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Analysis of Multi-SIM Behaviour in Tanzania's Telecom Market Using Binary Logit Model

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Abstract

This paper examines factors for multi-SIMs usage in the mobile services, and its economic implications to mobile operators in Tanzania. A random sample of 288 mobile phones subscribers from six mobile operators were included in the study. The study used binary logit model to estimate drivers for multi-SIMs usage, with marginal effects calculated to indicate appropriately the probabilities of usage for individual parameters used in the model. The findings showed that differences in perceiving quality of services and product differentiation are the main drivers for multi-SIMs usage. Multi-SIMs users are satisfied with multiple operators as no one operator provides a combination of their communication needs successfully. Also, customer-care related reasons like inaccessibility of sim swap raises customer's SIM multiplicity. The behaviour of customers to own multiple SIM cards increases the level of customer spending to multiple operators and reduces customer's profitability. This demands that network managements improve network quality, promotional activity, and customer care to win customers' share of usage.

Keywords: *multi-sim, marginal effect, logistic regression*

Introduction

The use of multi-SIM phones is a common phenomenon in Sub-Sahara African (SSA) countries where the SIM ratio is 1:7 (GSMA, 2018). The phenomenon has been significantly spurred by advancements in technology and falling prices of mobile devices, most of which are dual-SIM. Technological advancements have also enabled the emergence of eSIM mobile phones that enable customers to switch among multiple network mobile operators (MNO) in one devices, and in real time without the need of physical SIM cards. The use of multiple SIMs is a challenge to incumbent market players as it causes a dilution of existing customers' average revenue per user (ARPU) due to split of spend among operators. Parallel to this, it also poses an opportunity to new and small players to be used as secondary SIMs. This enables new operators to share the same market with established incumbents. Research has shown the existence of multiple SIM users in Tanzania using SIM cards from different operators at the same time (Anatory, 2015). The main products of operators in Tanzania are voice calls, short messaging service (SMS), data and mobile money services.

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There has been a number of marketing campaigns among mobile operators to persuade their users to keep only one SIM card (Airtel, 2018), with an emphasis on lower rates of call across networks. Such campaigns shows the prevalence of multi-SIM usage in Tanzania, as opposed to single SIM usage. Also, the Tanzania Communication Regulatory Authority (TCRA) has significantly lowered interconnection costs by 38% from TZS26 per minute to TZS16 per minute, starting from Jan 2018 (TCRA, 2017). Due to this move, it could have been expected that people could use only one SIM card to call across networks and cater for all their commutation needs by using a single SIM at lower rates. However, on the contrary, the number of subscriptions for multi-SIMs have not declined.

Tanzania is among the top 10 machine-to-machine (M2M) markets by connections in SSA with 397,000 connections at the end of 2018, equivalent to 1% of the total mobile connections in the region (GSMA,2018). A number of new M2M use cases are beginning to emerge in the country, and are expected to drive growth in the coming years. These new use cases increase the number of SIM cards as well, as the multi-SIM ratio.

The behaviour of mobile users to own multiple SIMs makes the official statistics reported by telecom authorities, based on SIM subscriptions among operators, to be overstated if they are considered as the number of individuals using mobile services. The TCRA reported that the total number of subscriptions reached 42m as of March 2018. This is almost twice the eligible population of age 15 or above, which is around 20m (NBS, 2018). Therefore, the subscriptions numbers do not show the real number of unique people who have access to mobile service in the country. The behaviour of customers using multiple SIM cards makes it difficult for operators to assess the value of their customers based on service usage. Customer usage in this case is split among SIMs from different operators. Return on investment (ROI) of decisions such as planning for capacity expansion and new investments in coverage services are highly impacted by maintaining customer value (Firli, Primiana & Kaltum, 2015). In the case of multiple SIM usage, the real value of customer is split among operators; hence it decreases as the SIM ratio increases.

Multi-SIM ownership is a form of multi-brand loyalty (MBL), where customers are loyal and use more than one brand in the same category. There have been studies like that from Mamun (2015) and Felix (2014) on multi-brand loyalty. The studies showed that what influence such consumer behaviour are factors like customer freedom and social norms that have a strong relationship to multi-SIM ownership and usage. Multi-SIM ownership enables customer to be multi-brand loyal since it facilitates ease of switching among network mobile operators. In a similar vein, the current paper aims to investigate the drivers and their weights on consumer preference that operators in Tanzania telecom market can exploit to improve their profitability and ARPU share, which is the real value driver rather than market share alone.

2. Review of Literature

2.1 Multi-SIM Ownership

Multi-SIM behaviour is a consumer behaviour whereby a customer keeps and uses more than one SIM card concurrently in a defined period of time. The active mobile subscriptions is counted on 90 days basis in telecoms as per definitions of world telecommunication/ICT indicators (ITU, 2010). The global tele-density is now around 103, excluding IoT (GSMA, 2018). Even a figure of 100 per cent mobile phone ownership is not possible. There are always people who will not use phones due to various reasons such as young age, old age, disability, poverty, being forbidden to use phones since they are in asylums and prisons, and those who opt not use the service voluntarily (Sutherland, 2009). As such, tele-density is a measure of the number of SIM connections, and does not give a correct information of the real number of users unless a multi-SIM ratio is given.

Sutherland (2009) outlined that people use multiple phones, SIM cards and telephone numbers to overcome patchy or poor network coverage, avoid network congestion, save money by making on-net calls, benefit from discounted or bundled tariffs for voice or data, and to receive calls or voicemail via an older number. He proposed that detailed research to identify the relative importance attached to each of these reasons should be done independently on each particular market, as each market is unique.

