The Role of Logistics in E-commerce Transactions: An Exploratory Study of Customer Feedback and Risk

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Abstract Logistics plays an important role in e-commerce; while most part of the transactions happen electronically, physical products need to be shipped to customers using conventional transport means. We report in this paper an exploratory study to understand how customers view logistics performance in deciding performance of sellers in e-commerce. Since it has been observed that risk plays a stronger role in online transactions compared to offline transactions, we study how the importance of logistics performance is influenced by risk characteristics of products sold through e-commerce websites. Our data for analysis have been derived from customer feedback available in eBay. Based on Chi square tests and the Marascuilo procedure, we find that the importance of logistics services increases as risk characteristics of products decreases from high to low.

Keywords Logistics · E-commerce · Product risk

1 Introduction

E-commerce has shown impressive growth in the last few years. For example, according to the survey of the UK Office for National Statistics, Internet sales by UK businesses rose to £222.9 bn in 2008 which was 9.8 % of the total value of all

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sales by nonfinancial sector businesses and an increase of 36.6 % on the 2007 Internet sales figure.

The role of logistics services has evolved as e-commerce grew. When online shopping business started growing, many prophesied that it was the end of the road for many of the intermediaries, who were dominant in traditional supply chains, as more and more suppliers and manufacturers were likely to prefer selling direct to customers in order to reduce delivery time, costs, and compete in the online market (Lancioni et al. 2000; Yankelovich 2000). This meant that most of the business for logistics service providers would be mainly limited to the "last mile" of the online shopping order cycle. However, this has not been the case and the logistics service providers dealing with Internet shopping have witnessed tremendous growth in business (Rabinovich and Bailey 2004). The focus of this paper is to study the role of logistics service providers in e-commerce transactions.

Several studies have stressed the importance of various operational factors, including factors related to logistics performance, in determining overall performance of a seller or an e-tailer (Sum et al. 2001). The importance of quality of physical distribution in the "last-mile" of e-commerce has been stressed (Lee and Whang 2001; Rabinovich and Bailey 2004). E-commerce, especially the B2C segment, is typically characterized by large numbers of small order sizes demanding shipments with a different distribution system compared to the brick-and-mortar business and hence provides larger scope for the role of logistics (Cho et al. 2008). It is believed that e-commerce has provided new opportunities to third-party logistics (3PL) service providers (Kroll 1999) and that with continued growth of e-commerce, the importance of logistics is set to increase.

Risk plays an important role in businesses and is considered more important in online transactions than normal offline transactions (Massad and Tucker 2000). Though there is a huge literature studying risk (e.g., Hofacker 2000; Miyazaki and Fernandez 2001; Finch 2007), there are not many studies that looked at the role of risk on the importance of logistics service in the e-commerce context. We take up this important research issue in this paper. Specifically, we study how the importance of logistics performance is influenced by risk characteristics of products sold through e-commerce websites. We have used customer feedback information available in eBay for the purpose.

The rest of the paper is organized as follows: It starts with a brief description of e-commerce along with the other literature relevant to logistics and risk in e-commerce. Our research hypothesis is established with reference to the existing literature in this section. Research methodology and analysis are detailed in Sect. 3. Section 4 discusses the analyses. Section 5 summarizes our research findings and discusses managerial implications. Section 6 concludes the paper with limitations and future research.

2 Literature Survey and Research Hypothesis

The Role of Logistics Performance in E-commerce

While the role of logistics on firm performance has been well researched in a traditional context (e.g., Morash and Clinton 1997; Wisner 2003), this topic has received relatively less attention in e-commerce context (Gunasekaran et al. 2007). Traditionally, logistics services are built to facilitate efficient flow of goods, information, and cash. This linear relationship is said to have been broken in the e-commerce context, but Rabinovich and Knemeyer (2006) have highlighted that this is not the case with evidence from the events of the past decade. According to them, the importance of logistics service providers has increased in the electronic marketplace.

Logistics plays a very important role in ensuring customer satisfaction. The factors related to logistics are experienced by customers after making payments, and are often grouped as one of the postpurchase factors. Studies have found that customers generally consider physical delivery as a very important factor (Esper et al. 2003; Agatz et al. 2008) and that logistics capability is positively associated with firm performance over the Internet (Cho et al. 2008). Much has been written about this "last mile" of Internet supply chains (Esper et al. 2003; Kull et al. 2007; Lee and Whang 2001). Unlike brick-and-mortar stores where the customer has the option of bringing the product himself, most of the transactions over the Internet rely on the use of a logistics channel for delivery of the products. Significant sources of customer dissatisfaction arises either due to late arrival (or nonarrival) of the product, accuracy of the order, and/or due to damaged products.

