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Signaling and Adverse Selection in Smartphone Market

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ABSTRACT

Smartphone has become part of a standard life for many people because of many activities, apart from communication, that can be carried on. Being an essential tool for communication and other information related activities, Smartphone quality is an important aspect among customers. The aim of this study was to uncover the influence of product information signaling on adverse selection reduction in Smartphone market. There were two groups of Smartphone owners, those with product information before going to the shop and those who got informed at the shop. The findings show that owners who had product information before reaching to the Smartphone vendor perceived higher quality than owners who did not have information before. Nevertheless, the higher the Smartphone quality the higher is the Smartphone price customer has to pay. Informed customers are not willing to buy low quality products even if they pay lower prices. Therefore, Smartphone vendors should ensure high quality and avail information to customers in order to improve customer welfare.

Keywords: Asymmetric information; unawareness; network formation

JEL Code: D82; D83; D85

1. INTRODUCTION

Smartphone is changing the way people work at a high pace. It has revolutionized the communication industry to a very large extent. Many people are turning to the device as a source of knowledge, interaction in social groups. The use of social media has also skyrocketed among individuals in the academic and nonacademic fields. Some people have gone far to feel incomplete without the device (Alfawareh & Jusoh, 2017). It is considered an important device in learning at higher levels since the internet facility can provide visual explanations on complex topics in the learning process. The sales of these devices are estimated to have recently surpassed the sale of any other computing device in the world (Iqbal & Bhatti, 2020). Students interact with fellow students and lecturers in the learning process through Smartphone. However, it does not go

without limitation as most students are destructed by Smartphone (Ifeanyi & Chukwuere, 2018).

In some places, telemedicine has become common due to the difficulties people have in accessing their physicians. The geographical location hinders some patients from reaching to the hospital in an easy way. Using Smartphone for medical consultation is a technological innovation that enhanced the expansion of medical services to people. The development thus facilitates the lives of both patients and doctors (Allaert, Legrand, Abdoul Carime, & Quantin, 2020). Smartphone use is said to increase in patient management, teaching and learning of medicine and health research (Atherley, Hu, Teunissen, Hegazi, & Dolmans, 2021).

The sale of smart phone is growing rapidly worldwide at a staggering rate (Stanley, Waxberg, & Russell, 2015) with an increasing replacement rate. The replacement speed of Smartphone has grown up to an average of less than a year (Cordella, Alfieri, Clemm, & Berwald, 2021). For instance, for the period from 2007 to 2018, iPhone had seen multiple series in the industry. For this period alone, there were a total of 360 series in the United States, 326 in Taiwan, 322 in Japan and 99 in South Korea (Son & Kim, 2021). This shows how fast the device is changing people's attitude towards communication and other applications. With this rapid replacement speed, the reason for owning a Smartphone is beyond communication. Some (Dammert, Galdo, Galdo, & Galdo, 2015) use their smart phone to access job vacancy information provided by companies on the internet. However, smart phone series craving by customers indicates that fashion is taking its place in the industry. Brand and make of the device cannot be obsolete in the main function of communication in less than a year. This durability issue also has an environmental implication which is beyond the reach of the current study.

Smartphone market is expanding due to its technological driving advantage. In India the number of Smartphone users has increased making India the second in the world after China. The Indian government set a policy of manufacturing 1 billion Smart phones by 2025. Even though, the market for Smart phone in India has not surpassed the market for feature phones. For the people leaving in the suburban areas, feature phones are dominating the market especially after being enhanced with internet (Kathuria, Kedia, & Bagchi, 2019). In Czech Republic (Mirvald, 2015), the growing demand for Smart phone and the asymmetric information among buyers has increased the introduction of fake smart phones or their accessories.

Smart phone market is growing with genuine and fake products all together. With asymmetric information, customers are less informed compared to sellers concerning product quality. Currently, there are many sources of information concerning Smartphone brands and their quality. Customers can work independently to search for product quality from friends, other people, or website. Despite the availability of Smartphone quality information sources, some customers complain on the quality of their Smartphone. The current study aims at analyzing the influence of signaling on adverse selection in the Smartphone market. To meet this objective, the study intends to answer the following question: *Are the Smartphone quality perceptions between informed and uninformed customers different? If quality perceptions significantly differ, which group of customers has a positive attitude?* The answers to these questions are important indicators on whether signaling is worthy investing money among Smartphone vendors.

The rest of the study is organized as follows. Section 2 reviews the literature on issues of consumer behavior, signaling, and adverse selection. The research methods are explained and described in section 3. Section 4 provides the research findings and discussions. And last but not least is section 5 which concludes on the findings and provides the recommendations.

