.93	16.54	44.36
Realname	6.57	21.29	4.72	11.02
Wiki	0.12	0.33	0.07	0.26
Bio	0.00	0.00	0.00	0.06
Favorability	2.74	9.70	9.59	24.66
Price	16.02	14.95	7.92	10.23
Reviews	21.19	74.10	23.94	61.64
Helpful	1.90	2.47	1.77	2.71
<i>N</i>	1477		1890	

Table 3. Descriptive Statistics for Paper and Digital Books

Table 2 shows descriptive statistics of variables. In our final sample (3,367 observations), books without any review are excluded. As reviews in Amazon.com are positive-biased, the sample also shows positive-bias. Mean value of Avg.Rating is 4.39 out of 5. About 12.64% (Verified), on average, are written by users whose purchases are verified. Mean value for the

⁴ Each book receives different level of attention from consumers. Close examination in our sample suggests that, if a book is not reviewed for the first two weeks, the book is more likely to be slowly and less reviewed in future. Thus, we can collect enough volumes of reviews for two months after publication if consumers are aware of the book.

proportion of reviewer identity disclosure (Realname) is only 5.53%. Two variables (Wiki, Bio) in author popularity are rather low. Only 9% of books have authors registered in Wikipedia. Average of author favorability is 6.58, meaning that each book has about 6.6 users who like the author of the book. Average Price, Reviews, Helpful variable for each book is 11.46, 22.73, and 1.83.

Table 3 compares descriptive statistics between paper and digital books in our sample. Paper books have 1,477 observations while digital books have 1,890 observations. Similarities as well as differences exist in statistics between paper and digital books. Mean value of average rating (=4.4) and diversity (=0.5) are almost same in both categories. In average, 16.54% of reviews per digital book are written by verified purchasers while only 7.64% per paper book. But, mean value of the proportion of reviewer identity disclosure is slightly higher per paper book. In author popularity, 12% (in paper) and 7% (in digital) of books have an author with Wikipedia page. Author favorability appears to be about 3 times higher in digital books. On average, price of digital books is almost half of that of paper books while the number of reviews and average helpful votes are similar. Table 4 presents correlations between variables.

	ln(Rank)	Avg.Rating	Std.Rating	Credibility	Popularity	Favorability	Price	Reviews	Helpful
ln(Rank)	1								
Avg.Rating	0.0910***	1							
Std.Rating	-0.430***	-0.384***	1						
Credibility	-0.164***	-0.126***	0.0947***	1					
Popularity	-0.196***	-0.0707***	0.256***	-0.00431	1				
Favorability	-0.358***	-0.0525**	0.183***	0.0384*	0.190***	1			
Price	0.196***	0.0711***	-0.141***	-0.0423*	-0.00939	-0.152***	1		
Reviews	-0.350***	-0.0559**	0.294***	-0.0171	0.290***	0.259***	-0.0542**	1	
Helpful	-0.154***	-0.0299	0.245***	0.0806***	0.136***	-0.0361*	0.0666***	0.110***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4. Correlations of Variables

Moderating Roles of Review Credibility and Author Popularity

In our model, the product sales of each book are a function of direct effects and interaction effects by moderators as shown in Figure 1.⁵ The dependent variable is log sales rank. Following Chaevalier and Mayzlin (2006), we use the log specification instead of level so that the result shows the effect of a change of independent variables on the percentage change in the dependent variable.

We set up the following equation for regression analysis:

$$(1) \ln(\text{Rank}) = \alpha + \beta_1 * \text{Avg.Rating} + \beta_2 * \text{Std.Rating} + \beta_3 * \text{Std.Rating}^2 + \beta_4 * \text{Credibility} + \beta_5 * (\text{Avg.Rating} * \text{Credibility}) + \beta_6 * (\text{Std.Rating} * \text{Credibility}) + \beta_7 * \text{Popularity} + \beta_8 * (\text{Avg.Rating} * \text{Popularity}) + \beta_9 * (\text{Std.Rating} * \text{Popularity}) + \beta_{10} * \text{Favorability} + \beta_{11} * (\text{Avg.Rating} * \text{Favorability}) + \beta_{12} * (\text{Std.Rating} * \text{Favorability}) + \gamma * X + u$$

where X is a vector of control variables (Price, Reviews, and Helpful). Equation 1 represents direct effects of average rating and diversity (standard deviation and squared standard deviation) to log sales rank as well as moderation effects of credibility, author popularity, and favorability.