Late arrival of the product would often make customers wait for the product with compounded anxiety levels. Logistics performance mainly deals with delivery speed and reliability but several studies have also included responsiveness, communication, order handling, and distribution (e.g., Cho et al. 2008) in the scope of logistics. In general, logistics performance can be improved by employing multichannel distribution, and most multichannel e-tailers offer online consumers the option to return product via online stores, which is greatly valued by customers (Agatz et al. 2008). The logistic platform for e-commerce fulfillment consists of logistics structure (e.g., direct distribution or via distribution centers), logistics processes (e.g. order handling, storing, packing, and transportation), and systems for information and reporting (Aldin and Stahre 2003).

In spite of the rich literature on the role of logistics in physical distribution, a detailed look at the studies on the role of logistics in e-commerce reveals that they have not considered how the importance of logistics varies depending on risk characteristics of products. However, there is evidence that risk plays a significant role in e-commerce and risk characteristics of products could affect the role of logistics in ensuring customer satisfaction. We review some important studies on risk in e-commerce in the next section.

2.1 Risk on Consumer Behavior in E-commerce

While it has been recognized that perceived risk plays a very significant role in influencing consumer behavior especially in e-commerce transactions, there does not seem to be many studies that analyzed the impacts of risk. Massad and Tucker (2000) have provided a comparative study of online and offline (or traditional) bidding behaviors. Following the classification of risk by Hofacker (2000), they have proposed that price comparison risk is higher in traditional auction, while four other types of risk (time risk, vendor risk, security risk, privacy risk, and performance risk) are higher in the online environment. Miyazaki and Fernandez (2001) have found that perceived risks of online transactions might reduce with higher levels of Internet experience. Doolin et al. (2005), using an Internet-based survey in New Zealand, have found significant association of perceived risk and perceived benefits of Internet shopping with the amount and frequency of online purchases made. Lim (2003) has identified four sources of risk in relation to online shopping: Technology, vendor, consumer, and product. Lacohee et al. (2006) have found that online users carried out a personal risk assessment prior to engaging with a service.

In this research, we use an interesting new framework suggested for deciding risk classification by Finch (2007). As per this perspective, the risk characteristic of a product is a function of its price and ambiguity. Finch (2007) has provided a detailed empirical testing on the behavior of online consumers of auction environment based on risk classifications of Massad and Tucker (2000). He has proposed that the risk exposure was determined both by the amount (price) paid and the degree to which a product could be accurately described (ambiguity). Collecting and analyzing 1,000 customer feedbacks for each category, he has found that service-oriented quality dimensions are likely to be given higher importance for low-risk categories and that product-oriented quality dimensions will get higher importance for high-risk categories.

However, a review of the available previous literature shows that there are no studies relating product risk specifically with logistics. It is generally accepted that logistics-related factors are essentially service-oriented. Hence, in the absence of other specific studies on the impact of risk on logistics-related factors, we extend the findings of Finch (2007) to the case of online ratings in terms of the following hypotheses.

Research Hypothesis: *The importance associated with logistics in e-commerce transactions will be more for lower risk products than for higher risk products.*

3 Research Methodology

3.1 Data Collection

In this research, we have used customers' feedback from eBay. The online auction site, eBay, was founded in 1995 and is well-known as the world's best auction engine or marketplace. It has operations in 37 countries with a total customer base of 233 million. The second author has collected data from eBay's UK website, which is the UK's largest online market with more than 14 million active users and more than 10 million items on sale at any given time. A significant number of users utilize eBay as their primary or secondary source of income (eBay Worldwide 2008).

3.1.1 Data Collection Strategy

We have collected our data from e-Bay during the summer of 2008. At the end of a transaction on eBay, the buyer rates the seller with a feedback, which could be positive, negative, or neutral. The feedback is not necessarily only based on the product characteristics; it frequently stresses the service attributes of the entire transaction. Such feedbacks have been collected to interpret the customer's/buyer's satisfaction level. Each feedback has been read and converted into a quantitative form by classifying it into one of the following six categories:

(1) Delivery speed/timeliness
(2) Delivery speed/timeliness and other service factors like sorting, picking, packaging, communication, order tracking etc.
(3) Other service factors (all excluding delivery speed/timeliness)
(4) Product-only
(5) Product and service related and
(6) Nonspecific

The first three categories together form the service-only category. Of these three, the first two are related to logistics (transport and delivery).