2. LITERATURE REVIEW

2.1. Theoretical Literature Review

The theory of reasoned action was developed by Icek Ajzen and Martin Fishbein in 1975 as an improvement over the information integration theory (Ajzen & Fishbein, 1975). They formulated the theory after trying to determine the differences between attitude and behavior. The first change from the integration theory is behavioral intention. This theory also concedes that some factors exist that can limit the behavioral persuade of attitude. For example, lack of money can change the attitude of going out for recreation to staying back home. Consequently, Theory of Reasoned Action predicts behavioral intention, an in between for stopping at attitude predictions and actually predicting behavior because it separates behavioral intention from behavior (Nickerson, 2022). According to Trafimow, (2009), the most proximal cause of behavior is behavioral intention (what one intends to do or not to do). Behavioral intention, in turn, is determined by attitude (one's evaluation of the behavior) and subjective norm (one's evaluation of what important others think one should

do), either of which might be the most important determinant of any particular behavior.

The theory has been widely accepted as a leading theory in the social psychology. However, it has received criticism mainly due to the fact that the theory is not falsifiable. It is claimed that for the theory to be good, it must be falsifiable the characteristic which reasoned action theory lacks even though one of its assumptions has been falsified (Trafimow, 2009). Despite these criticisms, the current study finds the theory useful in explaining consumer behavior in making purchase decision. It is a consumer behavior theory which centers on the association amid marketing and the preexisting feelings consumers convey to their purchasing verdict. Accordingly, consumers act on behaviors that they believe will create or receive a fastidious outcome, familiar or otherwise. As such, logical decision-making is the principal component of what forces consumers to make purchases.

This concept of consumer behavior leans on the importance of specificity over ignorance. In other words, a consumer may only take a specific action when given a reason to believe there shall be a specific desired result. From the time consumer decides to move forward with a decision to the instant the action is finished, a consumer can change his or her mind or select a different course of action. This has led marketers to several insights, the first being how they must associate a purchase with a specific positive result. For instance, AXE advertises its body sprays products in such a way that all who uses them might believe they have improved desirability with women. The theory then emphasizes the importance of moving consumers through the sales pipeline, rather than keeping them idle, where they might have an opportunity to talk themselves out of a purchase or decide to spend their money on a competing brand.

The theory is well applied even in the Smartphone market where companies are busy marketing their products and coming up with improved series. Ignorance, however, makes customers buy products with undesirable qualities. This is due to information asymmetry where the selling side is having more information concerning the product than the purchasing side of the market. The asymmetric information then results into adverse selection where consumers end up having undesirable product. The solution to adverse selection is signaling or advertisement which provides true information about the product.

In his famous paper, the market for 'Lemon', George A. Akerlof in 1970, was the first to formalize the adverse selection problem. In his paper, Akerlof

analyzed the situation where the seller is more informed about the good than the buyer of that good. The analysis shows that there four forms which cars can fit in; new and used cars, bad and good cars. That new cars can be either good or bad, and used cars can be good or bad. The buyer knows with uncertainty that there are some proportions of bad cars in the market but cannot tell exactly which one is good or bad. Sellers of bad cars tend to brand their cars as good one and therefore can sell their cars at relatively lower prices than the prevailing price. Since sellers of good cars know the quality of their machines, they will not be willing to sell their cars at a lower price than the quality. In the way, bad cars will drive good cars out of the market (Akerlof, 1970).

According to Akerlof, (1970), dishonest in the market can lead into nonexistence of the market. The problem is well pronounced in underdeveloped than developed countries. Some unfaithful traders tend to paint their bad products as good products so that they can sell at the same price as good products. The quality differences cannot be identified by customers. To mitigate the problem of information asymmetry, Akerlof brought in suggestions that reduce quality uncertainty. One of the solutions is licensing practice which reduces quality uncertainty. Also providing brand names can reduce quality uncertainty. This is due to the fact that brand names indicate quality but also give the consumer a means of retaliation if the quality does not meet expectation. For the consumer will then curtail future purchases. Often too, new products are associated with old brand names to ensure the prospective consumer of the quality of the product.

Insurers apply various methods to attract good consumers associated with less expected cost and avoid bad consumers whose expected costs are high. That is, picking cherry or skimming cream, and dropping lemon (Einav, Finkelstein, & Mahoney, 2021).

From investment perspective (Michaely & Shaw, 1994), asymmetric information is a situation where some investors are better informed than others about prospective returns of an investment. The outside informed investors possess better knowledge about firm's future prospects than uninformed investors. As a result, they will bid for more shares of the more successful firms, leaving the uninformed investors with a disproportionate amount of the less successful issues. Nevertheless, given the fact that the allocation is not on a pro rata basis, the bias against uninformed investors can be even larger if the investment bankers favor the informed investors. Given the rationality of

market participants, the uninformed investors require a higher average return to compensate them for their allocation disadvantage leading into under-pricing in the initial public offering (IPO) market. However, if there are issues in which the ignorant investors have a priori knowledge that the knowledgeable investors will not participate, there is no allocation disadvantage, and under-pricing is irrelevant.