Valdecantos (2009) classified the drivers of multi-SIM behaviour into four groups relating to operators, mobile market, mobile ecosystem, and society. Operator-related factors includes actions of operators such as promotional offers and pricing strategies that use discounts advantage as an attempt to gain market share.

Drivers grouped as mobile ecosystem includes the availability of unlocked handsets, multiple SIM handsets, and niche devices such as SIM-slot net-books and blackberries. Handset are the key drivers in the growth of multi-SIM behaviour: they reduce the cost of initiation, especially in the dual SIM phone mode of a multi-simmer. Other modes of multi-SIM based on handsets include multi-SIM by physically switching SIM cards in phones, or having multiple phones.

Mobile market drivers are quality of services, coverage and aggressive acquisition of new market entrants/followers as a result of large market share gap among operators. Multiple SIM occurrence is also attributed to social composition, norms, rhythm of life and cultural-specific issues; which also include a number of non-rational factors such as social status, image and relationships (Valdecantos, 2008).

2.2 Behavioural Economics Theory

The behavioural economic theory (BET) deals with variables affecting decision-making and consumer demand (Francisco, Madden & Borrero, 2009). Neoclassical economic theories assumed that human actors have stable preferences, and engage in

maximizing utility. Therefore, consumer choices were able to be predicted using expected utility optimization; i.e., what drives satisfaction for a user when s/he uses a good are the characteristics of that good as compared to alternatives.

These neoclassical economics approaches assumed that human decision-makers are fully rational. However, theoretical approaches and experimental economics have shown that human nature does not fulfil the idea that it can always choose the most optimal decision when it is made in own self-interest due to some limitations available (Dhami, 2016). That is, human beings are not fully *homo economicus* as assumed by neoclassical economics. Instead, they can be explained based on three categories of rationality limitations: judgement heuristics, cognitive biases, and framing effects (Tom, 2011).

2.3 Multi-brand Loyalty

As mentioned earlier, multi-SIM behaviour is a mode of customer behaviour under the marketing concept of multiband loyalty (MBL). Single and true loyalty is rare in telecoms in view of the spurious loyalty amplified by multi-SIM ownership. Tuominen (1999) defined brand loyalty as a positive attitude towards a brand, which leads to consistent buying of a brand over time. Both behaviour and attitude are key to measuring brand loyalty. Low levels of differentiation among brands, combined with more choices and lower risks in brand switching, contribute to higher occurrences of multi-brand loyalty (Bennett & Rundle-Thiele, 2005).

Felix (2014) found that motivations for MBL arises from three factors: tangible product benefits, family tradition, and perceived freedom. Further, he identified three types of MBL. The first is perfect substitute loyalty, which occurs when customers perceive two or more brands for a particular product category as nearly identical, and divide their loyalty between them; with the products becoming used as perfect substitutes. The second is specialized loyalty, in which customers find differences among brands and simultaneously use them to achieve different needs, or change their purchases to fit different contexts. The third one is biased loyalty, which develops when customers have differential preferences to several brands, which lead to one brand to have more repurchases than the other. However, all brands in a customer's loyalty set are alternatives to each other; and can be recommended to friends and family.

Loyal consumers are less price-sensitive compared to non-loyal consumers. Yoon and Tran (2011) showed that value-conscious customer are loyal than deal-prone customers; and also variety-seeking non-loyal consumers are insensitive to pricing compered to deal-prone non-loyal customers. Deal-proneness tends to make customers move from one brand to another without taking into account the full value in the long-term, while value-conscious customers stay loyal (ibid.). This situation can be explained in terms of customer irrationality in decision-making: customers are present-biased as is explained through the hyperbolic discounting model of delay discounting.

Dick and Basu (1994) suggested that multi-brand loyalty is derived from individual's strong attitude toward brands with little perceived differentiation, so brands are regarded as alternatives to each other, and are viewed as equally satisfying. This may lead to MBL because alternatives have the same perceived satisfaction.

Telecommunication services providers are likely to be undisguisable in their core services since they have a similar product mix. Mobile operators in Tanzania offer the same core service, which are voice, sms, data and mobile money. The differentiation can only be derived from their quality of services, and customer service levels. Therefore, since telecommunications is an industry where tangible product benefits are not differentiated, and the preference of multi brand loyalty is high, operators have to rely on perceived freedom and superior customer experience to command a leading value share.

3. Conceptual Framework and Indicators Mapping

The paper uses the conceptual framework in Figure 1 to analyse consumer preference of communications service that leads consumers to use one operator or multiple operators at the same time. The conceptual framework model of drivers of multi-SIM behaviour is derived from the literature of multi-brand loyalty and multi-SIM usage, and modelled by the researchers.

