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SMARTPHONE USAGE IN THE GREATER ACCRA REGION OF GHANA: WHAT ARE THE CRITICAL DRIVERS?

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ABSTRACT

Smartphone usage has increased significantly in recent times across rural, peri-urban and urban locations. However, the key underlying factors that drive the increased demand and usage are unclear. This study analyses the factors that influence people's choice for smartphones across different geographical settings in the Greater Accra Region of Ghana, using a sample of 305 respondents. Data was collected using programmable tablets through a case study survey that sampled individuals across different locations randomly. By employing probit regression analysis, the study established that geographical location matters in the choice of smartphone usage. Urban and peri-urban locations significantly influence smartphone use while rural location was found to be insignificant. Education, age, access to mobile applications and access to mobile money services are positive and significant drivers of smartphone usage. Besides, the number of registered Subscriber Identity Module (SIM) cards used and affordability, negatively and significantly impacts on smartphone use. These findings are relevant to electronic consumers and companies, regulators and policymakers.

Contribution/ Originality: This study contributes to the existing literature by investigating the factors that influence smartphone usage in Ghana. The findings revealed the importance of geographical location, social and economic factors in people's choice for smartphones. Promotional activities, expanding mobile network to rural areas, and proper targeting of youth are recommended policy options.

1. INTRODUCTION

Information and Communication Technology (ICT) is a critical tool for national development and an enabler of the transformation of economic processes that facilitate production and trade (Asongu, 2013; World Bank, 2017). Technological development remains a key driver for employment creation, poverty reduction and economic growth. ICT application has proved useful in trade liberalization due to information availability and capital flows in the economy (Tiwari, 2008; Karlsson et al., 2017).

Mobile phone use, which is part of the ICT tools, dates back to the 1980s and was mainly used for business operations rather than promoting social conversations (Jumoke et al., 2015). Technological developments within the mobile industry led to a sharp growth in the number of users. For instance, between the year 2002 and 2017, the

number of mobile phone users rose from 2 billion to 5 billion globally, and it is projected to reach 5.9 billion by 2025 (Hagel *et al.*, 2013; Jumoke *et al.*, 2015; GSMA, 2018). Recently, the use of mobile devices, especial smartphones, has become prominent, especially among the youth for social conversations, educational, agricultural and other purposes. It is estimated that about 34.5 million subscribers exist in Ghana, with about one-third of the population being active internet users.

Over the years, mobile phone devices have become very instrumental in human interactions economically, socially and culturally (Kalogeraki and Papadaki, 2010). It is no doubt that mobile phone devices are permeably entrenched in the lives of many people (Dergol-Dery *et al.*, 2017). In some cases, people tend to be incomplete when their mobile phone devices are not at hand. The surge in technological solutions to address local and global problems accounts for the influx and use of mobile phone devices (Sarfoah, 2017). The technological solutions associated with mobile phone devices are as a result of its efficiency and flexibility.

Mobile phone devices have made communication easy and reliable (Jumoke *et al.*, 2015). Hitherto, communication between people was inefficient and cumbersome as it could take days, weeks and months to communicate information between people. People were also limited with the sort of information that could be communicated. However, the use of advanced mobile device technology in recent times has made it possible for cross-border communications. Besides, it has allowed people to access certain platforms for jobs or to complete certain tasks without necessarily being physically present (Kulesz, 2016).

Evolution of the mobile phone and telecommunication industry has led to the development of various types and brands of phones. Identifiably, there are three types of mobile phone, namely basic phone, feature phone and smartphone. All these types have over the years played complementary roles in societal development in the areas of health, agriculture, education, communication, finance, trade and many other sectors. However, the complexities associated with modern economies have made smartphone use imperative. For instance, the introduction of ICT in the banking industry has contributed in sustaining the use of mobile phone devices that enable access to operational features in electronic banking. The use of mobile money platforms is directly linked to using mobile phone devices to promote financial inclusion, especially in developing and emerging economies.

A fairly new space in Ghana where the use of mobile phone devices has been applied is the agricultural sector. Sustained productivity in the agricultural sector has been backed by a number of strategies, among which is the use of ICT. The primary purpose of mobile phone devices in agriculture is to drive an agriculture information service that establishes a coherent database for tracking the transformation of markets (Zhang *et al.*, 2016). Recent efforts to advance agriculture information services involve employing ICT digitization in agriculture. Albeit digitization of technology is popular in the advanced countries, Ghana is yet to optimize its full potentials in the agricultural sector.