In the job hiring market, uncertainty is very high. The employer is not certain bout the productive capability of job applicants (Spence, 1973). In his easy, Michael Spence tried to show how employer learns about signals in the hiring process making it as a circle. The applicant incurs cost in signaling, for instance education. The cost of signaling will determine the signaling decisions by the applicant, that is, maximization of return net of signaling costs. After being hired, the employer will start observing the relationship between marginal product and signals of employees. This will shape the employer's conditional probabilistic beliefs thereby reframing the offered wage schedule as a function of signals and indices. In his easy, indices are characteristics which the applicant cannot discretionarily alter such as sex, age, and race. However, he argued that a signal cannot distinguish one applicant from another, unless the costs of signaling are negatively correlated with productive capability. This condition is important because, if it does not hold, then given the offered wage schedule, everyone will invest in the signal in exactly the same way, so that they cannot be distinguished on the basis of the signal. Signaling costs, in the job market goes beyond direct monetary costs including psychic, and time.

2.2. Empirical Evidence

de Andrés, Correia, Rezola, & Suárez, (2022) analyzed the role of funding portals as signaling offering quality in investment crowd funding. Using Probit model in estimation, they uncovered that when the issuer fee does not include securities, there is a negative effect on the success of the offering. But, when this fee combines a gross fee and financial securities, the sign of the coefficient becomes positive and statistically significant. They observe that, the results highlight the relevance of the signal sent by the portals regarding offering quality as a mitigating factor of the adverse selection problem.

In insurance market, Puelz & Snow, (1994) tested the hypotheses that equilibrium in the insurance market entails low-risk types selecting contracts with higher deductibles, and insurance firms offering nonlinear pricing of insurance coverage. They revealed a strong relationship between risk type and

deductible choice. Their results show that low-risk types signal by selecting higher deductibles and are being compensated for doing so by paying a lower average premium for insurance coverage. The insurers are therefore able to identify the risk types from the signaling implied by choice of deductibles. In their study, signaling played a great role in reducing the adverse selection problem.

Signaling (Sadeh & Kacker, 2020) was found to negatively affect firm performance due to attraction of low quality potential partners. This attraction is due to the fact that signaling makes firms disclose their financial representation performance (FRP). They argue that the negative effect of signaling might be due to the fact that the signaling cost is higher compared to the benefits of signaling. Due to fear of other enterprises copying the information disclosed, firms must ensure quality in signaling which is costly. However, their findings show that when signaling is combined with screening, firm's performance improves thereby mitigating the adverse selection problem.

Signaling among online traders (Mavlanova, Benbunan-Fich, & Koufaris, 2012) seem to varied depending on their quality. Low–quality sellers tend to avoid expensive, easy-to-verify signals and use fewer signals than do high–quality sellers. Online customers who are aware of using signals can easily identify sellers of low quality products from those who sell high quality products. In their study, website has been used as a means of sending signals to customers and therefore a source of data collection. The signals sent by sellers were used as unit of analysis. Unlike other studies reviewed, their study is closely linked to the current study only that customers are not involved.

Using detailed data on loan characteristics and borrower repayment, Kawai, Onishi, & Uetake, (2022) studied how signaling affects equilibrium outcomes and welfare in an online credit market. They built and estimated an equilibrium model in which a borrower may signal her default risk through the reserve interest rate. Comparing markets with and without signaling relative to the benchmark with no asymmetric information, they revealed that signaling can restore up to 78 percent of the damage caused by adverse selection. They found that adverse selection destroys as much as 34 percent of total surplus.

2.3. Research Gap

Studies of market signaling from sellers to customers to avoid adverse selection are not limited. But very few studies have worked on customers' opinion

concerning quality of product by comparing pre-purchase informed customers and customers who just get to know the product at the vendor's site. Using eBay Smartphone vendors' product information, Waryoba, (2018) revealed that signaling offsets adverse selection. The current study analyzed customers' perception on quality that lacked in the previous study.

3. METHODOLOGY

3.1. Research Approach

The study used a mixed research approach with both quantitative and qualitative information collected at the same time. Molina-Azorin, (2016) argues that mixed methods research is an opportunity to improve our studies and our research skills. The overall purpose and central premise of mixed methods studies is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems and complex phenomena than either approach alone. However, the approach require more work and financial resources as well as more time (Creswell & Piano Clark, 2007).

Mixed methods research has options which consist of gathering the information at the same time (concurrent design) or introducing the information in phases (sequential design). In gathering both forms of data concurrently, the researcher may seek to compare them to search for congruent findings. When qualitative data collection precedes quantitative data collection, the intention may be to first explore the problem being studied and then to follow

Table 1: Mixed Methods Approaches

Approach	*Type*	*Purpose*	*Limitations*	*Resolution*
QUAL + quan	Simultaneous	Enrich description of sample	Qualitative sample	Utilize normative data for comparison of results
QUAL→quan	Sequential	Test emerging Ho; determine distribution of phenomena in population	Qualitative sample	Draw adequate random sample from same population
QUAN + qual	Simultaneous	To describe part of phenomena that cannot be quantified	Quantitative sample	Select appropriate theoretical sample from random sample
QUAN qual	Sequential	To examine unexpected results	Quantitative sample	Select appropriate theoretical sample from random sample

Source: Morse (1991)

up on this exploration with quantitative data that are amenable to studying a large sample, so that the results can be applied to a population. Alternatively, when quantitative data precede qualitative data, the intention may be to test variables with a large sample and then to explore in more depth with a few cases during the qualitative phase (Molina-Azorin, 2016).