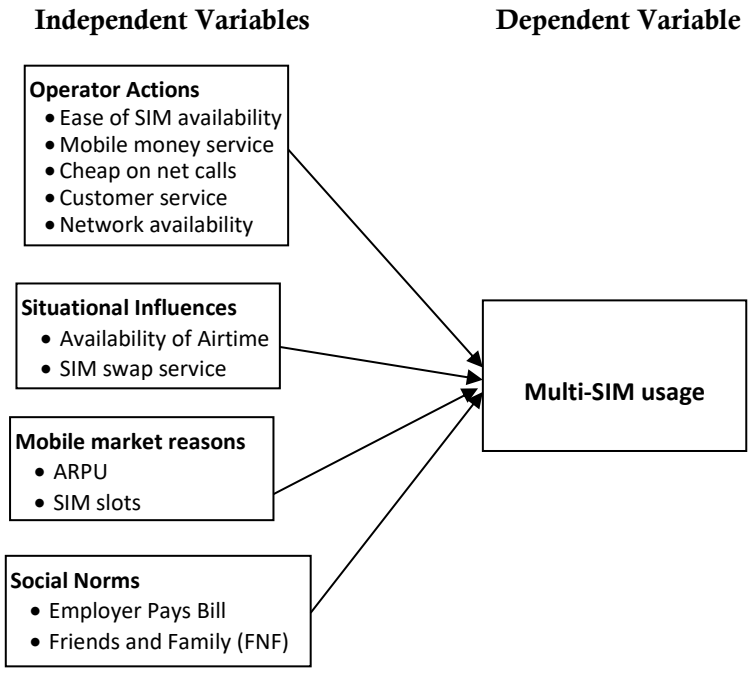

Figure 1: The Conceptual Framework

The concepts have been defined in terms of indicators that are measurable, so as to operationalize them, as shown in Table 1.

Table 1: Concepts to Indicators Mapping

Concept	Indicators	Comments
Operator Actions	• Cheap on net calls • Aggressive acquisition Campaigns • Free on net calls • Same network closed user group offers (CUG)	Specific actions that operators do take time to time that lead to multi-SIM behaviour to subscribers.
Situational Influences	• Availability of Airtime • Availability of SIM swap points • Sales Personnel recommendations • Gift from a friend • A temporary number for contact	These are situational Circumstances that make a person own a SIM just to use it temporary and throw it afterwards.
Mobile Market reasons	• Type of tariff used • National coverage among operators. • Availability of dual SIM phones	Prepaid or post-paid
Specialized Products	• Accessibility and quality level of mobile money, internet, voice, entertainment products, gaming and loan services.	Keep a second SIM since the main SIM does not have all the service one needs, e.g., entrainments, gaming
Social Norms	• Family and Friends preference of operators • Separate business and personal uses (employer pays bill)	

4. Methodology

Data were collected from 288 mobile subscribers through structured questionnaire, which was administered to selected mobile subscribers using random digital dialling (RDD). The secondary data was collected through published and printed matter: books, journals, government reports, and trusted websites. Mobile companies were considered as a strata, and thus proportionate stratified random sampling was used to select a sample due to their unequal sizes of the number of mobile phones subscribers. Thereafter, questions were posed to a total of 288 mobile subscribers. The selection criteria for the sample was owners of SIM cards who had used it at least once in the last 90 days; hence the sample distribution as in Table 2.

Table 2: Sample Distribution per Mobile Company

No.	Category of Respondents	Frequency	Percentage
1.	Vodacom Subscribers	92	32%
2.	Tigon Subscribers	79	27%
3	Airtel Subscribers	76	26%
4	Halotel Subscribers	29	10%
5.	Zantel Subscribers	7	2%
6	TCCL Subscribers	5	2%
	Total	288	100%

4.1 Model Specifications

In modelling multi-SIM status, the dependent variable was a binary choice whether a mobile user is a multi-SIM or not, and therefore the answer was either 'Yes' or 'No': a typical case of qualitative dichotomous variable. However, the drivers for multi-SIM usage can be expressed both qualitatively and quantitatively. When the response variable is continuous, one could only use linear models for estimation such as the Ordinary Least Squares to determine the effects of the explanatory variable on the response variable. Unfortunately, this model suffers a limitation, i.e., its disturbance term is potentially heteroscedastic, and the model probability predictions are not necessarily bounded within 0 and 1 (Pindyck & Rubin-field, 1981; Greene, 1994). In this regard, when the response variable is dichotomous, a linear probability models cannot be used. Gujarati (1988) proposed the use of Probit or Logit models as the remedies for this problem.

Theoretically, in specifying a Logit model, Let $Y_t^* = \beta X_i + \mu_i$, where Y_t^* is a latent response variable, β is a vector of parameters to be estimated, X_i is a vector of explanatory variables, and μ_i is the error term. In practice, Y_t^* is unobservable, and we observe only a dummy variable Y_i, which in this case is defined as:

$$\begin{cases} Y_i = 1 \; if \; Y_i^* > 0 \; (a \; mobile \; phone \; owner \; is \; a \; multi - sim \\ Y_i = 0 \; if \; otherwise \end{cases}$$

Accordingly, the probability of multi-SIM usage is denoted as:

$$\begin{aligned} Pr\,o\,b(Y_i = 1) &= Pr\,o\,b(Y^*{}_o > 0) \\ &= Pr\,o\,b(\mu_i > -\beta X_i) \\ &= 1 - F(-\beta X_i) = F(\beta X_i) \end{aligned}$$

where F is the cumulative distribution function (CDF) of the error term μ_i.