3.1.2 Risk Characterizations

As mentioned earlier, we are interested in understanding how the importance of logistics varies depending on the risk characteristics of the products involved in e-commerce transactions. Based on Finch (2007), we have characterized risk of a product in the form of price and ambiguity. High-price products with high ambiguity (HPHA) are classified as high-risk products, and low-price products with low ambiguity (LPLA) are classified as low-risk products. The other two

products such as high price with low ambiguity (HPLA) and low price with high ambiguity (LPHA) are classified as medium-risk products. Thus, we have created three product classifications—high risk, medium risk, and low risk.

Low price products are defined in this study as products below £100 and high price products were those costing above £200. In the low-price low-ambiguity category, DVDs, comics, video games, and accessories and computing accessories were considered. In the high-price low-ambiguity category, laptops, digital cameras, and other electronics were considered. In the high-ambiguity category, products such as antiques (wooden and oriental), paintings, art, pottery ,and coins were considered. Based on the price range of the high-ambiguity products sold, sellers were classified into one of the two categories low-price high-ambiguity and high-price high-ambiguity. Our choices of these product categories to represent the risk groups are consistent with those of Finch (2007).We have collected 1000 positive feedback ratings for each of the four product categories (therefore, 4000 in all). Evaluation of positive feedback provides a sense of what customers view as important and is in line with previous studies (e.g., Finch 2007).

For each of the product categories, effort was made to ensure that the sellers selected were active with significant activity levels in the past few months. This could be confirmed by the number of customer feedbacks within the past 90 days (from June to August 2008). Only the latest 25–100 feedbacks were considered for each seller.

3.2 Interpretation of Feedback Data

The following strategy was adopted for interpreting customer feedback. Feedback such as "thank you" and "excellent eBayer" were considered as nonspecific. Feedback such as "excellent item," "product met expectations," and "excellent product price" were classified as product-only. "Fast and excellent condition" and "great transaction" were considered to be both product and service related. "Fast and well packed" was put into the service-only category under the subcategory of delivery speed and others, while comments such as "excellent service" and "great communication" were placed in the other services subcategory.

This data interpretation process can be more easily understood with the help of Table 1, which gives examples of a few customer feedback data being converted into quantitative data.

As mentioned earlier, we have collected 1000 positive feedback ratings for each of the four product categories (therefore, 4000 in all) and the ratings were classified into one of the earlier mentioned six categories. Details are included in Table 2.

After collecting the data, in line with the focus of this study, we have considered only the following feedbacks for further analysis:

Table 1 Examples of Feedback category description

Feedback examples	Service-only			Product-only	Service and product	Not specific
	Delivery speed	Speed & other service	Other service			
1) Super fast delivery, product as described.					1	
2) Brilliant service, highly recommended.			1			
3) Good eBayer!						1
4) Perfect transaction.			1			
5) Super fast delivery and excellent item.					1	
6) Great product and communication.					1	
7) Quick delivery, would recommend.	1					
8) Item as described and quick delivery.					1	
9) GREAT eBayer. Thank you!						1
10) Brilliant, wow very impressed. Very quickly received. Not a mark or scratch.					1	
11) Great item!				1		
12) Fast and good packing		1				
Total	1	1	2	1	5	2

Table 2 Frequencies of eBay feedback

	Low price—low ambiguity (Low-risk products)	High price—low ambiguity (Medium-risk products)	Low price—high ambiguity (Medium-risk products)	High price—high ambiguity (High-risk products)
1. Service related				
1.1 Speed of Delivery/ Timeliness	202	256	45	63
1.2 Speed and other service factors	95	98	102	91
1.3 Others (excluding speed of delivery and timeliness)	45	70	94	80
Service-related total	342	424	241	234
2. Product related	91	142	245	244
3. Service and Product related	318	322	388	417
4. Not specific	249	112	126	105
Grand Total	1000	1000	1000	1000

a) pure logistics-related (combining frequencies corresponding to items 1.1 and 1.2 of Table 2)
b) other services-related (item 1.3 of Table 2) and
c) product-related (item 2).