The current study used a simultaneous approach but with large portion of quantitative data and one question on qualitative data. However, the sample size is the same for all alternatives. This approach is also referred to as convergent parallel approach where both qualitative and quantitative data are collected at the same time. This was due to the fact that the researcher had no sufficient time to go for the sequential approach where one approach is followed by another for verification. Quantitative data were taken on prices of the Smartphone where respondents were required to state the monetary cost of the gadget. Other quantitative information on the attitudes of the respondents concerning Smartphone quality has been collected also. The study also inquired on the views of the customers concerning what should be done on Smartphone market information improvement.

3.2. Data Collection

The study applied an online survey using Google form. Using the researcher's contacts, the link was shared to respondents who shared the link to their contacts rendering into Snowball sampling technique. This is because of high rate of non-response among the shared contacts. Since students were major source of information, the study involved class representatives to share the Google form link to their class mates. The study planned to reach a sample size of about 384 respondents using the Cochran sample calculation technique because of the large population size. The sample size come from the critical difference of 0.05, confidence interval of 95 percent giving the Z-score of 1.96, and the success rate of 0.5. However, due to non-response the study managed to survey only 75 respondents.

3.3. Data Analysis

Some of the analyses were directly copied since Google form was automatically analyzed once submission was done. But, mostly the data were extracted from Google in excel sheet form to allow further statistical analysis in STATA software. The study used T-squared approach to analyze quality mean differences between customers who had information before going to the shop and those

who were informed right at the shop. This is referred to as profile analysis for one sample Hotelling's T-Square.

Sepanski, (1994) provided a detailed illustration of how the multivariate Hotelling's T^2 is derived from the univariate *t*-statistics. Although not every detail in his analysis has been included in the current study, the main points can be easily followed by the reader of this article. The univariate *t*-statistics, for the case of unknown but finite variance, is given by equation (1) below.

$$T_n = \frac{\sum_{i=1}^{n}(X_i - \mu)}{\left(\sum_{i=1}^{n}(X_i - \overline{X}_n)^2\right)^{1/2}} = \frac{\sqrt{n}(\overline{X}_n - \mu)}{S_n} \Rightarrow N(0,1) \tag{1}$$

Where $\overline{X}_n = n^{-1}\sum_{i=1}^{n} X_i$ and $S_n^2 = n^{-1}\sum_{i=1}^{n}(X_i - \overline{X}_n)^2$

But, the finite variance condition is very strong which needs to be weakened. A classical necessary and sufficient condition which is weaker than finite variance is that there should exist $a_n \to \infty$ such that $\frac{1}{a_n}\sum_{i=1}^{n}(X_i - \mu) \Rightarrow N(0,1)$ is given by

$$\lim_{n\to\infty} \frac{t^2 P(|X| > t)}{EX^2 I[|X| \le t]} = 0 \tag{2}$$

Once this is achieved, it is said that the law of X denoted as $\ell(X)$ is in the domain of attraction (DOA) of the normal law. In this case, a_n can be chosen to satisfy the relation $a_n^2 = nEX^2 I[|X| \le a_n]$. The normalizing sequence, a_n, may be unknown, and it is true that equation (2) is equivalent to the condition $a_n^{-2}\sum_{i=1}^{n}(X_i - \overline{X}_n)^2 \to 1$. This leads to the same conclusion as in equation (1). The condition of fullness is the multivariate analogue of none degeneracy. The condition for law of X to be in the domain of attraction (DOA) of a full multivariate normal law is exactly as in equation (2) with norms replacing absolute

values. In which case, with a_n satisfying the relation $a_n^2 = nE\|X\|^2 I\left[\|X\| \le a_n\right]$, we have $a_n^{-1}\sum_{i=1}^{n}(X_i - \mu) \Rightarrow N(0, C)$, for some nonsingular (due to the fullness assumption) covariance matrix C. In applying the central limit theorem we encounter a problem of having a_n which depends on X, and may be unknown. Another problem which has been added is the appearance of C in the limit which may also be unknown. This leads into consideration of the multivariate analogue of T_n.