Therefore, the Logit model can be employed to estimate the probability of multi-SIM usage, and can be expressed as:

$$Pr\,o\,b(Y_i = 1/X_i) = \frac{1}{1 + e^{-\beta X_i}} = \frac{e^{\beta X_i}}{1 + e^{\beta X_i}}$$

In case of random sampling where all the observations are sampled independently, the contribution of the ith observation is written as:

$$P_i^{Y_i}(1 - P_i)^{1-Y_i}$$

Therefore, the likelihood function will be given as:

$$L = \prod_i^n P_i^{Y_i}(1 - P_i)^{1-Y_i}$$

If we take logarithm to both sides and replace P_i by $\frac{e^{\beta X_i}}{1+e^{\beta X_i}}$, the log-likelihood function becomes:

$$LogL = \sum_{i}^{n} Y_i \beta X_i - \sum_{i}^{n} log\left(1 + e^{\beta X_i}\right)$$

We notice that, in this model with binary dependent variable, the parameters $\beta's$ are not interpreted as the marginal effects on the dependent variable, but rather the marginal effect on the conditional probability, and is given as dp_j / dx_j; which gives the rate of change in the probability as a result of a unit change in the dependent variable, and which—according to Mukherjee et al. (1998)—is defined as $\beta_j P_i(1 - P_i)$. The econometric equations and representations used in this study are derived from Hill et al. (2008) and Mariano et al. (2012).

The model described in this study uses proxy variables from the main five drivers mentioned above, with their indicators as independent variables; and the multi-SIM usage status as the dependent variable. The following binary logistic regression model was thought. The probability of a customer been multi-SIM is determined from the binary logistic equation below:

$$\mathrm{P}\,(MULTISIM) = \frac{e^X}{1 + e^X}$$

Where *x* is obtained from the equation below:

$$\begin{aligned} X = {} & \beta_0 + \beta_1(\mathrm{QOS_{DISPERSION}})_i + \beta_2(\mathrm{SIMSLOTS})_i + \beta_3(\mathrm{EMPLOYERPAYSBILL})_i \\ & + \beta_4(SIM\_SWAP)_i + \beta_5(SIM\_CHANNEL)_i + \beta_6(FNF)_i + \beta_7(ARPU)_i \\ & + \beta_8(AIRTIME_{AVAILABILITY}) + \beta_9(PROMOTIONS)_i \\ & + \beta_{10}(ON\_NET\_CALL)_i + \beta_{11}(NETWORK_{AVAILABILITY})_i \\ & + \beta_{12}(CUSTOMER\_SERVICE)_i + \beta_{13}(MOBILE\_MONEY)_i \end{aligned}$$

The independent variables in the model above are defined as follows:

MULTISM = X (Dependent variable, a dichotomous multi-SIM status of customer *i*, takes values of YES = 1, NO = 0)
QOS_DISPERSION = Quality of service dispersion
SIMSLOTS = multiSIM handsets
EMPLOYERPAYSBILL = If employee pays phone bill
SIM_SWAP = Sim swap
SIM_CHANNEL = SIM purchase
FNF = Friends and family influence
APRU = Average monthly spend of a customer
AIRTIME_AVAILABILITY = Airtime availability
PROMOTIONS = Promotions satisfaction
ON_NET_CALLS =Affordability of on-net calls
NETWORK_AVAILABILITY = Network availability
CUSTOMER_SERVICE = Customer service satisfaction
MOBILE_MONEY = Mobile money satisfaction
β_0 = A constant
$\beta_{1\ to12}$ = Beta coefficient for independent variable 1 to 12.

5. Findings and Discussion

5.1 *Demographic Profiles of Respondents*

Individual characteristics form an important part of behavioural economics in relation to an analysis of choices that people make. The respondent's demographic characteristics, whose data were collected in this study, includes gender, education level, employment status and age.

5.1.1 Gender Distribution

Female respondents were 43%, and males were 57% as shown in Table 3. This implies that multi-SIM usage is higher among males compared to their female counterpart, at least for the sample surveyed. The national gender distribution in Tanzania, according to the 2022 population and housing census, is around fifty-fifty for male (48.7%) and female (51.3%) (NBS, 2022). Also, the percentage of male respondents with multiple SIMs was higher (73%) compared to their female (70%) counterparts.

Table 3: Gender of Respondents

Gender	No. of Respondents	Percentage Contribution	Single SIM users	Multiple SIM users	% of Multiple SIM users
Female	124	**43%**	37	87	70%
Male	164	**57%**	42	122	74%
Total	**288**	**100%**	**79**	**209**	**73%**

Source: Extracted from field work data

5.1.2 Age Distribution

As can be seen in Table 4, the age distribution shows that the majority of multiple SIM owners in terms of age group penetration are youth in the age groups of 25–34 and 35–44, which have 78% and 82% penetrations, respectively. This can be explained by the fact that the youth are more active users as they seek for better deals and variety of services among operators. Also, in the country's age profile, the youth group makes the largest part of the population.

Table 4: Age of Respondents

Age group	No. of Respondents	Percentage Contribution	Single SIM users	Multiple SIM users	% Multiple SIM users
Under 18	2	**1%**	2	0	0%
18–24	48	**17%**	15	33	69%
25–34	136	**47%**	30	106	78%
35–44	50	**17%**	9	41	82%
45–54	29	**10%**	14	15	52%
55–64	16	**6%**	6	10	63%
65+	7	**2%**	3	4	57%
Total	**288**	**100%**	**79**	**209**	**73%**

Source: Extracted from field work data

5.1.3 Level of Education

Table 5 shows that only 4% of the respondents were illiterate, 27% had primary level education, 30% had secondary level education, and around 40% had tertiary or university education. In general, the sample included mostly a literate group. Literacy level is associated with the ability to process information, and therefore easy adoption of multi-SIM usage after hearing of the benefits associated with multi-SIM usage. However, mobile penetration is still relatively low among the illiterate in the country. Since mobile technology is generally a new service, its diffusion would be expected to be fast within the educated than non-educated.

