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Adoption of E-commerce in Bangladesh: Probit Regression and Principal Component Analysis Approach

Mohammad Ahsan Uddin*

Department of Statistics, Faculty of Science, University of Dhaka, Bangladesh.

*Correspondence: munna_stat@yahoo.com (Dr. Mohammad Ahsan Uddin, Associate Professor, Department of Statistics, University of Dhaka, Bangladesh).

ABSTRACT

Web based services have turned into an integral part of peoples' life. Ease of use and several advantages lead to the popularity of adopting electronic commerce (e-commerce). Though a big number of customers visit and register on the commerce sites daily, the selling rate is low for lack of trust and loyalty. Trust is the main connector of companies and customers. Loyal customers are the important assets for the companies. This study aims at identifying the factors that are associated with the trust and risk perception of the customers on e-commerce. A primary dataset is collected on this occasion. Likert scale type questionnaire is involved in the questionnaire and data reliability is checked through Cronbach's alpha. Probit regression and principal component analysis are used as statistical analysis. The study finds the variables age, internet using purpose, market orientation, and technology as significantly related to trustworthiness of the customers on e-commerce, while the variables experienced using the internet, internet using purpose, and market orientation are potential determinants of risk perception. The study results suggest the e-commerce companies emphasize technologies for keeping accurate information, performing the outmost of the customers' benefit, and collecting customers' information. In addition, they should be conscious of the customers' opinion and pleasant experience, along with maintaining the mentioned delivery time.

Keywords: e-commerce, Trust perception, Cronbach's alpha, Regression, and Principal component analysis.

INTRODUCTION:

The current world is going ahead with the technological development. Electronic commerce (E-commerce) is one of the gifts of technological development, which facilitates people's life to adopt it in every sphere of life (Hossin *et al.*, 2018). E-commerce is internet based business, society needs to develop sustainable ecosystem for it (Poorangi *et al.*, 2013). Since, fake products create bad effect on the e-commerce ecosystem. Also, adoption of e-commerce is hampered by poor market information and poor infrastructure (Cui and Pan, 2015). But, e-commerce

adoption provides benefits to individuals and traders. In Bangladesh, e-commerce adoption is still in developing phase, though it started its journey in the late 1990s and experienced a little growth in 2001-2008 (Karim and Qi, 2018). The situation changed in 2012-2013 with the emerge of two e-commerce sites, Akhoni and Ajkerdeal (Mohiuddin, 2014). Their good appreciation encouraged foreign investor, Olx, Daraz, and Kaymu, to join the competition (Karim and Qi, 2018). Among the numerous recent e-commerce sites, Rokomari.com and Bikroy.com are mentionable who provide both buying and selling options (Rahman, 2015).

In future, e-commerce business strategy can bring glorious opportunity for our country. Trust is the basic principles of every business relationship (Hart & Saunders, 1997). This study addresses the key factors affecting the trust and risk perception of the customers on e-commerce. Necessary suggestions that the e-commerce companies can focus on to draw customers' satisfaction are also determined.

MATERIALS AND METHODS:

A primary dataset is collected and analyzed to obtain current view about perception towards e-commerce with respect to business to consumer (B2C) e-commerce websites. The data is collected from people of different age groups of Dhaka city. A sufficient questionnaire is made on this purpose, and the data collection is done using convenience sampling. The sample size for this study is 450, the calculation of sample size is shown below:

| | |
|--------------------------------------|--|
| $n = \frac{z^2 p(1-p)}{e^2}$ $= 450$ | <p><u>Where:</u> p = 0.25 = Estimate of the population proportion, (here we assume that 25% people adopt e-commerce) z = 1.96 (The standard value of z at 95% confidence level) e = 0.04 (Precision level 4%)</p> |
|--------------------------------------|--|

Oftentimes, Likert scales are applied in data on the attitudes, personalities, opinions, emotions, and descriptions (Allen and Seaman, 2007; Gliem and Gliem, 2003). The study devised thirty-four items to measure trust, risk perception, market orientation, technology trustworthiness and web experience. Each question was in a 5-point Likert item from "strongly disagree" to "strongly agree" categories. Cronbach's alpha measures scale reliability (Santos, 1999). It is used when there are multiple Likert questions, and the researcher wants to know which one is reliable or not (Bland and Altman, 1997). Cronbach's alpha is commonly calculated as the squared correlation of sample values which is obtained using a multi-item scale and their true values (Tavakol and Dennick, 2011). Mathematically:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_{Y_i}^2}{\sigma_X^2} \right),$$