The quantity we are normalizing by in the univariate T_n is $\sqrt{n}S_n$. The multivariate analogue of this is now the matrix $C_n^{1/2}$, where $C_n = \sum_{i=1}^{n}(X_i - \overline{X}_n)(X_i - \overline{X}_n)^T$. In formulating the univariate *t*-statistic, we divide by $\sqrt{n}S_n$, which suggests multiplying by $C_n^{-1/2}$ and therefore considering $T_n = C_n^{-1/2}\sum_{i=1}^{n}(X_i - \mu)$. Although, $S_n > 0$ we are not 100 percent sure that C_n is invertible. This is one minor drawback to the proposed method. Steven J. Sepanski proposed two ways to circumvent the problem of C_n lacking to being invertible. For some sequence $b_n > 0$, he defined

$$D_n = C_n + b_n I \tag{3}$$

Such that if b_n approaches zero at a very fast rate, $D_n = C_n$. Alternatively, the relationship becomes as in equation (4).

$$D_n = \begin{cases} C_n & \text{If } C_n \text{ is invertible} \\ I & \text{Otherwise} \end{cases} \tag{4}$$

In this case, C_n is the covariance matrix and is a nonnegative symmetry. It is this C_n which turns the statistics from a univariate into a multivariate statistics. With the assumption that C_n is measurable, D_n is also measurable. Therefore, either

equation (3) or (4) is a useful ingredient for the multivariate t-statistics given in equation (5) below.

$$T_n = D_n^{-1/2} \sum_{i=1}^{n} (X_i - \mu) \tag{5}$$

From the multivariate *t*-statistics, with other assumptions (Sepanski, 1994), taken into consideration, Hotelling's T^2 statistics is given as in equation (6).

$$H_n^2 = n^2 (\overline{X}_n - \mu)^T C_n^{-1} (\overline{X}_n - \mu) \tag{6}$$

It is argued that if the original sample is from a normal population then H_n is distributed as $((n-1)d/(n-d))F_{d,n-d}$ where $F_{d,n-d}$ denotes a random variable with F distribution with *d* and *n-d* degrees of freedom. Under the weaker hypothesis of generalized domain of attraction (GDOA), the modified Hotelling's T^2 statistics is give as in equation (7).

$$H_n^2 = n^2 (\overline{X}_n - \mu)^T D_n^{-1} (\overline{X}_n - \mu) \tag{7}$$

The Hotelling's T-square statistics is a multivariate version of the t-statistics which is testing the null hypothesis that, $H_0 = \dfrac{\mu_j}{\mu_{0j}} = 1$ against the alternative that, $H_a = \dfrac{\mu_j}{\mu_{0j}} \neq 1$.

That is the mean ratios between groups are equal against the alternative that the mean ratios are not equal. Therefore, the analysis is examining the differences in mean quality according to the attitude and the mean differences of the Smartphone price. That is, whether informed customers pay a different price from uninformed customer. Nevertheless, the test also measures whether mean quality differs from each group.

4. FINDINGS AND DISCUSSIONS

4.1. Signaling and quality

From the description above, it is important to investigate the difference between Smartphone owners who were informed before going to the shop and owners

who went to the shop uninformed about Smartphone quality. The Hotelling's T-squared generalized means test is used to make such a comparative analysis. Table 1 provides the means and the test statistics for the attitude questions concerning Smartphone quality. The attitude questions were four; one concerning the quality of the Smartphone. This question asked whether the owner considered the quality of his or her Smartphone was worth its price. The responses were arranged as; strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, and strongly agree = 5. Therefore, the minimum value in the descriptive statistics is 1 and the maximum value is 5. Meaning that, the respondent who strongly agreed that the quality was worth the price is considered to have Smartphone of the highest quality. On the same basis, the owner who strongly disagreed that the Smartphone was not worth the price was considered to own a Smartphone of the lowest quality.

The rest of the questions were concerned with features that customers considered to judge Smartphone quality. That is, whether customers considered quality to be reflected by camera resolution, processor, and capacity. Customers who knew the Smartphone quality before reaching to the Smartphone vendor were 60, and 15 customers were informed just at the shop. The Hotelling's T-squared test shows that the two groups of customers have their means different from one another. The test statistics are significant at all levels of significance. The null hypothesis displayed in the table states that the vectors of means are equal for the two groups. Since the test statistics are significant, we reject the null hypothesis. Therefore, the vectors of means are not equal for the two groups.

Table 2: Mean differences between informed and uninformed customers

	Quality information status		*Test Statistics*
Attitude	*Informed*	*Uninformed*	*2-group Hotelling's T-squared*
quality	3.983	2.933	19.030967
Camera	3.867	3.133	F test statistic:
Processor	4.383	3.467	((75-5-1)/(75-2)(5)) x 19.030967
capacity	3.417	2.867	F(5,69) = 3.5976
Price	421500	275000	Prob > F(5,69) = 0.0060
respondents	60	15	
Ho:		Vectors of means are equal for the two groups	

Source: Field data

From the assumption that quality is a positive function of attitude. It is clear that the quality of Smartphone is on average higher for customers who had prior information than for customers who did not have information before. Customers who were informed just at the vendor's site had little information concerning the quality of a Smartphone. However, customers who had searched Smartphone quality information before reaching to the vendor's site had more information about the quality of their Smartphone. Informed customers tend to have the same information that the vendor has. If a customer had information before, his or her questions concerning the device will inform the vendor not to lie about the quality aspects of the product. Such customers are not easy to deceive as far as quality is concerned.