The upgrading of functions and features of mobile phone devices is linked to developments in digitization of technology. Mobile phone devices have witnessed significant improvements and transformations that meet the changing technological needs and demand dynamics of people, especially smartphones which are more advanced compared with feature and basic mobile phone devices. Smartphones are capable of executing complex functions and software programmes on its platform. Hence, the soaring rate of their use, especially among the youth. This study seeks to understand the factors that influence consumers' choice for smartphone usage under different geographical settings (urban, peri-urban and rural) and their implications for development.

The rest of the study is structured as follows: Section two reviews the related literature on smartphone use and its determinants. The study methodology, sampling and empirical methods are presented in section three. The results and discussion of the findings are captured in section four while conclusions and policy implications are detailed in section five.

2. DETERMINANTS OF SMARTPHONE USE

Technology plays a key role in national development, and the way society engages and applies ICT is shaped by institutional arrangements (Jenn-Hwan, 2008). Low technological advancements as espoused by the modernization theory, weak social structure and limited technical-know-how affect the attainment of sound economic growth in most developing countries. The size of a country's technological sector is associated with the pace of economic growth with strong positive links to equity market development (Brown et al., 2016). Growth in the agricultural sector is a prerequisite for sustainable economic development (Khan and Ansari, 2018) and ICT is critical in transforming the growth processes and facilitating both production and trade (World Bank, 2017).

Aldosari et al. (2019) examined the perception of 183 farmers towards electronic media use (radio, television, Internet, mobile and helpline) and reported that Internet and mobile are useful sources of agricultural information to the majority (over 90%) of farmers. The study also highlighted the importance of extension in educating farming communities on the use of electronic media on agricultural production techniques. Previously, Moghaddam and Khatoon-Abadi (2013) reported that the presence of ICT centre and funding source influences the adoption of ICT in rural Golestan Provence irrespective of the economic status of users. Individual, social, innovation related factors, and the ability of household to communicate information are important dimensions of ICT adoption. Rural people's access to innovations and tangible benefits could lead to innovation adoption in rural development processes (Moghaddam and Khatoon-Abadi, 2013). However, the study found no correlation between formal education and ICT adoption. Furthermore, Giotopoulos et al. (2017) analyzed the determinants of ICT adoption among small and medium sized enterprises (SMEs) to show that research development activities, innovations, skilled and well-educated workforce, visionary leadership, and decentralized decision-making increase the likelihood of technology adoption among SMEs. ICT adoption decisions and processes are, therefore, complex and depend very much on firm resource availability, the organization, business environment and strategic orientation. ICT usage behaviour has also been linked to national cultures which cannot be generalized (Bankole and Bankole, 2016) and that cultural differences affect ICT adoption (Yuen et al., 2016).

Meanwhile, ICT diffusion is an effective tool for controlling corruption (Ali and Gasmi, 2017). Thus, as countries develop economically, their corruption levels improve by virtue of trade openness and better institutions. However, increases in general price level have direct profound effects on bribery, especially in developing countries. In assessing the behaviour of 503 mobile tourist consumers, Tan and Ooi (2018) observed some structural inconsistencies. They found mixed effects of age and gender in decision-making and showed that organizations can create effective mobile marketing campaigns using mobile tourism shopping. Wright et al. (2018) explored the use of ICT tools (webinars, YouTube, podcasts, mobile applications) in disease surveillance and reporting. The study found that farmers and agronomists alike are very receptive to using ICT to provide accurate and timely information on crop pests and diseases. Kosec and Wantchekon (2018) highlighted the importance of incentives and empowering individuals to act on information in service delivery.

Studies that examined the factors influencing consumer purchasing behaviour for mobile phones revealed that durability and advanced technological features matter for mobile phone consumers (Dziwornu, 2013; Dergol-Dery et al., 2017). A consumer choice study revealed that multimedia and innovative services were the key factors that drive consumers' choice of mobile phones though other factors (design, price, brand, reliability, outside influence) play a role (Karjaluoto et al., 2005). Dergol-Dery et al. (2017) revealed that user-friendliness, quality, and price are the main factors influencing tertiary students' brand choice of mobile phone in northern Ghana. Similarly, Ndadziyira (2017) assessed tertiary students' brand preference for mobile phones in Tanzania and concluded that product attributes, brand popularity, price, social influence, and marketing communications affect the choice of mobile phones. Different variables, therefore, affect the type and brand of phone used by people but price and quality appears to be key determinants from the perspective of consumers.

