

The Impact of Operational Criteria on Customer Satisfaction and Loyalty in E-commerce Environments: An Exploratory Study of Customer Ratings and Risk

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ABSTRACT: *Risk plays an important role in transactions over the internet. In this study, we explore the moderating role of risk on the relationships between performance of websites in terms of various operational criteria and their ability to win customers. We use data from online ratings of customers of 538 websites. Using canonical correlation analysis, we have found evidence of the moderating role of risk on the importance of product-specific criteria, but not on the importance of service-specific criteria. We have also found that risk does not play a significant role on the relationships between pre-purchase and post-purchase criteria and customer satisfaction/loyalty.*

KEYWORDS: *E-commerce, Marketing/Operations Interface, Customer Satisfaction, Customer Loyalty, Operational Criteria, Risk, Statistics, Canonical Correlation Analysis.*

1. Introduction

In today's competitive marketplace, customer is the king. Customer satisfaction and loyalty ensure repeat business and profitability to organisations. Customer satisfaction and loyalty are often shaped by behavioural and attitudinal factors (Dick and Basu, 1994; Gremler and Brown, 1996; Otim and Grover, 2006) both in online and real environments. This paper focuses on the relationships between performances of firms in terms of various operational criteria and customer satisfaction/loyalty in the context of electronic commerce. Recent studies have highlighted the need for e-commerce firms to develop sophisticated strategies to build customer satisfaction and customer loyalty (Burt and Sparks, 2003) especially in the context of the pricking of the internet bubble. The pace of growth of e-commerce seems to be slowing in recent years. For example, according to the survey of the UK Office of National Statistics, internet sales by UK businesses in 2006 grew by 29.1 per cent over the 2005 internet sales figure, but this growth is much smaller compared to the growth of 62% of internet sales (excluding financial sectors) in 2001 compared to the year 2000.

Though e-commerce and the so called e-tailing are relatively recent phenomena, much has been written about the customer service criteria and quality measurement in

e-tailing (Cao and Schniederjans, 2004; Collier and Bienstock, 2006). Effectiveness of fulfilling orders on time is stressed by Lee and Whang (2001). The role of managing operations especially in e-commerce and virtual enterprise environments has been highlighted in a recent review article (Gunasekaran and Kobu, 2007). The importance of quality of physical distribution in the “last-mile” of e-commerce has also been stressed (Lee and Whang, 2001; Rabinovich and Bailey, 2004).

In this paper, we use online customer ratings to identify the link between performance in terms of various criteria and customer loyalty/satisfaction. The last few years have seen many research studies that attempted to empirically analyse online ratings. However, a detailed look at these studies show that most of them considered ratings in terms of customer loyalty as the dependent variable and ratings in terms of performance criteria as the independent variables. There are also very few studies that addressed the moderating role of risk on the relationships between performance criteria and customer satisfaction/loyalty. The present paper aims to address these two research gaps. We consider both customer satisfaction and customer loyalty as our dependent variables and study the relationships between this set of dependent variables and the set of independent variables incorporating e-commerce operational criteria. In addition, we explore the moderating role of risk on these relationships. Since we have two dependent variables, we use canonical correlation analysis as our multivariate statistical analysis procedure.

The paper is organized as follows. The next section presents a literature review of the concepts relevant to this paper. A conceptual framework is presented and hypotheses are developed in Section 3, where details of data are also discussed. Details of our empirical analysis are presented in Section 4. Section 5 discusses the findings and highlights their managerial relevance. The last section provides a summary, conclusions, limitations of our study and scope for further research.

2. Literature review

This literature review is divided into four sub-sections. We provide a detailed review of various e-commerce operational criteria in the next sub-section. Research studies on the role of risk in e-commerce context are reviewed in Section 2.2. The literature on empirical studies on online customer behaviour is discussed in Section 2.3, while the literature on our data analysis procedure (canonical correlation analysis) is discussed in Section 2.4.

2.1 Operational criteria in e-commerce

In general, customers use a variety of criteria to judge the quality of a website involved in e-commerce activity. While most of the criteria pertain to the quality of service offered by the websites (website navigation experience, product delivery, etc.), there are

also a few criteria that are more specific to the product (e.g., prices). The service-specific criteria can be further divided as pre-purchase criteria and post-purchase criteria. Most of the product-specific criteria are pre-purchase criteria.

While price of a product is a product-oriented pre-purchase criterion, there are several other service-specific criteria experienced by customer before making purchase. They include good website browsing experience, availability of adequate product description, security of financial transactions, etc.

Post-purchase set of criteria are experienced by the customer after making payment. This involves the whole range of after-sales and support services. The importance of the role of logistics and supply chain operations in e-commerce environment has been well stressed in a recent review by Gunasekaran and Kobu (2007).