On the other hand, customers who come to the shop uninformed can be easily deceived concerning the quality of a product, especially electronic products like Smartphone. They come to realize that the quality does not meet their expectation later after they have started using the device. Once the device has been opened from its cover, it is not easy to return it to the vendor.

Customers who searched for Smartphone quality information before reaching to the vendor knows how good the product is. Even when they try to bargain the vendor will not reduce the price at a substantially lower level. The vendor will try to convince the customer to buy another device of the lower price. But since the customer is well informed about the quality, he or she will not go for the alternative choice suggested by the vendor. On the other hand, uninformed customers will go for another device since due to the vendor's suggestion. That is why we even see that the average price for informed customers is higher than the average price for uninformed customers. Meaning that, informed customers purchase high quality devices which are expensive and therefore pay higher prices.

From Table 2, we see that signaling is important in reducing adverse selection. If the product does not reflect its price, the customer has made an adverse selection due to lack of proper information concerning the product quality. On average, adverse selection is reduced when information concerning the commodity is released. As in the table, customers who were much informed had their Smartphone devices worth the price. Their utility for having Smartphone is higher because they do not regret on their decision to buy the device.

Therefore, Smartphone vendors should increase their effort to display information concerning the quality of these electronic devices. On the other

hand, customers should have their personal initiatives to search for product quality information before reaching to the vendor. This will save time spent on asking questions concerning quality.

4.2. Attitude towards factors determining quality

The study investigated on factors which customers considered as representing quality. This was a five scale showing how they considered quality. The scale was; strongly agree, agree, neutral, disagree, and strongly disagree with the scales of 5, 4, 3, 2, and 1 respectively. Four questions were asked concerning attitude of respondents. Three questions were about factors that determined quality and one question was about considering their Smartphone quality worth the price.

The study hypothesizes a mean score of 3 which is neutral from the arrangement thereby described. We reject the null hypothesis if the statistics is significant. From the analysis, the alternative hypotheses were that the empirical mean is above the hypothesized mean, that is, above 3. As shown in Table 4, only one attitude question is insignificant which shows that the calculated mean score is not statistically different from the hypothesized null mean score. The rest of questions shows mean scores different from the hypothesized mean score. Nevertheless, the calculated mean is above the mean score of 3. This is on the side of positive attitude.

Table 3: Customer's Attitude towards Quality

	Quality information status		*Test Statistics*
Attitude	*Male*	*Female*	*2-group Hotelling's T-squared = 4.9146045F test statistic:*
quality	3.681	3.929	((75-5-1)/(75-2)(5)) x 4.9146045
Camera	3.617	3.893	F(5,69) = .92906222
Processor	4.298	4.036	Prob > F(5,69) = 0.4677
capacity	3.255	3.393	
Price	364893.6	438035.7	
respondents	47	28	
Ho:		Vectors of means are equal for the two groups	

Source: Field data

The first question considered whether Smartphone owners considered camera resolution for quality. Female respondents have higher score on camera

consideration for quality. The t-statistics for female is large compared to the t-statistics for male respondents. This shows that the difference between hypothesized mean and calculated mean is more significant for female than for male Smartphone owners.

The study also considered phone processor for quality. As it can be shown in the table above, the difference between hypothesized and calculated mean is very significant compared to other categories which have been considered. The positive difference shows that Smartphone owners consider processor to assess the quality of a Smartphone. Nevertheless, the difference is much bigger for male respondents than for female respondents implying that male owners are much more concerned with phone processor than female owners. However, the overall rating shows that phone processor has more scores in determining the quality of the phone than other two factors namely camera and capacity. And for the case of capacity the difference between hypothesized mean and calculated mean is statistically insignificant.

The last question, in Table 3, inquired information concerning how Smartphone owners regard their Smartphone quality with respect to their prices. Contrary to what was reflected in the second question where we see male owners considering processor for quality assessment, their perception concerning the quality of their Smartphone is less significance compared to the female counterpart. There is no consistence between what has been declared in question two and the quality perception. However, female owners have shown consistence between their consideration of processor for quality and the overall quality of their phone. For male respondents the difference in statistical significance is very huge. This implies that even after considering processor for quality judgment, male owners did not find the quality reflecting the price of their phones. Although, the analysis still revealed that the difference between their perception for phone quality and the hypothesized difference is positive and statistically significant.