The positive effects of mobile ICTs on agricultural production and productivity have been documented by various studies (Ogutu et al., 2014; Aker and Ksoll, 2016; Fu and Akter, 2016). Ogutu et al. (2014) reported that the use of ICT-based management information system significantly increases the use of seeds, fertilizers, land and labour productivity in Kenya. Mobile ICTs have also been shown to impact positively on farmers' market participation and output prices received (Lee and Bellemare, 2013; Sekabira and Qaim, 2017). For instance, in Uganda, the expansion in mobile phone coverage is reported to reduce marketing costs and induces farmer participation in markets (Muto and Yamano, 2009). Similar reductions in search cost among rural households in northern Ghana have been documented (Zanello, 2012) with positive effects in changing market power (Asongu et al., 2018). Issahaku et al. (2017) reported that the ownership and use of mobile phones impact significantly on agricultural productivity and that extension services, access to markets and the adoption of modern practices are the impact channels, with household characteristics such as age of household head, income, sex, and migrants' mobile phone ownership (Benson, 2019).

Previously, Kiiza and Pederson (2012) analysed market information and technology adoption in Kenya in the context of ICT to show that wealth, access to microfinance loans, government awareness campaigns and membership to a farmer association are positive significant factors that influence information access. Distance to the trading centres and female-headed households negatively affect ICT-based market information access. Access to market information positively and significantly influences the adoption intensity for improved seed (maize, beans and groundnuts) with positive effects on yields and profit margins.

In education, the use of mobile phones on students' studying outcomes has received research attention in the literature. Most students use mobile internet mainly for entertainment with negative impact on their writing skills due to the use of sub-standard language composing text massages (Saleem and Bakhsh, 2017). A strong correlation was revealed between mobile phone usage and age of students. Similarly, Farahmand and Alinejad (2016) analysed the rate of mobile phone usage and its consequences among students in Iran to show that a significant relationship exists among mobile phone vulnerability, academic failures, identity crises, and family attachment. Mobile phone usage rate was found to account for 25.2% of students' academic failure.

Empirical evidence shows that smartphone use has large income effects (farm, off-farm and households) for males than female but the income effects are heterogeneous (Zanello, 2012; Ma et al., 2018). Gender, off-farm income, farmer education and farm size are the main significant drivers of smartphone use (Ma et al., 2018). Inclusive development and knowledge diffusion have also been linked to mobile phones (Asongu and Nwachukwu, 2016) and Kirui et al. (2013) revealed that gender, distance to the nearest mobile money transfer agent, education, and membership to farmer organization are the main determinants of mobile phone use among farm households. These studies suggest that there are gender effects in the use of smartphones.

3. MATERIALS AND METHODS

3.1. Sampling and Data Collection

The data for this study was part of a bigger survey on digitalization in agriculture, food and nutrition that focused on taking stock of the status and readiness of ICT application in agriculture in Ghana. The target population was mobile phone users in the Greater Accra Region of Ghana. A case study survey involving mobile phone users was conducted in three purposively selected locations presumed to have urban, peri-urban, and rural characteristics. A structured questionnaire was prepared and formatted on an Open Data Kit (ODK) and used to collect the data at Dzorwulu (urban), Dorwenya (peri-urban settlement) and Damfa-Otinibi (rural community). In the selected locations, purposive sampling of respondents was done based on mobile phone ownership and use following random walk sampling methodology. A total of 305 people were covered in the survey (at least 100 respondents in each selected location). The data collected covers the type of phone used, number of registered SIM cards in use, ability to send messages, main uses of phone and the factors influencing the choice of phone acquired.

3.2. Variable Description and Statistics

The main variables of interest included in the study, the mode of measurement and descriptive statistics are captured in Table 1.

Table-1. Variable definitions/measurement of instruments.