Based on equation 1, we estimate three models: (1) Model 1 includes only direct effects, which are average rating and diversity of reviews; (2) Model 2 extends model 1 by including moderating effects of review credibility; and (3) Model 3 further includes the moderation effects of author popularity and favorability. Table 5 presents the results of regression analysis using these models.

In model 1, average rating appears negative and significant (-0.13), meaning that increase in average rating is positively associated with decrease in log sales rank (i.e. increase in sales). This trend appears consistent in models 2 and 3. Thus, H1 is supported. Diversity, measured by standard deviation of ratings, appears negative and significant (-3.31) with higher degree

⁵ By assuming sales rank as an approximate measure of sales volume based on Schnapp and Allwine (2001), we use the term product sales and log sales rank interchangeably.

than average rating while its squared term is positive and significant (1.39). As hypothesized, diversity of ratings is positively and also quadratically associated with product sales. Although absolute values of coefficients for diversity are slightly smaller in model 2 and 3, the effect of diversity remains consistent. Thus, H2 is supported.

Model 2 observes moderating roles of review credibility, increasing R^2 by about 3 percent points. Direct effects (average rating and diversity) remain as same as in model 1. For credibility, interaction terms with average rating and with standard deviation both appear negative and significant at 0.1 and 0.05 p-level, respectively. Thus, credibility strengthens the positive association between average rating (or diversity) and product sales. Moderating roles of credibility appear stronger and more significant in model 3. H3 is supported.

Model 3 further observes moderating roles of author popularity and favorability, increasing R^2 by about 5 percent points compared to model 2. Direct effects (average rating and diversity) and moderating roles of credibility remain similar to models 1 and 2. For author popularity, an interaction term with average rating appears negative and significant at 0.01 p-level while an interaction term with diversity is insignificant. Thus, author popularity strengthens only the positive association between average rating and product sales. H4 is partly supported. However, neither interaction term with author favorability is significant. H5 is not supported.

	(1) Direct effects	(2) Credibility	(3) Author
Avg.Rating	-0.131**	-0.136**	-0.106*
Std.Rating	-3.312***	-3.016***	-2.440***
Std.Rating^2	1.386***	1.246***	0.877***
Credibility		0.483	0.732+
Avg.Rating×Credibility		-0.0738+	-0.0954*
Std.Rating×Credibility		-0.702***	-0.714***
Popularity			4.781**
Avg.Rating×Popularity			-1.090**
Std.Rating×Popularity			-0.221
Favorability			-0.0177
Avg.Rating×Favorability			-0.00257
Std.Rating×Favorability			0.00668
Price	0.0235***	0.0224***	0.0181***
Reviews	-0.00730***	-0.00803***	-0.00679***
Helpful	-0.0454***	-0.0405**	-0.0554***
_cons	12.87***	12.48***	12.25***
<i>N</i>	3228	3228	3228
adj. R^2	0.286	0.314	0.360

+ p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table 5. Regression Results of Proposed Models

Comparison between Paper and Digital Books

Now, we compare the roles of average rating, diversity, credibility, and author popularity on product sales between paper books and digital books. We propose the following equation by dropping author favorability from equation 1:

$$(2) \ln(\text{Rank}) = \alpha + \beta_1 * \text{Avg.Rating} + \beta_2 * \text{Std.Rating} + \beta_3 * \text{Std.Rating}^2 + \beta_4 * \text{Credibility} + \beta_5 * (\text{Avg.Rating} * \text{Credibility}) + \beta_6 * (\text{Std.Rating} * \text{Credibility}) + \beta_7 * \text{Popularity} + \beta_8 * (\text{Avg.Rating} * \text{Popularity}) + \beta_9 * (\text{Std.Rating} * \text{Popularity}) + \gamma * X + u$$

where X is a vector of control variables. Table 6 shows the results of regression analysis for two models (both with equation 2) using different sub-samples: (4) paper books and (5) digital books.