We have attempted to classify the e-commerce operational criteria as product-specific and service-specific criteria, and further as pre-purchase and post-purchase criteria. These classifications schemes are similar to the classifications employed in previous studies, though some of them have used different terminologies for their classification. For example, Jiang and Rosenbloom (2005) have categorized the criteria of bizrate into three categories: customer price perception, at-checkout satisfaction and after-checkout satisfaction. Otim and Grover (2006) categorized bizrate criteria as pre-purchase services, transaction related services, and post-purchase services. Thirumalai and Sinha (2005) have again categorized bizrate criteria as order fulfillment and order procurement variables. Finally, Heim and Field (2007) have aggregated the criteria of epubliceye into four categories: website design, fulfillment/reliability, security/privacy and customer service. Online rating sites use different terminologies to group these criteria under different categories. For example, www.bizrate.com uses about 10 criteria, while www.epubliceye.com uses nine.

2.2 Risk and consumer behaviour in electronic commerce

The significance of perceived risk in influencing consumer behaviour has been well recognized in the literature (e.g., Hallikas et al., 2002), especially in the context of online transactions (Miyazaki and Fernandez, 2001; Lim, 2003; Doolin et al., 2005; Lacohee et al., 2006). Massad and Tucker (2000) provided a comparative study online and offline (in-person) bidding behaviour. Following the classification of risk by Hofacker (2000), they proposed that price comparison risk was higher in in-person auction, while four other types of risk (time risk, vendor risk, security risk, privacy risk and performance risk) were higher in online environment. A detailed empirical testing on the behaviour of online consumers of auction environment has been provided by Finch (2007) based on risk classifications of Massad and Tucker (2000). He 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). Using the dimensions of price and ambiguity to categorize products into different risk categories, he found that service-oriented quality dimensions were likely to be given higher importance for low risk categories and that product-oriented quality dimensions would get higher importance for high risk categories.

2.3 Empirical studies on customer behaviour over the Internet

There have been several interesting empirical studies based on online customer ratings. Some studies have attempted to relate the customer ratings to individual operational drivers (e.g., Heim and Sinha, 2001; Heim and Field, 2007), some have attempted to identify patterns in the ratings based on the kind of products sold (e.g., Thirumalai and Sinha, 2005), while a majority of the studies attempted to identify the relationships between customer ratings in terms of different operational criteria on the ratings on customer loyalty. Otim and Grover (2006) studied online customer ratings from bizrate using ordinary least squares analysis to identify the effects of pre-purchase, transaction-related and post-purchase services on customer loyalty. They found that post-purchase service criteria (order-tracking support, on-time delivery and customer support) influenced customer loyalty significantly. Similar conclusions were made by Jiang and Rosenbloom (2005) using Bizrate data by employing structural equation modeling.

It may be noted that most of the above studies have attempted to study the influence of operational criteria with customer loyalty as the only dependent variable. The only exception is the study of Jiang and Rosenbloom (2005), who have used both customer satisfaction and customer loyalty in their study. But none of the studies have attempted to study the influence of risk on the relationships between operational criteria and customer satisfaction/loyalty. We aim to address these two important research gaps in this paper: we study the influence of various operational criteria with both customer satisfaction *and* customer loyalty as the dependent variables, and further study the moderating role of risk on these relationships since perceived risk plays an important role in shaping consumer behaviour (Hofacker, 2000) and is especially important with online customers (Doolin et al., 2005).

2.4 Data analysis methodology -- Canonical correlation analysis

As mentioned in the previous subsection, most of the previous studies on online ratings have used regression as their primary data analysis procedure since they considered customer loyalty as the only dependent variable. Since we have two dependent variables in our analysis, we have chosen canonical correlation analysis (CCA) (Green et al., 1966; Hair et al., 1998) as our primary data analysis procedure. Thus CCA is used in this study to identify the relationships between two sets of variables, dependent variables (customer satisfaction and customer loyalty) and independent variables (the eight e-commerce assessment criteria).

In canonical correlation analysis, linear combinations of independent variables (called the independent variate) and a linear combination of dependent variables (called the dependent variate) are developed. The weights for the linear combinations are chosen to maximise the correlation between the independent and dependent variates. Unlike standard regression analyses where the weights (coefficients) are considered of interest, in CCA, the correlations of individual variables with the corresponding variates are important. These correlations are called canonical loadings. More than one canonical function (involving one dependent variate and one independent variate) is normally estimated in CCA, and the maximum number of canonical functions that can be estimated is equal to the smallest number of variables in the set of either the dependent or independent variables (Hair et al., 1998).