Where, *k* is the number of items, σ_X^2 is the variance of sum of all items, and $\sigma_{Y_i}^2$ is variance of *i*th item (Gliem and Gliem, 2003). Since, it is a ratio of two variances; its theoretical value varies from zero to one. Higher values of alpha are more desirable and the researchers, as a rule of thumb, require a reliability of 0.70 or higher (Raat *et al.*, 2005). Customers' trustworthiness and risk perception are expressed in two categories: "agree" and "disagree", which put the analysis within binary choice models. Probit model is an option for explaining a binary (0 or 1) dependent

variable (Greene, 2003; Gujarati *et al.*, 2004). For estimating probabilities of customer's trustworthiness and risk worthiness, the model can be written mathematically as:

$$L_i^* = X_i' \beta + \epsilon_i$$

Where, L_i^* is a latent variable (not observable) expressing trust and risk perception and what is observed is a dummy variable L_i given by (Rosett and Nelson, 1975).

$$L_i = \begin{cases} 1, & \text{if } L_i^* > 0 \\ 0, & \text{otherwise.} \end{cases}$$

The X_i is a vector of explanatory factors consisting of age, education status, experienced of using internet, internet using purpose, payment system, market orientation, and technology; the β is the vector of unknown parameters and the ϵ_i is the random error term assumed to be normally distributed. The probit model expresses the probability p_i that L_i takes the value 1 as –

$$p_i = \text{prob}(L_i = 1) = [\epsilon_i > -X_i' \beta] = 1 - F[-X_i' \beta] = F[X_i' \beta]$$

Where, *F* is a cumulative distribution function of ϵ_i (Cappellari and Jenkins, 2003). As the coefficients of unknown parameters β 's do not have simple interpretation (Bagozzi *et al.*, 2015), except the case that it tells how the variable is related to the dependent variable, this model is best interpreted through marginal effects (Greene, 1996). For the normal distribution, this is given as:

$$\frac{\partial E(L_i|X_i)}{\partial X_i} = F(Z_i) \beta$$

Where, $Z_i = X_i' \beta$, which shows the effect of an increase in X_i on p_i and this effect depends on the slope of the probit function which is given by (Z_i) and the magnitude of the parameter (Saha *et al.*,1997).

To assess potential elements of customer’s trust-worthiness and risk perception in e-commerce, principal component analysis (PCA) is used, which reduces considered variables to a fewer number of uncorrelated variables (Wold *et al.*, 1987). It reduce data dimension and increase clustering visualization. PCA uses linear combinations of linearly uncorrelated original variables (Bro and Smilde, 2014). For the p-component random vector X , consider the linear combinations.

$$Y_1 = l_{11}X_1 + l_{21}X_2 + \dots + l_{p1}X_p,$$

$$Y_2 = l_{12}X_1 + l_{22}X_2 + \dots + l_{p2}X_p,$$

Table 2: Item-Total Statistics

| Item-Total Statistics (if corresponding item is deleted) | | | | |
|--|------------|----------------|--------------|---------------------|
| | Scale Mean | Scale Variance | Correlation* | Cronbach's α |
| Necessary skills and ability to carry out online transaction | 111.19 | 116.719 | 0.374 | 0.766 |
| Necessary technology knowledge to carry out online transaction | 111.25 | 117.232 | 0.319 | 0.768 |
| Technology obstacles should not be a major concern | 111.69 | 117.426 | 0.255 | 0.772 |
| Technical failure | 111.56 | 117.050 | 0.316 | 0.768 |
| Predict performance by the customers | 110.94 | 119.382 | 0.263 | 0.771 |
| Past and future behaviors are positively related | 110.79 | 118.341 | 0.295 | 0.770 |
| When the new one is dealing, I had a pleasant experienced | 110.99 | 119.134 | 0.279 | 0.770 |
| Care, concern, goodwill to their customers | 111.08 | 114.664 | 0.441 | 0.762 |
| Performing the outmost of the customers benefit | 111.23 | 117.229 | 0.322 | 0.768 |
| Demonstrate customers believe | 111.54 | 116.594 | 0.334 | 0.768 |
| Risky when fail to meet customer expectations | 110.81 | 123.393 | 0.044 | 0.770 |
| Risky when the products inferior quality | 110.80 | 120.771 | 0.181 | 0.774 |
| Risky when the products may be dangerous | 111.42 | 120.617 | 0.151 | 0.776 |
| Risky when the products may be available lower price | 111.01 | 121.330 | 0.133 | 0.767 |
| Risky when it may cause others to think poorly | 111.66 | 119.364 | 0.209 | 0.774 |
| Risky when the products delivered may fail my personal image | 111.31 | 119.452 | 0.233 | 0.772 |

And so on where the Y 's are the required principal components which are being extracted using maximization of variance (Thomaz and Giraldi, 2010).