Variable	Measurement	Obs.	Mean	SD
Phone type (PTYP)	1 if a respondent used a smart phone in 2019, 0 otherwise	305	0.819	0.385
Age (AGE)	1 if respondent is 35 years and below, 0 otherwise	304	0.723	0.447
Sex (SEX)	1 if respondent if male, 0 otherwise	305	0.567	0.496
Marital Status (MSTAT)	1 if respondent is married, 0 otherwise	305	1.393	0.534
Education (EDUC)	Maximal education level attained by respondent (years)	303	2.003	0.795
Location (RURAL)	1 if rural location, 0 otherwise	305	0.340	0.474
Location(URBAN)	1 if urban location, 0 otherwise	305	0.331	0.471
Location (PERI-URBAN)	1 if peri-urban location, 0 otherwise	305	0.327	0.470
Number of registered SIM cards (NSIM)	Number of SIM cards in active use	305	1.678	0.698
Nature of Work (NOWK)	1 if the nature of work of respondent influences his smartphone use decisions, 0 otherwise	305	0.288	0.453
Affordability (AFFD)	1 the choice for smartphone use is based on affordability (income), 0 otherwise	305	0.573	0.495
Fashion (FASH)	1 if the choice for smartphone is due to fashion, and 0 otherwise	305	0.180	0.385
Peer influence from Friends (FRDS)	1 if the decision to use smartphone is based on friends influence, 0 otherwise	305	0.180	0.385
Access to applications (APPS)	1 if the decision to use smartphone is based on access to mobile applications, 0 otherwise	305	0.324	0.468
Access to Mobile money (MOMO)	1 if the decision to use smartphone is to facilitate mobile money transactions, 0 otherwise	305	0.829	0.376

Age influences the use of smartphones, especially among the youth (15-35 years) and the working class. Evidence shows that the use of mobile phones among older persons (above 65 years) declines (Benson, 2019). The expectation is that mixed effects will result based on the age of individuals. *Sex* could influence the use of smartphones as male farmers are better able to use mobile money services through mobile phones than their female counterparts (Kirui *et al.*, 2013; Ma *et al.*, 2018). Also, households that own mobile phones tend to have greater share of males among their members (Benson, 2019).

Marital status: Is a socio-economic variable likely to influence the use of smartphones. Unmarried persons are more likely to use smartphones than married couples due to family obligations such as payment of school fees, medical expenses and the like. *Education* has been linked to building the skills of individuals to be able to use mobile devices and other applications easily. Educated individuals are more likely to use smartphones for various purposes and farmer education has been found to impact significantly on the use of smartphones (Ma *et al.*, 2018). Positive effects can be expected. *Location* can influence the type of phones used by individuals. In areas with no electricity or that experience frequent power cuts, mobile phones with durable batteries are preferred by consumers. The availability of internet connection services in a particular geographical location could also influence people's choice of phones. Where internet services are limited, the use of basic phones will likely dominate people's choice of phones.

Furthermore, the *number of registered SIM cards used* could influence the choice of mobile phone used by individuals. Network instability and poor coverage in some locations led to the manufacturing of dual SIM card phones. This could probably also influence people's choice of mobile phones used.

Nature of Work: The type of work engaged by individuals could likely influence their mobile phone choices. Sedentary office workers are more likely to use smartphones than farmers engaged in crop production. Thus, the

purpose for which individuals use phones varies from one profession to the other and this could impact on smartphone use.

Affordability is related to the ability of an individual to pay the cost of a mobile phone. It has been shown that richer households are more likely to own mobile phones than poorer households (Benson, 2019). The income level of individuals largely determines the type and kind of mobile phone they use.

Fashion is a social phenomenon likely to push most people into using some types of mobile phones to enable them to keep pace with technological developments. Both the young and the old in society are abreast of new technological developments in the mobile phone sector, hence the desire to own and use the latest phone brands in the market. Positive effects on smartphone use are expected.

Mobile phone ownership is very important and it has been shown to impact significantly on productivity in the agricultural sector (Issahaku *et al.,* 2017). The ownership of more than one phone could stimulate the use of smartphones. Mobile phone ownership is associated with the working age group (15-64 years) (Benson, 2019). *Pear influence* could influence the use of smartphones, especially among the youth. Individuals would like to use smartphones simply because their friends are using some for varied purposes.

Access to applications: technological advances have made it possible for people to access multiple applications on smartphones and this could likely be a key driver for the increasing demand and use of smartphones.

Finally, *mobile money services* could impact on the use of smartphones. The desire of people to transact business, receive money transfers, and send money to others at the comfort of their homes is leading customers to use smartphones. Positive effects are expected.