Though not so popular as some other multivariate analyses (e.g., regression), CCA has been used in the literature to study the relationships between a set of dependent and a set of independent variables (Cannon and St. John, 2004; Tran and Ratson, 2006; Kim et al., 2007). Narasimhan and Das (2000) have used this technique to study sourcing's role in developing manufacturing flexibilities. Grandon and Pearson (2004) have used CCA along with confirmatory factor analysis to explore the causal link between strategic value and adoption of electronic commerce as perceived by top managers in small and medium sized enterprises. They considered three variables to represent strategic value (operational support, managerial productivity, and strategic decision aids) and four variables to represent adoption of e-commerce (organizational readiness, external pressure, perceived ease of use, and perceived usefulness), and collected primary data from 100 questionnaires. Montabon et al. (2007) have used CCA to study the relationships between environmental performance and financial performance of 45 leading firms. They used four dependent variables (product innovation, process innovation, return on investment and sales growth) and 20 environmental management practices of large firms. Jang et al. (2006) have used CCA to study the relationships between levels of e-relationship marketing and financial performance of 39 top hotel companies. Both the studies used a combination of content analysis of websites and secondary data to collect data for their study.

3. Methodology

3.1 Conceptual framework

Figure 1 provides a conceptual framework of the analysis presented in this paper. We consider customer satisfaction *and* customer loyalty as indicators of success of an organization in winning a customer. We assume that customers' experience in terms of

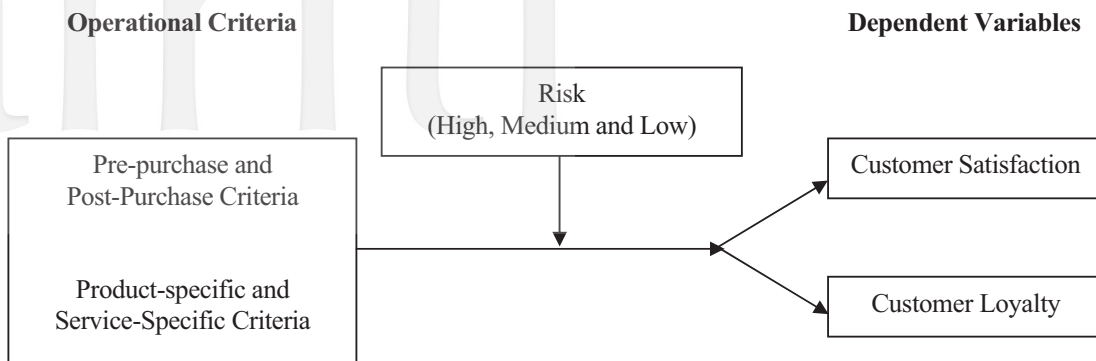


Figure 1 Conceptual Diagram of the Impact of Risk on the Influence of E-commerce Operational Criteria in Deciding Customer Satisfaction and Loyalty

the different e-commerce operational criteria has a relationship with their satisfaction and loyalty to an e-commerce website. In line with previous studies on online risk, we then conjecture that this relationship is moderated by the risk characteristics of the products sold through the websites. We define risk in terms of price and ambiguity, similar to the definitions by Finch (2007). We then attempt to verify the hypotheses discussed in the next section.

According to Oliver (1997), satisfaction is considered as consumer judgment on the quality of a firm's goods and services. It is the outcome of a subjective evaluation about whether the selected firm meets or exceeds expectation. Loyalty is the repeat purchase behaviour of customers (Lee et al., 2006). We would like to highlight here that there are several studies that considered customer satisfaction as an antecedent of customer loyalty (e.g., Kim et al., 2010). Most of them aim at testing the relationship between satisfaction and loyalty. In this study, our focus is not on testing the link between satisfaction and loyalty. The marketing literature has several studies that consider both satisfaction and loyalty as outcomes of performance (e.g., Jiang and Rosenbloom, 2005; Deng et al., 2010). First of all, there is consensus in the literature that satisfaction can be considered as an outcome of efficiencies of performance (Jiang and Rosenbloom, 2005; Deng et al., 2010). While satisfaction can be considered as an antecedent to loyalty, the latter depends also on several other factors such as switching costs (Deng et al., 2010) or quality of loyalty programs (Vesel and Zabkar, 2009) or the level of attachment (Yuksel et al., 2010), making loyalty a different outcome variable compared to satisfaction. In fact, there is debate among marketing researchers on the relationship between satisfaction and loyalty (e.g., Ngobo, 1999). Thus, there is a consensus in the literature that both satisfaction and loyalty are outcome (dependent) variables of firm performance. Our conceptual framework is based on this consensus. However, we do not focus on the link between satisfaction and loyalty as it is not the objective of this study.