There are several interesting findings from the results. First of all, the findings from model 3 in previous analysis are not observed at the same level in paper books sample while all the findings appear the same in digital books. In digital books sample, H1 (average rating), H2 (diversity), H3 (credibility), and H4 (author popularity) are supported. In details for paper books sample, average rating appears insignificant and, thus, H1 is not supported. Diversity of reviews appears significant in

both of paper and digital books. H2 is supported. Only an interaction term of review credibility with diversity is significant. H3 is partly supported. All interaction terms of author popularity are not significant, leading H4 not supported. Thus, only H2 (diversity) and H3 (2) (credibility*diversity) are supported in paper books sample. As a result of these findings, user reviews in digital books have more significant and stronger effect on product sales than those in paper books. H6 is supported by this observation.

To summarize, we found the followings: increase in average rating and diversity (of ratings) is positively associated with increase in product sales; both credibility of reviews and author popularity strengthen the positive association between average rating (or diversity) and product sales; user reviews in digital books are more strongly related with product sales than those in paper books.

	(4) Paper	(5) Digital
Avg.Rating	-0.0237	-0.139*
Std.Rating	-1.326***	-4.073***
Std.Rating^2	0.417*	1.838***
Credibility	-0.240	1.245*
Avg.Rating×Credibility	-0.00558	-0.140**
Std.Rating×Credibility	-0.603***	-0.474***
Popularity	-2.296	8.340**
Avg.Rating×Popularity	0.253	-1.778**
Std.Rating×Popularity	0.974	-1.624***
Price	-0.00310	0.0435***
Reviews	-0.00578***	-0.00933***
Helpful	-0.161***	-0.0105
_cons	13.35***	11.51***
<i>N</i>	1418	1810
adj. <i>R</i> ²	0.279	0.419

* p<0.05, ** p<0.01, *** p<0.001

Table 6. Comparison of Regression Results of Paper and Digital Books

CONCLUSION AND FUTURE RESEARCH

In this research, we analyzed the direct effects of both average rating and diversity of reviews and the moderation effects of both credibility of reviews and author popularity (and favorability) on product sales using the data from Amazon.com. Major findings are: (1) average rating and diversity (of ratings) are important signals for product sales while the effect of diversity is stronger; (2) credibility (of reviews) enhances the quality of signals (e.g. average rating, diversity) to product sales; (3) author popularity (measured by sellers) enhances the quality of signals to product sales while author favorability (measured by users) does not; (4) all these findings (1-3) are observed strongly in digital books sub-sample, but not in paper books sub-sample.

This paper contributes by providing a richer understanding of user reviews on product sales under framework of "signals of quality and quality of signals". In addition, it provides an insightful view to the conflicting findings from previous research. Including Chaevalier and Mayzlin (2006), previous research found average rating reflects the level of product sales while Clemons et al. (2006) found that diversity of ratings is a more important indicator for sales than average rating. Our analysis agrees with Clemons et al. (2006) that diversity reflects product sales better, but comparison of paper and digital books suggests that average rating can be an indicator for product sales of more digitalized products.

From the managerial perspective, this paper suggests that firms can boost product sales (for a product with high average rating and high diversity of ratings) by providing more credible review environment or by enhancing the brand image of the product. In this context, the efforts and investments of review sites in keeping credible reviews will increase overall sales. Sometimes, firms behave unethically by providing misleading reviews (favorable towards themselves and unfavorable to competitors) to keep high average ratings. However, our findings (positive effect of diversity on sales; stronger effect of diversity than average rating) suggest that those unethical behaviors provide little incentive.

Although we found interesting findings on moderating roles of credibility and author popularity, the comparison between paper and digital books provoked several questions. Where does this difference come from? One argument could be

difference between two consumer groups - one buying paper books and the other buying digital books. Consumers buying digital books might be more technology-oriented, with higher chance of acquiring information from the online user reviews. Another reason could be the fact that many digital books are written by unfamiliar authors and are self-published. Compared to digital books, paper books enjoy quality guarantee to some extent, by popular authors and verified publishers. This fact makes consumers to rely on user reviews of digital books. Future research on these questions would be interesting.