4.3. Smartphone price difference according to attitude

The following table shows the difference in Smartphone price according to owners' consideration of processor for quality. Those owners who favored much processor for judging the quality of Smartphone are considered to have more technical information concerning the quality of Smartphone. We analyze price differences according to their attitude on processor being considered for quality. From the descriptive analysis, the findings shows that those who strongly

disagree in considering processor for quality assessment were only three, the same number as those who just disagree on the same judgment. Therefore, only 6 respondents out of 75 respondents did not consider processor for quality judgment.

For the group that strongly disagreed on the judgment of quality basing on processor, the lowest first percentile paid one hundred and twenty thousand Tanzanian Shillings for the Smartphone, while the highest ninety ninth percentile paid two hundred and eighty thousand Tanzanian Shillings for Smartphone. For the group that disagreed, the lowest first percentile paid twenty thousand Tanzanian Shillings for the phone and this is not a Smartphone but rather featured phone. The highest ninety ninth percentile paid three hundred thousand Tanzanian Shillings for the Smartphone.

In the survey, eight respondents were undecided on the consideration of processor for quality assessment. These were neutral in their consideration of processor for quality assessment. The lowest first percentile for this group paid one hundred and eighty thousands for the Smartphone, while the highest ninety ninth percentile paid one million Tanzanian Shillings.

Another group is those who agreed and strongly agreed that when considering Smartphone quality, processor was an important factor. The group who agreed consists of 23 respondents whose lowest first percentile paid thirty thousand Tanzanian Shillings for the Smartphone, while the highest ninety ninth percentile paid one million and four hundred and fifty thousand Tanzanian Shillings for the Smartphone. The group that said they strongly agree that when purchasing Smartphone, processor is considered for quality assessment, the lowest first percentile paid one hundred and twenty thousand Tanzanian Shillings for their Smartphone. The highest ninety ninth percentile paid one million and six hundred thousand Tanzanian Shillings for the Smartphone.

On average, as customers considered processor for Smartphone quality assessment, the price of a Smartphone kept increasing. This is to say that higher processor attracted higher price because of higher quality. From the simple regression analysis, customers who strongly supported the argument of processor being an indicator of quality paid about 43.53 percent higher price than the rest of customers. When the analysis was reversed to make those who disagree with the statement, we find out that they paid about 177 percent less price than the rest of the respondents. The rest categories on the processor argument were not statistically significant and on considering all the categories

together, no single category is statistically significant. Clearly, processor consideration when purchasing Smartphone reflects quality consideration. That means, the quality of a Smartphone is reflected in its price.

To certain on the argument of price and quality, Table 5 provides simple estimates from linear regression analysis on the attitude differences concerning quality and the price. Panel (a) is the analysis showing attitude variation on processor consideration for quality and the price of a Smartphone. For model 1 which exposes all attitude levels, strongly disagree is taken as the base variable from which comparison is made. Model 2, 3, and 4 are taken to make comparison of one attitude against the rest. It is only significant attitudes which have been considered for the later models, that is, models 2, 3 and 4.

When considering processor for quality assessment, owners who disagreed paid 117 percent lower price than owners who strongly disagree. The difference is significant at 10 percent levels of significance, which however is insignificant when confidence interval is considered.

Table 4: Price difference according to attitude

(a) Processor	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Strongly Disagree	Base			
Disagree	-1.172*(.5905)	-1.780***(.4304)		
Neutral	.5318(.4896)			
Agree	.4767(.4440)			
Strongly agree	.7516*(.4337)		.4353**(.1804)	
Constant	12.05***(.4176)	12.66***(.0861)	12.37***(.1284)	
R-Square	0.2383	0.1897	0.0739	
Adj. R-Square	0.1948	0.1786	0.0612	
(b) Capacity				
Strongly Disagree	Base			
Disagree	-.9295**(.3638)	-1.010***(.3245)		
Neutral	-.1060(.3044)			
Agree	.1373(.2610)			
Strongly agree	.1770(.2407)			
Constant	12.59***(.1819)	12.67***(.0918)		
R-Square	0.1325	0.1170		
Adj. R-Square	0.0829	0.1049		

contd. table 4

(c) Camera				
Strongly Disagree	Base	-.8156**(.3319)		
Disagree	.3290(.3885)		-.4938*(.2585)	
Neutral	.8491*(.4259)			
Agree	.8456**(.3480)			
Strongly agree	.9836***(.3467)			
.3570*(.1924)				
Constant	11.84***(.3125)	12.65***(.0939)	12.66***(.0990)	12.47***(
.1133)				
R-Square	0.1465	0.0764	0.0476	0.0450
Adj. R-Square	0.0977	0.0637	0.0346	0.0320
(d) Quality				
Strongly Disagree	Base	-.8438**(.3624)		
Disagree	.4314(.4485)			
Neutral	.6087(.4077)			
Agree	.8122**(.3729)			
Strongly agree	1.117***(.3766)		.4847**(.1927)	
Constant	11.80***(.3426)	12.65***(.0936)	12.43***(.1090)	
R-Square	0.1455	0.0691	0.0798	
Adj. R-Square	0.0967	0.0564	0.0671	

Source: Field data

Those with neutral response and those who agreed seem to have a positive and economically significant different price than those who strongly disagreed to consider processor for quality assessment. But, the different is statistically insignificant. Owners who strongly supported the argument that processor is considered for quality assessment, had to pay 75.16 percent higher price than those who strongly disagree with the statement. The difference is statistically significant at 10 percent levels of significance, but insignificant with confidence level consideration. The insignificance comes in because the confidence interval crosses zero.