The literature on CCA has studies in which the dependent variables may be thought to have antecedent relationships. CCA cannot explicitly consider these antecedent relationships. These studies can be justified because the antecedent relationships among independent variables are not the focus of these CCA studies. For example, Tutuncu and Kucukusta (2010) studied the relationship between job satisfaction and EFQM business excellence model using CCA. Though job satisfaction could be considered as an antecedent of business excellence, these two have been included as the two dependent variables of CCA. In the context of customer satisfaction data, Allen and Rao (2000) have described the use of CCA for understanding the relationships among overall satisfaction, repurchase intention and a loyalty index when these are dependent on a set of product and service quality issues. Though the three dependent variables (overall satisfaction, repurchase intention and a loyalty index) have antecedent relationships (e.g., level of satisfaction could influence repurchase intention which in turn could influence loyalty index), these three are used as the dependent variables along with six different product and service quality issues as independent variables. Thus the use of satisfaction and loyalty as the two dependent variables in our CCA model is similar to the use of interrelated dependent variables in the CCA literature.

3.2 Hypothesis development

We have highlighted in the literature review on risk in e-commerce (Section 2.2) that though there are several studies that used online ratings to understand the influence of operational criteria on customer satisfaction/loyalty, there is no study that analysed the impacts of risk. As mentioned in that section, Finch (2007) has provided a recent and interesting study on the moderating role of risk in an online environment. Using online customer feedback, he found that service-oriented quality dimensions were likely to be given higher importance for low risk categories and that product-oriented quality dimensions would get higher importance for high risk categories. Hence, we adapt the findings of Finch (2007) to the case of online ratings, and propose the following hypotheses in this paper.

Hypothesis 1a: The importance of product-specific criteria in explaining customer satisfaction and loyalty will be more than the importance of service-specific criteria for high risk products.

Hypothesis 1b: The importance of product-specific criteria in explaining customer satisfaction and loyalty will reduce as the risk levels of products decrease.

Hypothesis 2a: The importance of service-specific criteria in explaining customer satisfaction and loyalty will be more than the importance of product-specific criteria for low risk products.

Hypothesis 2b: The importance of service-specific criteria in explaining customer satisfaction and loyalty will increase as the risk levels of products increase.

As mentioned earlier, studies in the literature attempted to categorise the operational criteria into pre-purchase and post-purchase criteria. Otim and Grover (2006) and Jiang and Rosenbloom (2005) have found that post-purchase criteria have stronger influence on customer loyalty than pre-purchase criteria. Though a risk perspective is absent from these studies, we use their results to make the following hypotheses.

Hypothesis 3: The importance of pre-purchase criteria in explaining customer satisfaction and loyalty varies across risk groups.

Hypothesis 4: The importance of post-purchase criteria in explaining customer satisfaction and loyalty varies across risk groups.

3.3 Data

Data used in our analysis has been obtained from the online rating site, www.epubliceye.com, during 2007-08. Features of this website and the suitability of data from this website for empirical analysis have been discussed in detail by Heim and Field (2007). Table 1 also shows a grouping of these criteria in line with the discussion in the previous section. It may be noted that all are service-specific criteria except the factor “comparative prices”, which is the only product-specific criterion. Ratings for a total of 538 websites were used in the study. Table 2 provides overall summary of the data. Customer support registered the largest spread of ratings with a website receiving a rating as low as 0.01. All the criteria had significant correlations with each other at 0.01 level.

4. Empirical analysis

We now describe our analysis to identify the moderating role of risk on the relationships between e-commerce operational criteria and customer satisfaction/loyalty. As mentioned earlier, risk in our case is defined in terms of the general price of the product and the level ambiguity associated with the product. This definition of risk is in line with similar studies in the literature (e.g., Finch, 2007). Our approach has been to classify websites in terms of general price levels (low and high) and in terms of ambiguity of specification of products (low and high). For example, in general, websites selling books can be categorized as low price and low ambiguity, whereas websites selling services can be categorized as high price and high ambiguity. Computers, electronic goods, vehicles, sporting goods are generally high priced but low ambiguity items. We then categorized high price and high ambiguity websites as high risk websites. Low price

Table 1 Definitions of Total Satisfaction Rating, Customer Loyalty and E-commerce Assessment Criteria Form www.epubliceye.com

Criterion	Description
Dependent Variables	
Total Satisfaction Rating	A graphical and numeric average of all customer satisfaction ratings received from consumers on this merchant.
Customer Loyalty	This category allows consumers to indicate their likelihood of shopping with the merchant again.
Independent Variables	
<i>Pre-purchase Criteria</i>	
Comparative Prices	An explicit definition not available in the website.
Management Accessibility	This category allows consumers to rate how easily they were able to contact management or someone in charge with inquires or problems that required live support.
Payment Process	This category allows consumers to rate their satisfaction with how their order was processed.
Privacy Experience	This category allows consumers to rate their experience with the privacy practices of the business relative to their privacy policy.
<i>Post-purchase Criteria</i>	
Satisfaction with Claims	This category allows consumers to rate their experience with the reliability of the advertising and product claims made by the merchant.
On-Time Delivery	This category allows consumers to rate the fulfilment practices of the merchant.
Customer Support	This category allows consumers to rate how well the merchant stands behind their product or service after the sale.
Ease of Returns/Refunds	This category allows consumers to rate the returns and refund practices of the business.