RESULTS AND DISCUSSION:

The Reliability Statistics at **Table 1** provides the actual value for Cronbach's alpha. It is seen that Cronbach's alpha is 0.776, which indicates a high level of internal consistency for our scale with the data.

Table 1: Reliability statistics

| Reliability statistics | |
|------------------------|-----------------|
| Cronbach's Alpha | Number of Items |
| 0.776 | 34 |

The final column of **Table 2** shows the values of Cronbach's alpha if the corresponding items are deleted. We can see from the values at last column that removal of any item would result in a lower Cronbach's alpha (lower than 0.776). Therefore, we would not remove these questions.

| | | | | |
|---|--------|---------|-------|-------|
| Risky when the products delivered may fail the expected time | 111.11 | 120.112 | 0.194 | 0.774 |
| The web sites are good at collecting customers information | 111.07 | 119.181 | 0.273 | 0.771 |
| Web sites encourage customers to send their feedback | 110.86 | 118.748 | 0.296 | 0.770 |
| Feeling embarrassed to send negative feedback | 111.04 | 119.176 | 0.243 | 0.772 |
| Web sites review and customers opinions effectively | 111.13 | 118.538 | 0.281 | 0.770 |
| Customers opinion can reach the relevant department | 111.23 | 117.655 | 0.315 | 0.769 |
| Customers opinion can easily be lost | 111.19 | 120.675 | 0.174 | 0.775 |
| Customers opinion can influence the way of website | 110.76 | 119.431 | 0.283 | 0.770 |
| Receiving a timely response | 111.10 | 119.241 | 0.268 | 0.771 |
| Purchasing is solved effectively and satisfactorily | 111.26 | 117.631 | 0.318 | 0.768 |
| Web sites value customers opinion | 111.09 | 119.116 | 0.280 | 0.770 |
| Allowing customers contribution to the sites | 111.19 | 117.595 | 0.344 | 0.767 |
| Transactions and deliveries work out quite smoothly by the joint effort | 111.01 | 119.092 | 0.321 | 0.769 |
| Finding out mistake during transaction | 111.10 | 117.818 | 0.323 | 0.768 |
| Conflicting information on the different pages | 110.89 | 120.456 | 0.201 | 0.774 |
| Capable of processing a large number of transactions | 111.24 | 114.915 | 0.425 | 0.763 |
| Technologies are effective keeping the accurate data | 111.12 | 117.914 | 0.329 | 0.768 |
| Getting access to the data without permission | 110.53 | 121.635 | 0.121 | 0.775 |

*Corrected Item-Total Correlation

Table 3 shows the probit regression model results that investigate the factors behind the trustworthiness of the customers on e-commerce. The result finds the variables age, internet using purpose, market orientation, and technology as significant, while education status, experienced of using internet, and payment system are insignificant at 5% level of significance. Age has a significant association (p-value 0.047) with trust in online business. Holding other factors constant, a percentage increase in age significantly increases probability of having trustworthiness on e-commerce by 0.260. For the variable internet using

purpose, the respondents using internet for educational purpose, online banking, and online game have significantly 0.545, 0.632, and 0.401 times chance, respectively, of having trust on e-commerce with respective p-value 0.083, 0.022, and 0.073. Market orientation significantly increases the chance of having trust on e-commerce by 1.021 times with p-value less than 0.001. Also, the respondents who frequently use internet based technologies have significantly 0.727 times probability of having trust on e-commerce with p-value less than 0.001.