In the same processor category, Model 2 shows that those who disagree with quality assessment using processor significantly pay a lower price than the rest of the customers. And Model 3 cements on the results in Model 2 by clearly showing that those who strongly support the argument that processor were used for quality assessment paid about 43.53 percent higher price than the rest. The implication here is that higher processor Smartphone is sold at a

higher price. Alternatively, customers who value much on the processor of a Smartphone prefer higher processor Smartphone than lower processor Smartphone. As a result, they are willing to pay higher price for the Smartphone with higher processor. As for the processor case, the same trend is depicted when considering other categories namely camera and capacity. Those owners who had less consideration of these features paid lower price than owners who much considered the categories.

Table 5: Price difference influence of attitude for combined factors

Attitude	*Coefficient*	*Ho: Constant variance*
Strongly agree that quality reflect price	.3937**(.1793)	Chi2(1) = 2.21
Disagree that processor is considered for quality	-1.593***(.4151)	P-Value = .1371
Disagree that capacity is considered for quality	-.6252**(.3067)	Ho: Model has no
omitted variables		
Strongly agree that camera resolution reflect quality	.0745(.1772)	F(3,67) = 3.64
Constant	12.55***(.1151)	P-Value = .0171
R-Square	0.3165	
Adjusted R-Square	0.2775	

Source: Field data

The argument is raised that these factors reflect quality of Smartphone. However, in order to be assured with this statement, the study went further asking Smartphone owners if their quality reflect the price paid. Just as it was for the case of categories explained before, owners who said strongly supported the arguments that their Smartphone quality was worth the price, paid about 112 percent higher price than the owners who strongly disagreed with the statement. The implication is that as far as Smartphone is concerned, higher quality attract higher price.

The simple linear regression analysis for combined factors is somewhat consistent to the single factor dummy variable analysis. The analysis in Table 5 shows some of the factors and attitude. The selection is based on the significance of single factors. The model analyzed in the table has undergone a robustness check for inclusion of the selected variables. The inclusion of selected variables provides the best model in terms of the significance levels of individual variables but also from heteroskedasticity point of view. Many variables have proved to bring a model free from heteroskedasticity, but with many insignificant variables

compared to the one presented below. Nevertheless, the model specification test of the current model provides a slightly higher probability than others, even though the model is still miss-specified. So, on the specification point of view the current model is a lesser evil compared to other models that have been tried.

From Table 5, Smartphone owners who strongly agreed that their phone quality was worth the price paid 39.37 percent higher price than Smartphone owners who replied otherwise. Other things being equal, the difference is statistically significant at 5 percent levels of significance.

CONCLUSION

This study analyzed the effect of signaling on adverse selection. The findings show that customers with more information concerning Smartphone were satisfied with the quality of Smartphone they have. On contrary customers who did not have prior information concerning the Smartphone they purchased were not satisfied with their Smartphone quality. The implication is that signaling improves selection of product with appropriate qualities. Customers with information concerning Smartphone are not willing to pay a lower price for the lower quality Smartphone. While, the uninformed customer can be easily deceived by unfaithful sellers to pay lower price thinking the quality is the same. They later discover that the quality is not worth the price they paid for the gadget.

The study recommends that customers should increase their efforts in searching for product quality information before going to the shop. This helps to reduce the possibility of purchasing products with lower qualities than expected. Sellers must improve their customer care by providing clear information concerning their products. There should be warrant for Smartphone products to reduce selling of lower standard products. The warrants guarantees customers that whenever quality is lower than expected they can get their money refunded and this will make sellers comply with standard. Since sellers are not the manufacturer in this context, the warrant need will force traders to procure high quality Smartphone from trusted manufactures.

The current study, however, used a sample size which is small to make a generalized inference to all customers. Nevertheless, due to time limitation, the study was forced to use convergent parallel approach of the mixed research. However, it is important to have a sequential approach because it is a follow up

analysis which makes verification whenever findings get into unexpected direction. Due to financial constraint, the study was also forced to undertake an online survey which was not welcomed as expected. The expectation was that since the responses to the questionnaire was easy and could take a very short time, respondents could reach 300 in number. But this target was not reached because someone can fill or leave without filling according to one's feelings. This has been an impediment to the current study because accuracy increases with the sample size. Carrying a survey on face to face interview can be much positive in such a way to increase responses among respondents. Future studies can work on increasing the sample size by making face to face interview to curb the problem of none responses.

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