and low ambiguity websites are classified as low risk, while others (high price & low ambiguity and low price & high ambiguity) are classified as medium risk websites. Of the total of 538 websites, 73 have been classified as high risk representing 13.6% of total, 350 as medium risk (65%) and 115 as low risk (21.4%).

We attempted to identify the relationships between the eight independent variables (e-commerce assessment criteria) and the two dependent variables (customer satisfaction and loyalty) for the three risk groups. Since there is more than one dependent variable, we have used Canonical Correlation Analysis (CCA). Please see Section 2.4 for a brief introduction to CCA. We used the freely available Openstat software (<http://www.statpages.org/miller/openstat/>, last accessed on 18 January, 2011) to carry out CCA computations.

Table 2 Descriptive Statistics and Correlations
(All Correlations are Significant at 0.01 Level)

	A	B	C	D	E	F	G	H	I	J
Minimum	0.576	0.420	0.743	0.237	0.567	0.487	0.493	0.167	0.010	0.333
Maximum	1.000	0.999	0.999	0.999	1.000	1.000	1.000	1.000	1.000	0.999
Mean	0.917	0.940	0.939	0.929	0.942	0.921	0.941	0.891	0.922	0.925
Standard Deviation	0.068	0.075	0.035	0.088	0.055	0.055	0.066	0.150	0.112	0.103
Total Satisfaction Rating (A)	1.000									
Customer Loyalty (B)	0.854	1.000								
Comparative Prices (C)	0.589	0.538	1.000							
Management Accessibility (D)	0.859	0.843	0.522	1.000						
Payment Process (E)	0.879	0.837	0.596	0.857	1.000					
Privacy Experience (F)	0.769	0.746	0.536	0.758	0.812	1.000				
Satisfaction with Claims (G)	0.898	0.886	0.592	0.870	0.876	0.727	1.000			
On-Time Delivery (H)	0.677	0.611	0.450	0.665	0.661	0.589	0.639	1.000		
Customer support (I)	0.790	0.799	0.478	0.876	0.792	0.679	0.833	0.619	1.000	
Ease of Returns/ Refunds (J)	0.633	0.637	0.474	0.685	0.612	0.571	0.680	0.483	0.661	1.000

Hair et al. (1998) have suggested a series of stages for conducting CCA. We followed these procedures while conducting our analysis. They have suggested conducting statistical significance test for the canonical correlations of each of the two canonical functions (specified as Function 1 and Function 2). Results are presented in Tables 3 and 4. Table 3 presents the results of tests of each canonical function separately for the three risk groups. The results show that the two canonical functions are statistically significant for the high risk and low risk groups at 0.01 level, but the second canonical function for medium risk group is not statistically significant. Function 1 for all the three risk groups show high levels of canonical correlation (i.e., correlation between the dependent variate and the independent variate), while function 2 for medium risk is quite low. Table 4 presents results of four different multivariate tests of both Function 1 and Function 2 simultaneously for each risk group. The results indicate that the canonical functions, taken collectively, are statistically significant at 0.01 level for each of the three risk groups.

Table 3 Measures of Overall Model Fit for Canonical Correlation Analysis

	Canonical Correlation	Canonical R ²	% Trace	Chi-Sqr	D.F.	Prob.
High Risk (Sample Size 73)						
Function 1	0.945	0.894	80.177	165.835	16	0.000
Function 2	0.470	0.221	19.823	16.61	7	0.020
Medium Risk (Sample Size 350)						
Function 1	0.957	0.916	97.141	861.116	16	0.000
Function 2	0.164	0.027	2.859	9.389	7	0.226
Low Risk (Sample Size 115)						
Function 1	0.914	0.835	82.634	216.237	16	0.000
Function 2	0.419	0.175	17.366	20.928	7	0.004

Table 4 Multivariate Tests of Significance

Statistic	Approx. Stat.	Value	Prob. > Value
High Risk			
Wilkes Lambda	Chi-Squared	168.329	0.000
Hotelling-Lawley Trace	F-Test	33.7691	0.000
Pillai Trace	F-Test	10.0789	0.000
Roy's Largest Root	F-Test	69.5546	0.000
Medium Risk			
Wilkes Lambda	Chi-Squared	863.6229	0.000
Hotelling-Lawley Trace	F-Test	232.2924	0.000
Pillai Trace	F-Test	38.0418	0.000
Roy's Largest Root	F-Test	468.8785	0.000
Low Risk			
Wilkes Lambda	Chi-Squared	218.2302	0.000
Hotelling-Lawley Trace	F-Test	34.2088	0.000
Pillai Trace	F-Test	13.5214	0.000
Roy's Largest Root	F-Test	68.177	0.000