Table 3: Probit regression model estimates of the selected covariates for having trust on e-commerce along with standard error (SE), z calculated value (Z), and p-value

| Covariates | Coefficient | SE | Z | p-value |
|-------------------------|-------------|-------|--------|---------|
| Constant | -3.158 | 1.009 | -3.129 | 0.002 |
| Age | 0.260 | 0.142 | 1.826 | 0.047 |
| Education status | | | | |
| Secondary | 0.457 | 0.851 | 0.538 | 0.590 |
| Higher secondary | 0.643 | 0.857 | 0.751 | 0.452 |
| Graduate | 0.430 | 0.904 | 0.476 | 0.634 |

| | | | | |
|--------------------------------------|--------|-------|--------|--------|
| Higher | 0.320 | 1.379 | 0.232 | 0.816 |
| Primary | - | - | - | - |
| Experienced of using internet | | | | |
| Agree | -0.398 | 0.258 | -1.542 | 0.123 |
| Disagree | - | - | - | - |
| Internet using purpose | | | | |
| Entertainment | -0.029 | 0.294 | -0.099 | 0.921 |
| Educational purpose | 0.545 | 0.315 | 1.731 | 0.083 |
| Shopping | -0.193 | 0.207 | -0.931 | 0.351 |
| Information search | -0.201 | 0.311 | -0.645 | 0.518 |
| Social networking | -0.125 | 0.261 | -0.479 | 0.631 |
| Online banking | 0.632 | 0.278 | 2.276 | 0.022 |
| Online game | 0.401 | 0.224 | 1.788 | 0.073 |
| Others | - | - | - | - |
| Payment system | | | | |
| Visa | 0.018 | 0.294 | 0.063 | 0.950 |
| Amex | -0.789 | 0.536 | -1.472 | 0.141 |
| PayPal | -0.163 | 0.897 | -0.897 | 0.855 |
| Amazon payments | -0.927 | 0.707 | -1.311 | 0.189 |
| Master card | -0.037 | 0.325 | 0.116 | 0.907 |
| bkash | 0.586 | 0.231 | 2.535 | 0.111 |
| Rocket DBBL | -0.005 | 0.213 | -0.024 | 0.980 |
| Cash on delivery | - | - | - | - |
| Market orientation | | | | |
| Agree | 1.021 | 0.209 | 4.882 | <0.001 |
| Disagree | - | - | - | - |
| Technology | | | | |
| Agree | 0.727 | 0.221 | 3.285 | <0.001 |
| Disagree | - | - | - | - |

Table 4: Probit regression result for marginal effect on trust

| Variables | Marginal effect | SE | Z | p-value |
|--------------------|-----------------|-------|-------|---------|
| Age | 0.072 | 0.034 | 2.085 | 0.037 |
| Education purpose | 0.096 | 0.079 | 1.217 | 0.223 |
| Online banking | 0.119 | 0.086 | 1.390 | 0.164 |
| Online game | 0.103 | 0.074 | 1.396 | 0.162 |
| Market orientation | 0.342 | 0.062 | 5.469 | <0.001 |
| Technology | 0.242 | 0.064 | 3.776 | <0.001 |

The marginal effects of the variables at **Table 4** are obtained by multiplying the coefficient of each independent variable (**Table 3**) by the inverse of the likelihood function using median as the values of each independent variable (Isa & Siyan). The variables age, market orientation, and technology have significant marginal effect on trustworthiness at 5% significance

level. The variable age is significant under 5% level of significance as its corresponding p-value is 0.037 which is less than 0.05. The corresponding marginal effect is 0.072, that is customer's trust significantly increases 7.2% towards e-commerce when age increases 1 year, keeping other covariates at a fixed level. Meanwhile, customer's trust significantly (p-value

<0.001) increases by 34.2% towards e-commerce for those who agree about market orientation compared to those who disagree about market orientation. Similarly, customer's trust significantly (p-value <0.001) increases by 24.2% towards e-commerce for those who frequently use internet based technology.

Table 5 presents the probit regression model results on customer risk perception. The result finds the variables experienced of using internet, internet using purpose, and market orientation as significant, while age, education status, payment system, and technology are insignificant at 5% level of significance. For those

who are experienced of using internet, the probability of risk perception significantly (p-value 0.016) decreases by 0.545. For the variable internet using purpose, the probability of risk perception significantly decreases by 0.472 and increases by 0.726, respectively, for the respondents using internet for entertainment, and social networking compared to those who belong to others category with respective p-value 0.087, 0.002. Market orientation significantly increases the chance of having risk perception on e-commerce by 0.450 with p-value 0.019.