Table 5: Education Level

Age group	No. of Respondents	Percentage Contribution	Single SIM users	Multiple SIM users	Multiple SIM users %
Illiterate	11	**4%**	8	3	27%
Primary	79	**27%**	31	48	61%
Secondary	85	**30%**	25	60	71%
Tertiary	66	**23%**	11	55	83%
University	47	**16%**	4	43	91%
Total	**288**	**100%**	**79**	**209**	**73%**

Source: Extracted from field work data

Further, Figure 2 also reveals that the level of education correlates to the multi-SIM usage status of the respondents. The percentage of multiple SIM users increases from 27% for illiterates, and steadily climbs across the education ladder to 91% for respondents with university-level education.

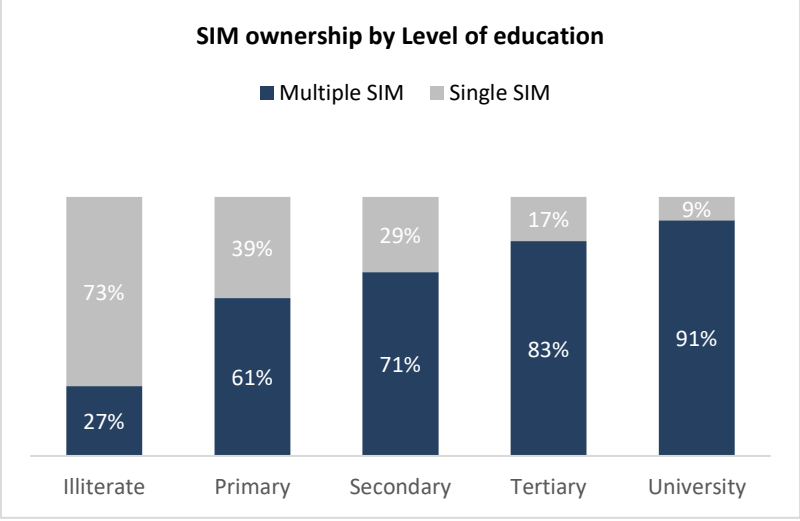

Figure 2: Respondents' SIM Multiplicity by Education Level

5.1.4 Employment Status

Table 6 presents the employment status of the respondents. The distribution of the employment status shows that the biggest group of mobile service users are self-employed (33%), followed by farmers (18%), unemployed workers (14%), temporary workers (13%), and permanent employees (11%).

Table 6: Employment Status

Employment Status	No. of Respondents	Percentage Contribution	Single SIM	Multiple SIMs	Multiple SIM Users %
Student	27	**9%**	12	15	56%
Farmer	53	**18%**	24	29	55%
Self-employed	94	**33%**	20	74	79%
Permanent employed	31	**11%**	3	28	90%
Temporary employed	38	**13%**	5	33	87%
Unemployed	40	**14%**	13	27	68%
Retired	5	**2%**	2	3	60%
Total	**288**	**100%**	**79**	**209**	**73%**

Source: Extracted from field work data

The data in Table 6 shows that SIM multiplicity is highest in permanent employed respondents at 90%, and lowest in the farmers' group, at 55%. This can be explained by the fact that for permanent employees using office SIMs, bills are paid by employers, and so the employees have room to own and pay for a second SIM. In the case of Tanzania, geographical coverage also matters: most permanent employees tend to live in cities and sub-urban areas where there is good network coverage, compared to rural areas where the coverage is limited even for a single mobile phone operator. As such, operator availability in rural areas may possibly explain the low number of multiple SIMs among the rural population, mostly of farmers, compared to permanent employed users who reside in cities and towns.

5.1.5 Tenure of Mobile Services

Table 7 presents the respondents' tenure of mobile services. The distribution of respondents by their tenure of using mobile service shows that almost one-third have been using mobile service for more than ten years; and that only 4% of the users have used mobile services for the first time within a year.

Table 7: Tenure on Mobile Service

Tenure on Mobile Service	No. of Respondents	Percentage Contribution	Single SIM	Multiple SIMs	Multiple SIM Users %
< 1 year	10	**4%**	9	1	20%
1 to 3 years	29	**10%**	11	18	62%
3 to 5 years	59	**20%**	19	40	68%
5 to 10 years	107	**37%**	24	83	78%
More than 10 years	83	**29%**	16	67	81%
Total	288	100%	79	209	73%

Source: Extracted from field work data

The statistics in Table 7 imply a steadily growing telecom market in the country. In terms of multiple SIM usage, respondents with longer tenure on mobile service generally have shown a high rate of multiple SIM usage compared to those with short tenure. Tenacity could imply that customers are more tech-savvy to demand more services, and also have matured big demands for services: hence, they want to own multiple SIMs for both service satisfaction and savings on prices. More generally, respondents with more than 10 years of using mobile telecom services are 81% penetration of multi-SIM higher than the national average of 73%.

5.1.6 Mobile Products Usage

Multiple SIM card customers can use different products from different operators. Table 8 shows customers and the number of product users by each operator. Even though the sample had only 288 respondents, these also reported the services they use with their other SIM cards. The number of product usage associated to the six operators from the respondents were 514.

Table 8: Mobile Products Usage

Operator	Calls	SMS	Internet	Mobile Money	Entertain	Total
Vodacom	141	112	80	156	49	175
Tigo	104	90	51	93	38	136
Airtel	100	85	72	69	39	116
Halotel	31	42	39	12	8	58
Zantel	9	6	5	4	3	14
TTCL	9	4	10	1	2	15
Total	**394**	**339**	**257**	**335**	**139**	**514**

Source: Extracted from field work data

The usage of different services among operators is non-uniform. Table 9 show that operators who performs well in one service, performs low in another. The ranking of customer affinity for services among users is different for each operator. Overall, voice call is the most popular service among all operators. However, Vodacom outstands on mobile money performance. TTCL and Halotel—whose overall market shares are low—have above-average usage of the Internet among their customers. Airtel has the highest penetration of its base using voice, SMS and VAS products.