Table 5 shows the results of canonical correlation analyses for the three risk groups. The first few rows show results of redundancy analysis. As per Hair et al. (1998), the redundancy index is the equivalent of computing the squared multiple correlation coefficient between the total independent variable set and each variable in the dependent variable set, and then averaging these squared coefficients to arrive at an average R². According to them, this index provides a summary measure of the ability of a set of

Table 5 Results of Canonical Correlation

Variates/variables	High risk		Medium risk		Low risk	
	Function 1	Function 2	Function 1	Function 2	Function 1	Function 2
	Redundancy analysis for dependent variables					
Variance proportion	0.946	0.053	0.927	0.073	0.924	0.076
Redundancy index	0.846	0.012	0.849	0.002	0.772	0.013
Redundancy analysis for independent variables						
Variance proportion	0.503	0.046	0.729	0.053	0.494	0.034
Redundancy index	0.450	0.010	0.668	0.001	0.412	0.006
Canonical loadings						
Dependent variables						
Total satisfaction rating	0.964	0.265	0.98	-0.2	0.984	-0.176
Customer loyalty	0.981	-0.194	0.945	0.326	0.938	0.347
Independent variables						
<i>Pre-purchase criteria</i>						
Comparative prices	0.670	0.214	0.657	-0.267	0.386	-0.163
Management accessibility	0.890	0.236	0.934	0.029	0.828	0.095
Payment process	0.885	0.232	0.947	-0.052	0.855	-0.421
Privacy experience	0.543	0.083	0.854	-0.093	0.653	-0.074
<i>Post-purchase criteria</i>						
Satisfaction with claims	0.946	-0.295	0.974	0.079	0.955	0.117
On-time delivery	0.740	0.119	0.738	-0.525	0.452	-0.179
Customer support	0.308	-0.308	0.95	0.154	0.774	0.003
Ease of returns/refunds	0.411	0.131	0.711	0.182	0.494	-0.081
Ranks based on canonical loadings of independent variables						
<i>Pre-purchase criteria</i>						
Comparative prices	5		8		8	
Management accessibility	2		4		3	
Payment process	3		3		2	
Privacy experience	6		5		5	
<i>Post-purchase criteria</i>						
Satisfaction with claims	1		1		1	
On-time delivery	4		6		7	
Customer support	8		2		4	
Ease of Returns/refunds	7		7		6	

independent variables (taken as a set) to explain variation in the dependent variables (taken one at a time). Generally speaking, the redundancy index is analogous to the R^2 measure used in multiple regression analysis. Looking at Table 5, we find that redundancy indices for Function 1 for all the three risk groups are very high for dependent variables and reasonably high for independent variables. Function 2 for all the three risk groups show very low levels of redundancy indices. Hence, we do not use Function 2 in our further analysis.

Hair et al. (1998) consider using canonical loadings (correlations between individual variables with the corresponding variates) to interpret the results of CCA to be more appropriate than using canonical weights (i.e., the weights used to estimate variates). Hence, canonical loadings are shown in the remaining rows of Table 5. Note that the dependent variables have high loadings exceeding 0.90. The independent variables have varying degrees of correlations with the corresponding independent variates, as their canonical loadings (for Function 1) varies from a low of 0.308 for “customer support” for high risk group to a high of 0.974 for “satisfaction with claims” for medium risk group. As suggested by Hair et al. (1998), we interpret these canonical loadings to indicate the strength of relationships between the sets of dependent variables and independent variables in this study, and use them for testing Hypothesis 1-4. For convenience, a ranking of the independent variables on the basis of their canonical loadings is listed in the bottom rows of Table 5. Before proceeding to testing the hypotheses, we should point out that Hair et al. (1998) suggest using validation of CCA results through one of several procedures. One suggested procedure is the sensitivity analysis of the independent variable set, where canonical loadings are examined for stability when individual independent variables are deleted from the analysis. We have carried out such a procedure and checked that the canonical loadings of independent variables and canonical correlations given in Table 5 are stable and consistent for the omission of independent variables.