REFERENCE

1. Cao, Q., Duan, W., and Gan, Q. (2011) Exploring determinants of voting for the “helpfulness” of online user reviews: A text mining approach, *Decision Support Systems*, 50(2), 511-521.
2. Chen, Y. and Xie, J. (2005) Third-party product review and firm marketing strategy. *Marketing Science*, 24(2), 218-240.
3. Chevalier, J. A. and Mayzlin, D. (2006) The effect of word of mouth on sales: Online book reviews, *Journal of Marketing Research*, 43(3), 345-354.
4. Clemons, E. K., Gao, G., and Hitt, L. M. (2006) When Online Reviews Meet Hyperdifferentiation: A Study of the Craft Beer Industry. *Journal of Management Information Systems*, 23(2), 149-171.
5. Danescu-Niculescu-Mizil, C., Kossinets, G., Kleinberg, J., and Lee, L. (2009) How opinions are received by online communities: a case study on amazon. com helpfulness votes. In *Proceedings of the 18th international conference on World wide web*, ACM, 141-150.
6. Dawar, N. and Parker, P. (1994) Marketing universals: consumers' use of brand name, price, physical appearance, and retailer reputation as signals of product quality, *The Journal of Marketing*, 58(2), 81-95.
7. Dellarocas, C. (2006) Strategic manipulation of internet opinion forums: Implications for consumers and firms, *Management Science*, 52(10), 1577-1593.
8. Forman, C., Ghose, A., and Wiesenfeld, B. (2008) Examining the relationship between reviews and sales: The role of reviewer identity disclosure in electronic markets, *Information Systems Research*, 19(3), 291-313.
9. Ghose, A. and Ipeiritos, P. G. (2011) Estimating the helpfulness and economic impact of product reviews: Mining text and reviewer characteristics, *IEEE Transactions on Knowledge and Data Engineering*, 23(10), 1498-1512.
10. Keller, K. L. (1993) Conceptualizing, measuring, and managing customer-based brand equity, *Journal of Marketing*, 57(1), 1-22.
11. Kirmani, A. and Rao, A. R. (2000) No Pain, No Gain: A Critical Review of the Literature on Signaling Unobservable Product Quality, *Journal of Marketing*, 64(2), 66-79.
12. Kumar, N. and Benbasat, I. (2006) Research note: the influence of recommendations and consumer reviews on evaluations of websites, *Information Systems Research*, 17(4), 425-439.
13. Luca, M. (2011) Reviews, reputation, and revenue: The case of Yelp.com, *Harvard Business School NOM Unit Working Paper*.
14. Mayzlin, D. (2006) Promotional chat on the Internet, *Marketing Science*, 25(2), 155-163.
15. Mudambi, S. M. and Schuff, D. (2010) What makes a helpful online review? A study of customer reviews on Amazon.com, *MIS quarterly*, 34(1), 185-200.
16. Poston, R. S. and Speier, C. (2005) Effective use of knowledge management systems: A process model of content ratings and credibility indicators, *MIS Quarterly*, 29(2), 221-244.
17. Qiu, L., Pang, J., and Lim, K. H. (2012) Effects of conflicting aggregated rating on eWOM review credibility and diagnosticity: The moderating role of review valence, *Decision Support Systems*, 54(1), 631-643.
18. Schnapp, M. and Allwine, T. (2001) Mining of book data from Amazon.com, In *Presentation at the UCB/SIMS web mining conference*.
19. Tan, K. W., Swee, D., Lim, C., Detenber, B. H., and Alsagoff, L. (2007) The impact of language variety and expertise on perceptions of online political discussions, *Journal of Computer-Mediated Communication*, 13(1), 76-99.

20. Willemsen, L. M., Neijens, P. C., Bronner, F., and de Ridder, J. A. (2011) Highly Recommended! The Content Characteristics and Perceived Usefulness of Online Consumer Reviews, *Journal of Computer-Mediated Communication*, 17(1), 19-38.
21. Zhu, F. and Zhang, X. (2010) Impact of online consumer reviews on sales: The moderating role of product and consumer characteristics, *Journal of Marketing*, 74(2), 133-148.