We have excluded frequencies corresponding to items 1.3, 3, and 4 from further analysis. Since the above table lists 2000 feedbacks for medium-risk group, we have used the average for 1000 feedbacks in the remainder of this study. The data collected were tabulated and statistical tests were conducted to draw a conclusion regarding the research hypothesis. Details are discussed below.

4 Analysis and Results

We have conducted data analyses in two stages. In Stage 1, we have first verified whether there is a significant difference in the frequency of logistics-related, other service-related, and product-related feedbacks across the three risk categories. We have employed the Chi square test for this purpose of analysis. Stage 2 was based on the results of Stage 1 to check if the frequency of feedbacks is higher or lower for different categories.

Stage 1
In this stage, we have used a simple Chi square test (Anderson et al. 2002) to test whether the number of pure logistics-related, other service-related, and product-related feedbacks differ significantly across the risk groups.

Table 3 shows the results of the Chi square analysis. The Chi squared value is significant ($p = 0.000$) showing that frequencies of logistics-related, other service-related, and product-related feedbacks differ significantly among the low-risk, medium-risk, and high-risk products. This result partially supports our research hypothesis in that the importance of logistics varies across the risk categories. However, in order to verify the hypothesis further, we need to complete Stage 2.

Table 3 Results of Chi square analysis for risk categories

	Low risk	Medium risk	High risk
Pure logistics related feedback—actual value	297	251	154
Pure logistics related feedback—expected value	211.53	256.96	255.51
Other services related feedback—actual value	45	82	80
Other services related feedback—expected value	62.37	75.77	68.86
Product related feedback—actual value	91	193	244
Product related feedback—expected value	159.1	193.27	175.63
Chi square = 124.7			
Degree of freedom = 4			
$p = 0.000$			

Stage 2

The Chi square test shows that the frequencies are significantly different. We can intuitively conclude, by looking at the absolute values of frequencies, that logistics-oriented feedbacks have a higher frequency for low-risk products than for high-risk products (297 > 154). To confirm this statistically, we have used the Marascuilo procedure (Marascuilo 1966; Levine et al. 2007).

Application of the procedure requires three steps (Levine et al. 2007). Calculations for these steps are shown in Table 4.

Step 1 Let k be the number of groups to be compared. In our case, $k = 3$ as there are three groups (low risk, medium risk, and high risk). Further, let p_i be the proportion of logistics-related feedbacks over total feedbacks considered for group i. We compute absolute values of the differences $(p_i - p_j)$ (where i is not equal to j) among all $k(k-1)/2$ pairs of proportions. In our case, we have three pairs (low–medium, medium–high, and low–high) to be compared

Step 2 Calculate critical value using the formula $\left(\sqrt{\chi_U^2}\sqrt{\frac{p_i(1-p_i)}{n_i} + \frac{p_j(1-p_j)}{n_j}}\right)$ where χ_U^2 is obtained from Chi square statistical tables based on a prespecified significance level and $(k-1)$ degrees of freedom and n is the total number of observations for each group. For calculations in Table 4, χ_U^2 = 5.9915 for a 5 % significance level with two degrees of freedom

Step 3 The difference in proportions $(p_i - p_j)$ among a pair is compared with the critical value. A pair is considered to be significantly different if the absolute difference in proportions is greater than the corresponding critical value. Table 4 shows that the absolute values of differences in proportions are greater than the corresponding critical values for all the three pairs (low–medium, medium–high, and low–high). These findings support our research hypothesis

It can be seen from Table 4 that the absolute value of the proportion difference for medium and low risk (0.2087) is greater than the critical range (0.0763), and hence it can be concluded that the difference in logistics-related feedbacks for low- and medium-risk products is statistically significant (297 > 251). Thus, logistics-related factors are more important for low-risk products than for medium-risk

Table 4 Comparison of 'logistics only' feedbacks

Groups	Low risk	Medium risk	High risk
Pure logistics-related feedbacks	297	251	154
Other services-related feedbacks	45	82	80
Product related-feedbacks	91	193	244
Proportion of pure logistics-related feedbacks to total	0.6859	0.4772	0.3222
Pairs	Med–low	High–med	Low–high
Absolute value of difference in proportions	0.2087	0.1550	0.3637
Marascuilo critical value	0.0763	0.0747	0.0756

products. Similarly, we can observe that the difference in logistics-related feedbacks for medium- and high-risk products is statistically significant (251 > 151), and further that the difference in logistics-related feedback for low- and high-risk products is statistically significant (297 > 154). Thus, we can conclude in this study that logistics-related products are more important for medium-risk products than for high-risk products.