Table 9: Product Usage Penetration by Operator

Operator	Calls	SMS	Internet	Mobile Money	Entertain	Total
Vodacom	81%	64%	46%	89%	28%	100%
Tigo	76%	66%	38%	68%	28%	100%
Airtel	86%	73%	62%	59%	34%	100%
Halotel	53%	72%	67%	21%	14%	100%
Zantel	64%	43%	36%	29%	21%	100%
TTCL	60%	27%	67%	7%	13%	100%

Source: Extracted from field work data

5.1.7 Number of Individuals vs Number of SIM Cards

The most common number of SIMs owned by respondents is 2 (57%), followed by 1 (27%), 3 (14%), and then 4 and 5 that are extreme cases, which together accounted for only 1% of the respondents (Table 10).

Table 10: Respondents' Number of SIMs

Number of SIMs	No. of Respondents	% of Respondents	Total SIMs
1	79	**27%**	79
2	164	**57%**	328
3	41	**14%**	123
4	3	**1%**	12
5	1	**0%**	5
Total	**288**	**100%**	**547**

Source: Extracted from field work data

The overall SIM ratio which is the number of SIMs to the number of individuals is 1:9. This implies that, on average, the number of SIMs in Tanzania are almost twice the number of actual individuals using the SIMs. It means that, to get the number of individuals from the number of SIMs in the country reported by the telecommunication authority, one needs to divide that number by the SIM ratio. The SIM ratio of 1:9 obtained in this study is higher compared to the average in SSA, which is 1:7. This means Tanzania has a high rate of SIM multiplicity than the SSA average.

5.1.8 Modes of Multi-SIM

The most popular mode of using multiple SIM cards is by using dual SIM phones, which account for around two-thirds of the owners of multi-SIMs (Table 11). This is followed by owing more than one handset, accounting for 22% of the respondents. SIMs for additional gadgets (e.g., GSPs tracker) contributes 2%.

Table 11: Modes of Multi-SIM

Mode of Multi-SIMing	No. of Respondents	Percentage Contribution
Additional gadget (e.g., GSPs tracker)	4	2%
Have two different phones	47	22%
Dual SIM	141	67%
One phone, changes SIM when needed	17	8%
Total	209	100%

Source: Extracted from field work data

Table 10 further shows that 8% of the respondents use multiple SIMs on single non-dual handsets. These have to manually swap from one SIM card to another in one handset, depending on which operator they want to use at a particular moment.

5.2 Descriptive Analysis on Multi-SIM Usage

The reason of using multiple SIM cards are summarized in Figure 3 by using frequency distribution. The figure reveal that 'friends and family' is the highest driver, having 56% of all multiple SIM card users. It was revealed that, by one seeing a friend or a family member having a different SIM card from what s/he has, the latter assumes that there could be a reduced communication cost when using the same mobile subscription than when it is different. For example, it was assumed that owning an Airtel Sim-card is cheaper to communicate with someone with Airtel Sim-card than crossing to another mobile company. It was also thought it to be easy and cheap when doing mobile financial transactions while having the same mobile company subscription. This is followed by the 'offer and promotions' category, accounting for 39% of respondents; then by 'network coverage' (34%), 'cheap on net calls' (20%), 'avoid service outages' (18%), 'innovative service not available on primary SIM' (14%), 'separate social and business circles' (10%) and 'brand' (9%).

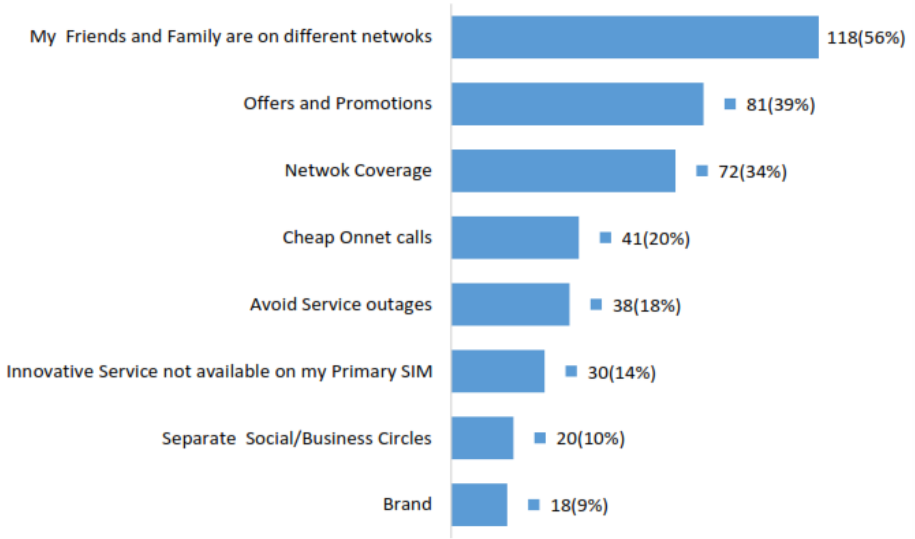

Figure 3: Respondents' Reasons for Using Multiple SIMs

5.3 Estimated Coefficients of the Logit Model

The following results gives an analysis of the drivers for multi-SIMs behaviour of mobile telecom customers in Tanzania. The signs of the estimated coefficients are used to depict the direction of the relationship between the dependent variable (multi-SIM usage) against a particular independent variable. The direction of the relationship can be positive (positively related), or negative (negatively related). However, the probability value in the last column signifies how important a particular variable is in influencing the dependent variable.