Table 5: Probit regression model estimates of the selected covariates for risk perception on e-commerce along with standard error (SE), z calculated value (Z), and p-value

| Covariates | Coefficient | SE | Z | p-value |
|--------------------------------------|-------------|---------|--------|---------|
| Constant | -5.398 | 204.422 | -0.026 | 0.978 |
| Age | 0.072 | 0.126 | 0.569 | 0.569 |
| Education status | | | | |
| Secondary | 4.865 | 204.421 | 0.024 | 0.981 |
| Higher secondary | 4.798 | 204.421 | 0.023 | 0.981 |
| Graduate | 4.494 | 204.422 | 0.022 | 0.982 |
| Higher | -0.304 | 294.928 | -0.001 | 0.999 |
| Primary | - | - | - | - |
| Experienced of using internet | | | | |
| Agree | -0.545 | 0.227 | -2.396 | 0.016 |
| Disagree | - | - | - | - |
| Internet using purpose | | | | |
| Entertainment | -0.472 | 0.276 | -1.707 | 0.087 |
| Educational purpose | 0.098 | 0.277 | 0.355 | 0.722 |
| Shopping | -0.137 | 0.188 | -0.727 | 0.466 |
| Information search | 0.102 | 0.283 | 0.361 | 0.717 |
| Social networking | 0.726 | 0.242 | 2.993 | 0.002 |
| Online banking | 0.116 | 0.253 | 0.458 | 0.647 |
| Online game | -0.113 | 0.203 | -0.558 | 0.576 |
| Others | - | - | - | - |
| Payment system | | | | |
| Visa | -1.101 | 0.332 | -3.314 | 0.211 |
| Amex | 0.727 | 0.466 | 1.560 | 0.118 |
| Paypal | 0.355 | 0.820 | 0.433 | 0.665 |
| Amazon payments | 0.044 | 0.601 | 0.074 | 0.941 |
| Master card | -0.402 | 0.346 | -1.162 | 0.245 |
| bkash | 0.320 | 0.207 | 1.542 | 0.122 |
| Rocket DBBL | 0.114 | 0.199 | 0.576 | 0.564 |
| Cash on delivery | - | - | - | - |
| Market orientation | | | | |

| | | | | |
|-------------------|--------|-------|--------|-------|
| Agree | 0.450 | 0.192 | 2.337 | 0.019 |
| Disagree | - | - | - | - |
| Technology | | | | |
| Agree | -0.149 | 0.200 | -0.746 | 0.455 |
| Disagree | - | - | - | - |

Table 6: Probit regression result for marginal effect on risk perception

| Variables | Marginal effect | SE | Z | p-value |
|-------------------------------|-----------------|-------|--------|---------|
| Experienced of using internet | -0.205 | 0.082 | -2.506 | 0.012 |
| Entertainment | -0.130 | 0.087 | -1.485 | 0.137 |
| Social networking | 0.242 | 0.062 | 3.859 | <0.001 |
| Market orientation | 0.145 | 0.060 | 2.418 | 0.015 |

The marginal effects of the selected variables on risk perception towards e-commerce are shown at **Table 6**. The variables experienced of using internet, social networking, and market orientation have significant marginal effect on risk perception of the e-commerce customers at 5% significance level. The variable experienced of using internet is significant under 5% level of significance as its corresponding p-value is 0.012 which is less than 0.05. The value of its corresponding marginal effect is -0.205 which indicates that customer’s risk perception significantly decreases 20.5% towards e-commerce for an individual who is experienced at using internet compared to an individual who is not experienced at using internet. Customer’s risk perception significantly (p-value <0.001) increases 24.2% for an individual who use internet for social networking compared to others, keeping all other variables at a fixed level. Meanwhile, customer’s risk perception significantly (p-value 0.015) increases by 14.5% towards e-commerce for those who agree about market orientation compared to those who disagree about market orientation.

Before proceeding for PCA, one has to check whether the data is appropriate for the analysis. For that reason, this study uses two statistics: the Bartlett test of Sphericity and the Kaiser-Meyer-Olkin Measure of

Sampling Adequacy (Chiciudean and Chiciudean, 2013).The Kaiser-Meyer-Olkin tests whether the partial correlations among the considered variables are small or not (Trujillo-Ortiz *et al.*, 2006). High values (close to 1.0) generally suggest that PCA may be useful with that data.

Table 7: KMO and Barlett’s Test

| | | |
|--|--------------------|---------|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 0.711 |
| Bartlett’s Test of Sphericity | Approx. Chi-Square | 722.102 |
| | df | 136 |
| | p-value | <0.001 |

Here at **Table 7**, Kaiser-Meyer-Olkin measure is 0.711 which indicates that the data set is valid for PCA. On the other hand, Bartlett’s test investigates the hypothesis that the underlying correlation matrix is an identity matrix, which would indicate that variables are not related (Tobias and Carlson, 1969). Small values (less than 0.05) of the significance level permit the use of PCA with the data. Here the p-value is less than 0.001 for Bartlett’s test that is under 5% level of significance there is enough evidence that PCA is useful for the data. So, this study can approach for the PCA with the dataset.