3.3. Data Analysis: the Probit Model

The theoretical foundations for this analysis are anchored on choice theory which describes individual actions and their motivations (Glasser, 1998). The behaviour and actions of individuals are based on the knowledge and information available to them at a particular time. Choice theory underscores the importance of individual actions in decision-making. For instance, a person's decision to use a smartphone is determined solely by the individual based on the information available and several factors could affect the decision-making process. The inner behaviour of individuals, therefore, directs their choices within a given ecosystem (Gabriel and Matthews, 2011). Hence, consumer's choice of the type of mobile phone device to use may be determined by internal and external factors which the individual has power to control.

Theoretically, the decision of an individual to use a smartphone is influenced by certain factors (individual, demographic and institutional). Let the latent variable Y_i represent the decision of an individual to use a smartphone and X_i represents independent variables, the quantitative response model can be written as:

$$Y_i = \alpha + \beta X_i + e_i \qquad (1)$$

Where α is the constant, β is the coefficient of parameters to be estimated, and e_i is the error term. Since the probability values often fall within the range of 0 and 1, the use of Ordinary Least Squares (OLS) in estimating Equation 1 is inadequate. The probit model is applied in this study since it has been shown to perform better even in small samples compared to the logit model. Assuming that X_i (vector of regressors) is influenced by the response variable Y_i, the model takes the form presented in Equation 2 below.

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$$P_r(y_i = 1/X_i = \emptyset \ (-\beta' X_i/\sigma) \tag{2}$$

Where y_i is the binary choice variable (decision to use smartphone), $\emptyset$ depicts the Cumulative Distribution Function of the standard normal distribution, σ represents unknown parameters to be estimated, and X_i represents the explanatory variables included in the model. The general probit model is specified in Equation 3 as:

$$\theta^{-1}(P_r) = \sum_{k=0}^{k=n} \beta_k X_{ik} \tag{3}$$

Where P_r is the probability of using a smartphone, X_i denotes explanatory variables that influence the decision of the kth individual to use a smartphone, and β_k are the coefficients of unknown parameters to be estimated.

The analytical models used are specified as:

$$Y_i = \beta_0 + \beta_1 SEX_I + \beta_2 AGE_i + \beta_3 MRST_i + \beta_4 EDUC_i + \beta_5 NSIM_i + \beta_6 NOWK_i +$$
$$\beta_7 AFFD_i + \beta_8 FASH_i + \beta_9 FRDS_i + \beta_{10} APPS_i + \beta_{11} MOMO_i + \varepsilon_i \tag{4}$$

$$Y_i = \beta_0 + \beta_1 SEX_I + \beta_2 AGE_i + \beta_3 MRST_i + \beta_4 EDUC_i + \beta_5 NSIM_i + \beta_6 NOWK_i +$$
$$\beta_7 AFFD_i + \beta_8 FRDS_i + \beta_9 FASH_i + \beta_{10} APPS_i + \beta_{11} LOC_i + \beta_{12} MOMO_i + \varepsilon_i \tag{5}$$

The location (LOC) variable was further decomposed into three levels capturing urban, peri-urban and rural locations. This enabled the researchers to quantitatively determine where location plays a role in the choice of smartphone use. Equation 4 was used in analyzing the full sample while Equation 5 took into consideration location specific (urban, peri-urban and rural) by running split sample regressions.

4. RESULTS AND DISCUSSIONS

4.1. Descriptive Statistics

The sample distributions show that about 34% were rural, 33% urban and 32% peri-urban. About 74% of the respondents were using smartphones, with the rest using basic phones (21%) and feature phones (4.6%). A large proportion (72%) of the sample was of the youth category aged between 15 and 35 years. This shows that the study covered the target category that goes in for smartphones for various reasons. A little over half (56%) of the respondents were males, with the rest being females. A large percentage of the surveyed respondents were using their phones for various purposes, namely for calls (99.1%), social media (80.7%), mobile money (82.9%), and photo taking (75.1%). In terms of stability/speed of Internet, rating responses for good varies among the different locations (35.1% urban; 39.4% peri-urban; and 31.6% rural). Rating quality of phone reception, however, decreases as people move from urban (47%), to peri-urban (40.8%) and to rural (22.7%). This is not surprising as most telcos providers tend to concentrate their attention in providing quality services in urban areas by erecting more masks at the expense of rural areas. Greater proportions (47.5%) of the respondents were using two registered SIM cards, with about 9.1% using more than two SIM cards.