Table 12: Results of the Binary Logit Model

Coefficients:	Estimate	Std. Error z	value	Pr(>|z|)	
(Intercept)	-1.6388	1.0782	-1.52	0.12853	
QOS_DISPERSION	0.78206	0.33102	2.363	0.01815	*
SIMSLOTS	1.10689	0.23069	4.798	1.60E-06	***
EMPLOYERPAYSBILL	1.75959	0.78788	2.233	0.02553	*
SIM_SWAP	-0.5578	0.27334	2.041	0.04128	*
SIM_CHANNEL	0.946	0.32998	2.867	0.00415	**
FNF	0.27105	0.21855	1.24	0.2149	
ARPU	0.49051	0.19942	2.46	0.0139	*
AIRTIME_AVAILABILITY	-0.44005	0.22384	1.966	0.0493	*
PROMOTIONS	-0.14774	0.52265	0.283	0.77743	
ON_NET_CALLS	0.11459	0.43158	0.266	0.79062	
NETWORK_AVAILABILITY	-0.04768	0.45009	0.106	0.91563	
CUSTOMER_SERVICE	-0.42653	0.70957	0.601	0.54776	
MOBILE_MONEY	2.08588	0.93926	2.221	0.02637	*

Notes: Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Source: Extracted from fieldwork data

The estimated results in Table 12 indicate partial effects of the explanatory variables on the multi-SIM behaviour of mobile telecom customers in Tanzania. The variables *SIMSLOTS, SIM_CHANNEL, ARPU, QOS_DISPERSION, EMPLOYERPAYSBILL, SIM_SWAP, AIRTIME_AVAILABILITY* and *MOBILE_MONEY* were statistically significantly associated with the multi-SIM usage behaviour at 5% level of significance; whilst variables *FNF, PROMOTIONS, ON_NET_CALLS, CUSTOMER_SERVICE* and *NETWORK_AVAILABILITY* were not statistically significant.

Regarding significant variables, only SIM_swap negatively influenced multi-SIM usage behaviour, which implies its availability discourage people to own multiple SIM cards. The availability of SIM-swap points represents situational influence factors. Thus, its non-availability makes people opt for multiple SIM cards. The remaining variables that are significant and with positive coefficients shows that they are all positively related to owning multiple SIM cards.

Further, the significance of QoS dispersion variable from the model indicates the difference in perceived quality of services and products differentiation among operators. According to Bennett and Rundle-Thiele (2005), the low levels of differentiation among brands, and more choices and lower risks in brand switching, impact the occurrence of multi-brand customers due to product specialization with less differences in the overall category.

The availability of multiple SIM phones and SIM card shops as market reasons and operator actions reasons, respectively, give a favourable environment for the ownership of multiple SIM cards to flourish in Tanzania. Consequently, the availability of SIM card shops where people can go and buy SIM cards on demand (SIM Channel variable), influences the ownership of SIM cards

positively. On the contrary, satisfaction on the availability of SIM-swap points affects negatively the use of multiple SIM cards. This can be explained by the fact that SIM-swap points give customers an assurance in case they damage or lose their SIM cards as they can easily replace them and get back online instead of having to buy a new SIM card. Thus, accessibility to swap points influenced customers to continue using their 'lost' SIM cards and elongate their SIM tenure and behaviour loyalty, which has low multiple SIM ownership propensity, according to Vebrov et al. (2016).

5.4 Marginal Effects and Interpretations

The logit model was used to identify factors that are significant in driving the use of multiple SIMs by mobile customers in Tanzania. The coefficients of the logistics model give only the sign (direction) that shows how the independent variable affects the dependent variable. Moreover, the regression was employed to understand the partial effects each of the variables have on the dependent variables in terms of magnitude and marginal effects. Table 13 presents the results.

Table 13: Marginal Effects Results and Analysis

Factor	AME	SE	z	p	lower	upper
AIRTIME_AVAILABILITY	-0.0641	0.0319	-2.0108	0.0443	-0.1266	-0.0016
ARPU	0.0715	0.028	2.548	0.0108	0.0165	0.1264
EMPLOYERPAYSBILL	0.2001	0.0611	3.2753	0.0011	0.0803	0.3198
FNF	0.0395	0.0316	1.2513	0.2108	-0.0224	0.1013
PROMOTIONS	-0.0222	0.0793	-0.2801	0.7794	-0.1775	0.1331
ON_NET_CALLS	0.0166	0.0623	0.2665	0.7899	-0.1055	0.1387
NETWORK_AVAILABILITY	-0.0071	0.0669	-0.1057	0.9158	-0.1381	0.124
CUSTOMER_SERVICE	-0.0664	0.1138	-0.5829	0.56	-0.2895	0.1568
MOBILE_MONEY	0.2113	0.0652	3.241	0.0012	0.0835	0.339
QOS_DISPERSION	0.1139	0.0466	2.4429	0.0146	0.0225	0.2053
SIM_SWAP	-0.0813	0.0388	-2.0934	0.0363	-0.1573	-0.0052
SIM_CHANNEL	0.1487	0.0532	2.7942	0.0052	0.0444	0.253
SIMSLOTS	0.1612	0.0288	5.6037	0	0.1048	0.2176

In Table 13 there are 8 independent variables (*QOS_ DISPERSION, ON_NET_CALLS, FNF, ARPU, SIM_CHANNEL, SIMSLOTS, EMPLOYERPAYSBILL* and *MOBILE_ MONEY*) that have positive marginal effects; and five independent variables (*SIM_SWAP, NETWORK_ AVAILABILITY, PROMOTIONS CUSTOMER_SERVICE AIRTIME_ AVAILABILITY*) with negative marginal effects.