Table 8: Descriptive Statistics

| | Mean | SD |
|--|------|-------|
| Technology obstacles should not be a major concern | 2.80 | 1.162 |
| Predict performance by the customers | 3.54 | 0.881 |
| When the new one is dealing, I had a pleasant experience | 3.50 | 0.872 |
| Care, concern, and goodwill to their customers | 3.41 | 1.008 |

| | | |
|--|------|-------|
| Performing the outmost of the customers benefit | 3.26 | 1.001 |
| Risky when the products have inferior quality | 3.69 | 0.910 |
| Risky when the products may be available at lower price | 3.48 | 0.990 |
| Risky when the products delivered may fail the expected time | 3.39 | 0.974 |
| Websites are good at collecting customers information | 3.42 | 0.881 |
| Websites encourage customers to send their feedback | 3.63 | 0.880 |
| Websites review customers opinions effectively | 3.35 | 0.946 |
| Customers opinion can influence the way of website | 3.73 | 0.828 |
| Receiving a timely response | 3.39 | 0.888 |
| Purchasing is solved effectively and satisfactorily | 3.23 | 0.963 |
| Capable of processing a large number of transactions | 3.25 | 1.019 |
| Technologies are effective in keeping the accurate data | 3.37 | 0.905 |
| Getting access to the data without permission | 3.96 | 0.977 |

Table 9: Communalities

| Communalities | | |
|--|---------|------------|
| | Initial | Extraction |
| Technology obstacles should not be a major concern | 1.000 | 0.487 |
| Predict performance by the customers | 1.000 | 0.477 |
| When the new one is dealing, I had a pleasant experience | 1.000 | 0.453 |
| Care, concern, and goodwill to their customers | 1.000 | 0.551 |
| Performing the outmost of the customers benefit | 1.000 | 0.462 |
| Risky when the products have inferior quality | 1.000 | 0.601 |
| Risky when the products may be available at lower price | 1.000 | 0.628 |
| Risky when the products delivered may fail the expected time | 1.000 | 0.537 |
| Websites are good at collecting customers information | 1.000 | 0.565 |
| Websites encourage customers to send their feedback | 1.000 | 0.387 |
| Websites review customers opinions effectively | 1.000 | 0.602 |
| Customers opinion can influence the way of website | 1.000 | 0.450 |
| Receiving a timely response | 1.000 | 0.607 |
| Purchasing is solved effectively and satisfactorily | 1.000 | 0.530 |
| Capable of processing a large number of transactions | 1.000 | 0.478 |
| Technologies are effective in keeping the accurate data | 1.000 | 0.450 |
| Getting access to the data without permission | 1.000 | 0.637 |

The term communality means the total influence on single observed variable from all the associated factors (Borůvka *et al.*, 2005). Communality for “getting access to data without permission” variable is 0.637 that means 63.7% variation of this variable is explained by the associated factors. Similarly, communality for “risky when the products may be available at lower price” variable is 0.628 that means 62.8% variation of this variable is explained from the factors associated with the study. Here, it is observed that the communalities of all variables ranges from 0.387 to

0.637, i.e. the component extracted can explain the variables well.

Table 10 is showing the Eigen values (Vajda, Valko, & Turanyi, 1985) and the explained percentage of variance in the original variables by the extracted factors. Eigen values bigger than 1 is the criteria to select the factors (Cliff, 1988). From the obtained Eigen values of components, it is seen that first 6 components’ Eigen value is greater than 1. So, the first 6 components should be considered as 6 factors. Here,

factor 1 to factor 6 are explaining 16.057%, 10.278%, 7.038%, 6.605%, 6.272%, and 6.104% of variation of data set, respectively. These 6 factors altogether can explain 52.354% of variation which is nearly 53% of total variation of the data set.