We first take up Hypothesis 1a for validation. Looking at the results in Table 5, we find that the only product-specific criterion “Comparative Prices” has a canonical loading of 0.67 for high risk group. However, many of the service-specific criteria have higher canonical loadings, though some other service-specific criteria have a lower loading. Based on the values of the loadings, we can conclude that the loading of “Comparative Prices” is not the highest, and hence, we feel that our results do not support Hypothesis 1a. However, to provide more concrete results, we extracted a common factor of all the seven service-specific criteria for each risk group using principal component analysis, and carried out a CCA of this factor and “Comparative Prices.” We first checked that all the assumptions of factor analysis are satisfied. We found acceptable results for the factor analysis with Bartlett’s test of sphericity showing that the correlations, when taken collectively, are significant. Kaiser-Meyer-Olkin Measure of Sampling Adequacy (MSA)

and MSA for individual criteria were above the acceptable level of 0.5. The factor analysis for all the risk groups yielded only one factor with eigenvalue above 1.00 and with high explanatory power of cumulative variance of all the service-specific criteria. This was also confirmed by a subsequent Scree plot test.

Results of CCA with two independent variables (“comparative prices” and factor score for all the seven service-specific factors) are shown in Table 6. Some results of this CCA (such as the significance of overall fit and multivariate measures of significance) are not shown in this table but have been found to be satisfactory. Canonical correlations, shown in the first row, are very high. Canonical loading of “comparative prices” (0.705) for high risk group is not larger than that of the factor score of the service-specific criteria (0.998). This result again does not support Hypothesis 1a; we cannot conclude that the importance of product-specific criterion in explaining customer satisfaction and loyalty is more than the importance of service-specific criteria for high risk group.

Hypothesis 1b is supported by the results shown in Tables 5 and 6. As per Table 5, canonical loading of “comparative prices” is the highest for high risk group, but decreases gradually to 0.657 for medium risk group and to 0.386 for the low risk group. Some researchers suggest that only the variables with canonical loadings above 0.45 could be considered significant enough (e.g., Baloglu et al., 1998) for further interpretation. Using

Table 6 Results of Canonical Correlation (Function 1) for Price- & Service-Specific Criteria

Variates/variables	High risk	Medium risk	Low risk
Canonical correlation	0.902	0.945	0.849
Redundancy analysis for dependent variables			
Variance proportion	0.947	0.926	0.912
Redundancy index	0.771	0.827	0.661
Redundancy analysis for independent variables			
Variance proportion	0.747	0.720	0.585
Redundancy index	0.608	0.643	0.422
Canonical loadings			
Dependent variables			
Total satisfaction rating	0.974	0.981	0.991
Customer loyalty	0.972	0.943	0.923
Independent variables			
Comparative prices	0.705	0.665	0.418
Factor score for all the 7 service-specific criteria	0.998	0.999	0.998

this yardstick, we find “Comparative Prices” do not have significance in explaining customer satisfaction and loyalty for the low risk group. Similar results can be derived from Table 6, supporting Hypothesis 1b; the importance of product-specific criterion in explaining customer satisfaction and loyalty reduces as the risk levels decrease.

Results of Tables 5 and 6 support Hypothesis 2a. The canonical loadings of all the seven service-specific criteria in Table 5 for low risk group are higher than that of “comparative prices”. Similar results are available in Table 6 also. Hence we conclude that the importance of service-specific criteria is more than that of product-specific criterion for low risk products.

Results of Tables 5 and 6 do not support Hypothesis 2b. The canonical loadings of all the seven service-specific criteria in Table 5 do not show any gradual trend. The canonical loading of the factor score for service-specific criteria in Table 6 should be considered as equal. Thus we conclude that the importance of service-specific criteria does not change across risk groups.

We find that Hypotheses 3 and 4 could not be convincingly verified using the results of Table 5. The canonical loadings of pre-purchase criteria (comparative prices, management accessibility, payment process and privacy experience) and post-purchase criteria (satisfaction with claims, on-time delivery, customer support and ease of returns/refund) do not show marked variation across risk groups. A subsequent analysis using factor scores of pre-purchase criteria and post-purchase criteria (shown in Table 7) also does not show any marked pattern. All the assumptions of factor analysis and canonical correlation analysis have been checked for the results in Table 7. All the canonical loadings of independent variables in Table 7 are above 0.9 and should be considered approximately equal. Hence, we feel that our results do not support Hypotheses 3 and 4; the importance of pre-purchase criteria or post-purchase criteria in explaining customer satisfaction and loyalty does not vary across risk groups.