Generally, we can deduct from Table 13 that any unit change on an independent variable either increases or decreases the probability of occurrence in the dependent variable by the percentage of the coefficient in the column of the average marginal effects (AME). Specifically, the positive marginal effects gives the following interpretations:

(a) ***EMPLOYERPAYSBILL*** (*Separate business and personal uses as a social norm influence*): Subscribers who have a SIM card whose bills are paid by employers are 20% more likely to own multiple SIM cards than subscribers whose bills are not paid by employers, *ceteris paribus.*

(b) ***ARPU*** (*Average revenue per user in a month*): Subscribers who have a higher ARPU bracket are more likely to own multiple SIM cards than those in the lower ARPU brackets, *ceteris paribus*.

(c) ***MOBILE_MONEY*** (*Mobile money service satisfaction as an operator action influences*): Customers who are dissatisfied with mobile money services have 21% more likelihood of owning multiple SIM cards, *ceteris paribus.*

(d) ***QOS_DISPERSION*** (*Product specialization):* Customers with dispersion in their assessment of operator's quality of services for various products (their perceived position in service quality on each product is not the same), are 11% more likely to own multiple SIMs, *ceteris paribus.*

(f) ***SIM_CHANNEL*** (*Availability of SIM card shops as an operator action factor):* The availability of service shops where customers can go and buy SIM cards increases the ownership of multi-SIMs by 15%, *ceteris paribus*.

(g) ***SIMSLOTS*** *(Availability of phones with multiple SIM slots as a market reason):* A device that carries two or more slots of SIM cards increases the likelihood of owning multiple SIM cards by 16% *ceteris paribus.*

The interpretations for the negative marginal effects of the variables (*SIM_SWAP, NETWORK_AVAILABILITY, PROMOTIONS CUSTOMER_SERVICE* and *AIRTIME_ AVAILABILITY*) are as provided, only *AIRTIME_AVAILABILITY* and *SIM_SWAP* are significant among the five.

(a) ***SIM_SWAP*** (*SIM swap points to get back SIM card in case it is damaged, lost or stolen as a situational influence):* Customers with sufficient SIM swap services access are 8% less likely to own multiple SIM cards, *ceteris paribus.*

(b) ***AIRTIME_AVAILABILITY*** *(Airtime availability as a situational influence):* Customers who are satisfied with airtime availability are 6% less likely to own multiple SIM cards, *ceteris paribus.*

Conclusion and Policy Implications

The contribution of mobile communications is fundamental to a country's economic and social development. The availability, quality and affordable mobile services improves the productivity of individuals and companies, promotes trade, creates jobs, generates wealth and enhances social welfare. However, individual mobile operators in developing countries have not been able to provide nation-wide coverage due to a number of limitations. This study has provided evidence that customers are forced to opt for multiple SIMS to avoid the lack of network coverage and quality gaps among operators. This can be reduced by providing a conducive environment for operators to invest in developing infrastructures to serve their customers seamlessly. Reliable networks, proper coverage and full range

of services will help Tanzania mobile operators reduce the high rate of multi-SIM usage, which is necessary for their profitability and further development of innovative products for their customers. This would also foster the overall development of the telecom industry.

The influences of social norms on multi-SIM use are hard to deal with from operators' perspective as they are customer-centred. This type of multiusers are bound to exist regardless of changes in operator actions and mobile market conditions. The issue of multiple SIMS being used in separate social circles and separates business and personal communications is an opportunity for operators to compete for SIM cards that are meant for different purposes, and which are independent from spend-perceptive. Provided that owners of multi-SIMs are centrally registered, as in case of Tanzania, it is not a problem for people to own different SIM cards for different uses. The other opportunity for multiple SIM cards per individual is in the 'internet of things' (IoT) area. This kind of SIM cards does not split the spend of individuals, rather it adds another service type that can be monetized by telecommunications. Operators have the opportunity to ensure their customers also uses *their* IoT services through strategies such as product bundling.

The findings of this study provide several managerial implications. First, they highlight the importance of understanding customer demands in the multi-SIM environment as customer are able to switch in real time and silently to alternative operators without lodging any complaints for improvement to their current operators. Multi-SIM empowers customers to seek satisfaction of their communication needs from whoever operator can provide. Hence, they do not patronage any operator to the extent of being patient to wait for operators to resolve issues, or improve their services. Thus, in this situation where frustrated customers can switch from one operator to another that fast, it challenges operators to pitch their products and try and turn spurious loyal customer into their permanent customers.

Mobile operators in Tanzania should use effective marketing to tap into the potential of multi-SIM behaviour and avoid the pitfalls associated with it. Fully understanding customer behaviour under multi brand loyalty will lead to launching relevant programs that are geared toward keeping their respective brands as the most preferable among equivalent alternatives. Operators should enhance and maintain high quality networks, and widen their coverage nationally. This includes the speed of internet connections, and the reliability of voice calls in their networks.

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