Table 10: Total variance explained

| Component | Initial Eigen values | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|-----------|----------------------|---------------|--------------|-------------------------------------|---------------|--------------|-----------------------------------|---------------|--------------|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.730 | 16.057 | 16.057 | 2.730 | 16.057 | 16.057 | 1.697 | 9.983 | 9.983 |
| 2 | 1.747 | 10.278 | 26.335 | 1.747 | 10.278 | 26.335 | 1.578 | 9.284 | 19.267 |
| 3 | 1.197 | 7.038 | 33.373 | 1.197 | 7.038 | 33.373 | 1.562 | 9.186 | 28.453 |
| 4 | 1.123 | 6.605 | 39.978 | 1.123 | 6.605 | 39.978 | 1.401 | 8.241 | 36.694 |
| 5 | 1.066 | 6.272 | 46.250 | 1.066 | 6.272 | 46.250 | 1.365 | 8.027 | 44.720 |
| 6 | 1.038 | 6.104 | 52.354 | 1.038 | 6.104 | 52.354 | 1.298 | 7.634 | 52.354 |
| 7 | 0.996 | 5.861 | 58.216 | | | | | | |
| 8 | 0.942 | 5.543 | 63.758 | | | | | | |
| 9 | 0.884 | 5.197 | 68.955 | | | | | | |
| 10 | 0.830 | 4.881 | 73.836 | | | | | | |
| 11 | 0.729 | 4.290 | 78.126 | | | | | | |
| 12 | 0.713 | 4.197 | 82.323 | | | | | | |
| 13 | 0.711 | 4.182 | 86.504 | | | | | | |
| 14 | 0.617 | 3.629 | 90.133 | | | | | | |
| 15 | 0.585 | 3.440 | 93.574 | | | | | | |
| 16 | 0.563 | 3.312 | 96.886 | | | | | | |
| 17 | 0.529 | 3.114 | 100.000 | | | | | | |

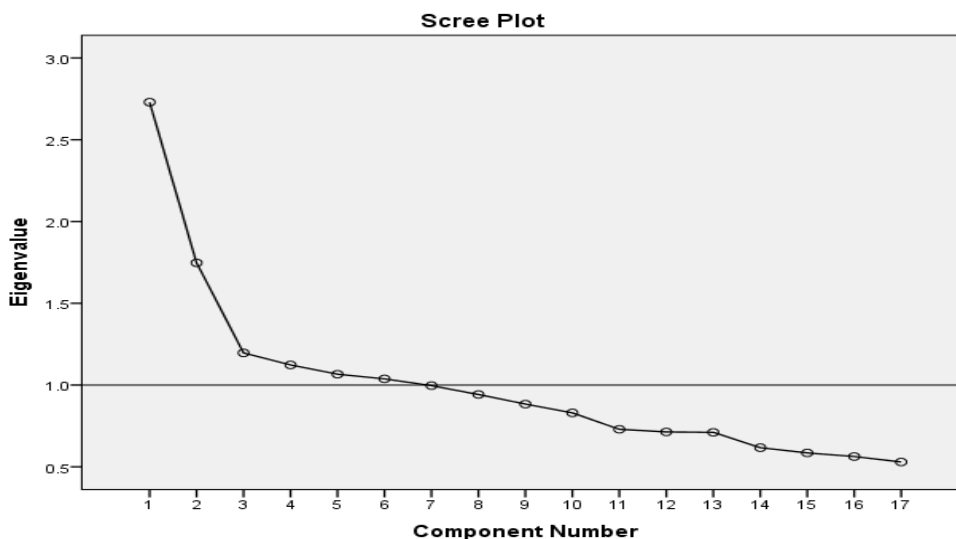


Fig 1: Scree plot of components.

A scree plot graph display the amount of variation explained by each component (Bro and Smilde, 2014). **Fig 1** indicates that only 6 components' Eigen values lie above 1 and rest of the components' Eigen value lie below 1, suggesting considering only 6 components that explain the variation of data set to a specific extent.

Table 11: Rotated component matrix

| | Component | | | | | |
|--|-----------|-------|-------|-------|-------|--------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Technologies are effective in keeping the accurate data | 0.647 | - | - | - | - | - |
| Performing the outmost of the customers benefit | 0.599 | - | - | - | - | - |
| Websites are good at collecting customers information | 0.581 | - | 0.306 | - | - | - |
| When the new one is dealing, I had a pleasant experience | - | 0.606 | - | - | - | - |
| Customers opinion can influence the way of website | - | 0.571 | - | - | - | - |
| Risky when the products delivered may fail the expected time | - | 0.522 | 0.396 | - | - | - |
| Getting access to the data without permission | 0.339 | 0.515 | - | - | - | -0.436 |
| Predict performance by the customers | - | 0.448 | - | - | 0.383 | 0.304 |
| Purchasing is solved effectively and satisfactorily | - | - | 0.676 | - | - | - |
| Technology obstacles should not be a major concern | - | - | 0.652 | - | - | - |
| Capable of processing a large number of transactions | - | - | 0.463 | - | - | - |
| Risky when the products may be available at lower price | - | - | - | 0.783 | - | - |
| Risky when the products have inferior quality | - | - | - | 0.660 | - | - |
| Websites review customers opinions effectively | - | - | - | - | 0.733 | - |
| Websites encourage customers to send their feedback | - | - | - | - | 0.479 | - |
| Receiving a timely response | - | - | - | - | - | 0.734 |
| Care, concern, and goodwill to their customers | 0.364 | - | - | - | - | 0.502 |