5 Discussion and Managerial Implications

While there are studies on the importance of logistics and on the influence of risk in e-commerce transactions, there seems to be no study that combines these two important research avenues. The present study has contributed to the literature by filling this gap by providing risk perspective on the importance of logistics in online transactions. Drawing on positive feedbacks of buyers in eBay transactions, this study has found that logistics-related feedbacks are more frequent for low-risk products (characterized by low price and low ambiguity) than for high-risk products (characterized by high price and high ambiguity). Our study agrees with the findings of Finch (2007) who found that service-oriented factors (that also included logistics service) would get higher importance for low-risk categories. Figure 1 summarizes these findings.

Our study has interesting practical implications to managers of online businesses. Logistics performance contributes to satisfaction of online customers more for low-risk products than for high-risk products. We interpret this result as support for customers being more attentive to logistics performance in the case of low-risk products. For low-risk products (low price and low ambiguity), customers do not usually spend much time on researching the product, order the product, and expect that the product is delivered as promised. Thus, delivery of the right product at the promised time seems more important to customers. On the other hand, for high-risk products (high price and high ambiguity), customers spend comparatively more time in reading product specifications more thoroughly and locating the most cost-effective supplier. Though they also expect that the product be delivered as per the original specification and at the promised time, customers

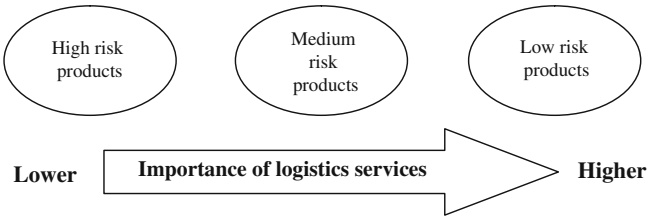

Fig. 1 Importance of logistics for different product types

buying high-risk products seem to provide lesser importance to logistics compared to other features of the product. This result agrees well with the literature. For example, Finch (2007) has found service-oriented attributes receive higher priority for low-risk products, while product-oriented attributes receive higher priority for high-risk products.

Managers of e-commerce websites can use our results to provide "optimal" level of logistics service for their products. Logistics performance attributes such as fast shipping and communication will be important for low-risk products, and will contribute to the favorable service perception of customers. However, for high-risk products, customers may not attach performance in terms of delivery time or communication at very high importance, and any special efforts and money spent on this may not necessarily be optimal.

6 Limitations and Future Research

In spite of the interesting finding on the importance of logistics for various product risk groups, our study has some limitations and future research could overcome them. We first wish to caution about the results discussed in the previous section. We have observed that logistics related feedbacks were more for low-risk products. However, this need not mean that those customers who posted logistics-related feedback do not care at all about other features of the transaction—such as product quality or other service categories. They do care about all features, but satisfied customers of low-risk products tend to emphasize logistics performance more.

Though online ratings and feedback data have been extensively used by previous research studies, our choice of data collection via eBay has the usual disadvantages of a secondary data source. For example, the researcher is not in control of data collection and raw data need to be converted to a form that is useful for the analysis. However, secondary data also have its own advantages, namely availability of large amounts of data and data collection without any bias on the part of the researcher.

We have used reasonable definitions of low and high prices in our study. Our maximum threshold for low price is £100, while the minimum threshold for high price is £200. However, given that these are subjective values, an interesting approach for future research would be to perform sensitivity analysis of the thresholds used for high and low prices.

We studied only positive feedback in this research. Thus, this study has examined how logistics supported e-commerce firms to improve their performance. In this sense, we studied logistics as a satisfier in the language of Ramanathan (2010). That is, we have studied how logistics performance contributed positively to customers who are happy with an e-commerce transaction. The fact that we have not included negative feedback in our analysis could be considered as a limitation of this study. We did not include negative feedback in our analysis, because (i) negative feedback is not so frequent in eBay compared to

positive feedback; (ii) there are very few cases where logistics services are cited as the main reason for dissatisfaction. However, we wish to stress that negative feedback could provide another equally important component to understanding customer preferences. This can help to understand the role of logistics as a dissatisfier—how logistics would contribute to the dissatisfaction of a customer who is not happy with a transaction. Study of negative feedback exclusively or in combination with positive feedback could also help to understand customer behavior further. This forms scope for future research.

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