5. Discussion

Our results have not supported Hypothesis 1a and we cannot conclude that the importance of product-specific criterion in explaining customer satisfaction and loyalty is more than that of service-specific criteria for high risk group. These findings are somewhat contrary to those of Finch (2007) who found product-oriented criteria would get higher importance for high risk categories. The contradictory results could be due to the nature of data used in our and Finch’s study. While Finch (2007) collected data from e-bay feedbacks, our data is based on customer ratings. One possible reason for this discrepancy could be that online feedbacks are affected by reporting bias as pointed out by Dellarocas

Table 7 Results of Canonical Correlation (Function 1) for Pre- & Post-Purchase Criteria

Variates/variables	High risk	Medium risk	Low risk
Canonical correlation	0.903	0.943	0.834
Redundancy analysis for dependent variables			
Variance proportion	0.945	0.926	0.915
Redundancy index	0.770	0.823	0.637
Redundancy analysis for independent variables			
Variance proportion	0.903	0.951	0.917
Redundancy index	0.736	0.846	0.639
Canonical loadings			
Dependent variables			
Total satisfaction rating	0.984	0.982	0.992
Customer loyalty	0.960	0.942	0.920
Independent variables			
Factor score for all the 4 pre-purchase criteria	0.993	0.976	0.944
Factor score for all the 4 post-purchase criteria	0.906	0.974	0.971

and Wood (2008). However, our results are somewhat in agreement with Finch's study in that the importance of product-specific criterion decreases for lower risk groups. Our support for Hypothesis 2a is also in line with Finch's study that service-specific criteria get higher importance for low-risk groups.

Our study also found that risk has no moderating role on the importance of service-specific criteria. This generally highlights the need to maintain adequate service levels for all products sold over the internet.

A very important result emerging from our study is the significance of both the pre-purchase and post-purchase criteria for all the risk groups. Our results do not find evidence of influence of risk here. In some sense, our results are contrary to that of Otim and Grover (2006) and Jiang and Rosenbloom (2005) that have found that post-purchase criteria to be more important than pre-purchase criteria. Our results highlight that both the pre-purchase and post-purchase criteria are important and should be emphasized by e-commerce websites. Significance of post-purchase criteria in maintaining customer loyalty has been stressed in several studies. Thirumalai and Sinha (2005) found that customer expectations of these set of criteria (called as order-fulfillment variables in their study) varied for different product segments (specialty, convenience and shopping goods). Jiang and Rosenbloom (2005) found strong relationship between "after-delivery satisfaction" and customer loyalty. Similar set of criteria has been recognized by Heim and

Sinha (2001) as important determinant of customer loyalty for electronic goods. Thus, our findings reinforce the universal view that correct product information and unexaggerated claims about product performance has led to customer loyalty in majority of the product categories. The importance of pre-purchase criteria explains the need to provide correct product information in the website, good website browsing experience and emphasizing prices for products in all risk groups. This also highlights the need for improving security of transactions on the internet. This finding is consistent with those of Odom et al. (2002), who found that security of a site using appropriate web assurance seals (such as Verisign) influenced consumers' online purchase behavior.

6. Summary, conclusions and limitations

The role of perceived risk in financial transactions, especially over the internet, has been well documented in the literature. Hence, our study has provided an effort to understand the moderating role of risk on the relationships between performance of e-commerce of websites in terms of various operational criteria and a collective set of customer satisfaction and customer loyalty. Using online ratings of customers of 538 websites over eight criteria as independent variables and customer satisfaction and loyalty as dependent variables, we found evidence of the moderating role of risk in the importance of product-specific criteria, but not on the importance of service-specific criteria. Similarly, we found that risk does not play a significant role on the relationships between pre-purchase and post-purchase criteria and customer satisfaction/loyalty.

We believe that the analysis presented in this paper contributed to the literature in two ways, by considering both customer satisfaction and customer loyalty as determinants of winning customers, and by providing risk perspective to existing studies that have used online ratings. However, we believe that there is scope for further improvement. We restricted our analysis to risk considerations but more experiments on different product groupings are possible. For example, the distribution of importance levels for shopping, convenience and specialty products as considered by Thirumalai and Sinha (2005) could be studied. When demographic, geographic and psychographic details of consumer are available, it would provide more targeted analysis. A busy "cash-rich, time-poor" customer in a developed country is likely to provide higher importance to convenience than a poor retired consumer in a developing country. Males, who generally do not enjoy shopping at a physical store, are said to prefer online shopping. Thus, many further useful insights can be attempted when such additional data on customer is collected by online rating firms and made available to the public.

Finally, the potential limitations of canonical correlation analysis (CCA) should also be pointed out here (Hair et al., 1998). First of all, CCA maximizes the correlation between dependent and independent variates and does not optimize the interpretability, and hence canonical loadings may not be stable. Stability analysis procedures have been suggested to overcome this limitation, which have been checked for all the analyses presented in this paper. Our CCA assumed linear relationships but this may not always be true. Though canonical loadings have been considered as more appropriate measures of checking the relationships than canonical weights, precise statistics to interpret CCA results are not yet fully developed, and our interpretations should be viewed with this limitation. However, it should be pointed out that CCA is finding more number of applications over the years, highlighting the acceptability of this multivariate statistical analysis procedure.

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