4.2. Determinants of Smartphone Use

To check for 'multicollinearity' among the 'regressors', a correlation analysis was performed (see Table A in Appendix). All the values of the variables obtained were below 0.5, suggesting the absence of 'multicollinearity'. This test results pave way for the models to be estimated. Table 2 presents the marginal effects of the probit results of the factors influencing smartphone use. Out of the 11 variables included in the model, seven were statistically

significant at various levels. The pseudo R² showed that the variables in the model jointly explain 27% of the observed variations.

The model predicted 80.9% of the marginal effects associated with the variables Table 2. The statistically significant factors that influence smartphone usage are age, education, number of registered SIM cards used, affordability (NSIM), fashion, access to mobile applications (APPS), and mobile money. Whereas age, education, APPS and fashion influence smartphone usage positively, affordability and NSIM influence smartphone usage negatively. For instance, the result for APPS shows that the probability of using smartphone increases by 4.8% given that the individual wants to have access to a variety of software applications for different activities. This may be so because smartphones can function efficiently with several applications as against 'basic phones'. Also, smartphone usage has positive relationship with access to mobile money (MoMo) services. Thus, the probability of using smartphone increases by 8.4% given that the consumer intends to use the phone for MoMo services. This could be attributed to the desire for individuals to use fashionable phones since MoMo services usually involves public display of phones and individuals may not want to feel inferior or ridiculed.

Table-2. Probit regression results of factors influencing smartphone usage.

Variable	dy/dx	Std. Err.	Z	P>|z|	[95% C.I.]		X
SEX^	-0.033	0.050	-0.66	0.512	-0.133	0.066	0.564
AGE^	0.167**	0.080	2.09	0.037	0.010	0.324	0.722
MRST	0.059	0.057	1.04	0.299	-0.053	0.173	1.396
EDUC	0.056*	0.033	1.70	0.090	-0.008	0.121	2.003
NSIM	-0.074*	0.040	-1.81	0.070	-0.154	0.006	1.676
NOWK^	-0.088	0.063	-1.39	0.164	-0.211	0.035	0.290
AFFD^	-0.169***	0.049	-3.41	0.001	-0.266	-0.071	0.574
FASH^	0.135***	0.049	2.17	0.006	0.039	0.232	0.181
FRDS^	0.090	0.066	1.36	0.172	-0.039	0.221	0.181
APPS^	0.137***	0.048	2.83	0.005	0.042	0.232	0.320
MOMO	0.475***	0.084	5.65	0.000	0.310	0.640	0.831
Goodness of fit							
Number of Observations = 303; LR Chi2 (12) = 94.95; Prob > Chi2 = 0.0000							
Pseudo R² = 0.2764; y = Pr (TYPE) = 0.809							

Note: The standard errors are in parenthesis. ***, **, and * means significant at 1%, 5% and 10% respectively. (^) dy/dx is for decrypted change of dummy variable from 0 to 1.

On the contrary, affordability decreases the probability of smartphone usage by almost 17%. Thus, considering that the price of smartphone increases and moves beyond the purchasing powers (income) of the consumer, the probability of using smartphone declines. Clearly, this is due to the income/budget constraints faced by individual smartphone consumers. Similar scenarios have been observed for the other variables except sex, marital status, nature of work, and peer influence from friends which were found insignificant. Both APPS and *Affordability* are statistically significant at 1%.

To establish whether geographical location matters in the use of smartphones, split sample analysis was performed based on urban, peri-urban and rural, and the results are presented in Table 3. Three separate models were run for rural [Model 1], urban [Model 2], and peri-urban [Model 3] and the different specifications also serve as a robust check for the model.

Table-3. Split analysis of the determinants of smartphone use based on location.