From rotated component matrix in **Table 11**, first factor is highly correlated with three variables: technologies are effective in keeping the accurate data, performing the outmost of the customers' benefit, and websites are good at collecting customer's information. These three variables are included in factor 1. Second factor has high correlation with five variables: when the new one is dealing, I had a pleasant experience, customers' opinion can influence website, risky when the products delivered may fail the expected time, getting access to the data without permission, and predict the customers. Third factor 3 has strong correlation with three variables: purchasing is solved effectively and satisfactorily, technology obstacles should not be a major concern, and capable of processing a large number of transactions.

In the case of fourth factor, there is high correlation with two variables: risky when the products may be available at lower price and risky when the products have inferior quality. From the above table we can see that factor 5 is highly correlated with two variables: websites review customers' opinions effectively, and websites encourage customers to send their feedback. The last factor, factor 6, has high correlation with two

variables: receiving a timely response, and care, concern, and goodwill to their customers. These findings are presented at **Table 12**.

These factors are representing potential elements of customer's trustworthiness and risk perception on e-commerce. The factor loading is showing that factor 1 is explaining the variation of the data set most. If the e-commerce companies focus on efficient technologies in keeping the accurate data, performing the outmost of the customers benefit and the websites that are good at collecting customers' information then e-commerce will attain more trust. Factor 2 implies that the customers give importance to the pleasant experience, their personal opinion, and time duration to deliver product. From factor 3, it is obvious that effective and satisfactory purchasing, having no technology obstacles, and capacity of large number of transactions have similar type of effect on trustworthiness and risk perception.

According to factor 4, those who believe that products of lower price are risky, also believe that products of inferior quality are risky. Factor 5 suggests that reviewing customers' opinion and encouraging the customers to send feed-back are almost equally

important. The last factor is explaining that for betterment of e-commerce trust worthiness and risk perception, receiving timely response is necessary, and care, concern, and goodwill should be shown.

Table 12: Included variables in factors

| Factors | Included Variables |
|----------|---|
| Factor 1 | Technologies are effective in keeping the accurate data, Performing the outmost of the customers benefit, and Websites are good at collecting customers information |
| Factor 2 | When the new one is dealing, I had a pleasant experience, Customers opinion can influence the way of website, Risky when the products delivered may fail the expected time, Getting access to the data without permission, and Predict performance by the customers |
| Factor 3 | Purchasing is solved effectively and satisfactorily, Technology obstacles should not be a major concern, and Capable of processing a large number of transactions |
| Factor 4 | Risky when the products may be available at lower price, and Risky when the products have inferior quality |
| Factor 5 | Websites review customers opinions effectively, and Websites encourage customers to send their feedback |
| Factor 6 | Receiving a timely response, and Care, concern, and goodwill to their customers |

CONCLUSION:

The study applied probit regression and principal component analysis to determine which factors matter most on the consumers’ trustworthiness and risk perception on e-commerce. Assessing trustworthiness, probit model finds the variables age, internet using purpose, market orientation, and technology as significant. Trust on e-commerce is higher among the older people than younger’s, a previous study also supports this result (Yoon and Occeña, 2015). If the internet user is using internet for educational purpose, or online banking, or online game, he/she has higher chance to have trust on e-commerce. Market orientation has positive association with e-commerce trust which is supported by a previous work (Corbitt *et al.*, 2003). Frequent internet users have higher trust on e-commerce. For having risk perception on e-commerce, the probit regression model results find the variables experienced of using internet, internet using purpose, and market orientation as significant. Risk perception is lower for the experienced internet users. Internet users for entertainment have lower risk perception, while user of social networking only has higher risk perception on e-commerce. The PCA part suggests the e-commerce companies for focusing on technologies for keeping accurate information, performing the outmost of the customers’ benefit, and collecting customers’ information. More-over, any pleasant experience of the customers, their personal opinion, and time needed to deliver product are the second most important factors to the customers. Customers also

want satisfactory purchasing having no technology obstacles, and capacity of large number of transactions.

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The author declares no conflict of interest.

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