Variable	Model [1]		Model [2]		Model [3]	
	dy/dx	P>|z|	dy/dx	P>|z|	dy/dx	P>|z|
SEX^	-0.042 (0.051)	0.413	-0.043 (0.050)	0.390	-0.023 (0.049)	0.643
AGE^	0.174** (0.080)	0.030	0.166** (0.082)	0.043	0.155** (0.078)	0.048
MRST	0.053 (0.058)	0.361	0.048 (0.059)	0.415	0.046 (0.056)	0.409
EDUC	0.064* (0.033)	0.055	0.097*** (0.034)	0.005	0.075** (0.032)	0.022
NSIM	-0.079** (0.041)	0.041	-0.062 (0.039)	0.119	-0.061 (0.039)	0.117
NOWK^	-0.047 (0.063)	0.454	0.007 (0.058)	0.896	-0.077 (0.061)	0.204
AFFD^	-0.165*** (0.050)	0.001	-0.113** (0.051)	0.027	-0.099** (0.051)	0.053
FRDS^	0.097 (0.067)	0.149	0.113** (0.058)	0.052	0.061 (0.069)	0.379
APPS^	0.139*** (0.049)	0.005	0.132*** (0.048)	0.006	0.124*** (0.047)	0.009
MOMO^	0.492*** (0.082)	0.000	0.486*** (0.087)	0.000	0.430*** (0.089)	0.000
RURAL^	0.056 (0.053)	0.290				
URBAN^			-0.299*** (0.067)	0.000		
PERI-URBAN					0.220*** (0.045)	0.000
LR Chi2 (12)	90.71		112.67		106.96	
Prob > Chi2	0.0000		0.0000		0.0000	
Pseudo R²	0.2641		0.3280		0.3114	
y = Pr (PTYP)		0.8036		0.8199		0.8010

Note: the standard errors are in parenthesis. ***, **, and * means significant at 1%, 5% and 10% respectively. (^) dy/dx is for decrypted change of dummy variable from 0 to 1.

Age positively and significantly influences the use of smartphones irrespective of geographical location. This means that the probability of using smartphones increases among the youth (aged between 15 and 35 years). For instance, Model [1] shows that the probability of using smartphone increases by 17.4% among rural dwellers, given that they are youthful in age.

Education has positive and significant impact on smartphone use in all the models estimated in line with theoretical expectations. Education enhances skills building, enabling people to be able to use complex and more sophisticated smartphones irrespective of where they reside. This finding supports previous evidence provided by Kirui *et al.* (2013) that with education farmers are more able to use mobile phones for money transfer services.

The number of SIM cards used is negative and significantly related to smartphone use only in rural areas. Thus, the probability of using smartphones declines by 7.9% given the number of registered SIM cards used (Model [1]). This suggests that the probability of using many SIM cards declines as people use smartphones.

The cost of a smartphone is related to the ability of people to afford it and use. *Affordability* is negatively and significantly related to smartphone usage in all models. The magnitude of the effect, however, declines as people move from rural to urban areas. For instance, the probability of using a smartphone declines by 16.5% and 11.3% for rural and urban locations respectively, given that the individual has the purchasing power (Model [1]). This could be attributed to the fact that as the purchasing power of individuals improve they tend to undertake investments (such as buying cars, land and other assets) while reducing consumption expenditure (smartphones). This result is consistent with previous finding that income and price are significant determinants of smartphone use (Karjaluoto *et al.*, 2005; Dergol-Dery *et al.*, 2017; Ndadziyira, 2017).

Access to mobile applications is very important, especially among the youth, and it is a key driver for smartphone use. Through mobile applications, people are able to access banking services, entertainment (games, music), and educational information easily, anywhere, and at any time. This made life more bearable for many smartphone users, hence the desire for it. Table 3 shows that the probability of using smartphones increases with access to mobile applications irrespective of geographic location of people. This amplifies the importance that people attached to mobile software applications. As reported by Dziwornu (2013) innovative services significantly drive smartphone usage and access to mobile applications is part of the innovative services that come with smartphones. Also, product attributes have been found to influence smartphone use (Ndadziyira, 2017) and access to varied applications is one of such attributes.

Digitalization in the financial sector plays a role in the use of smartphones. *Access to mobile money services* (MoMo) is shown to have positive and significant influence on smartphone usage at 1% level of significance regardless of location. With improvements in both mobile network coverage and quality of the service, the use of smartphones for mobile and banking transactions is on growth trajectory. The marginal effects Table 3 revealed increased probabilities of using smartphones for MoMo. This outcome confirms earlier findings by Kirui *et al.* (2013) that the use of mobile phone-based money transfer services impact significantly on agricultural commercialization, input use and household incomes leading to improved access to financial services in rural areas.

Finally, geographic location matters in the use of smartphones Table 3. The results of Models [2] and [3] show that urban and peri-urban locations influence the use of smartphones. While the probability of using smartphones decreases by 29.9% in urban location, there is a probability increase of 22% usage in peri-urban areas. This may be attributed to the market dynamics and saturation of smartphone use in urban areas. Frequent power cuts that characterized most urban centres could be driving down the demand for smartphones in favour of basic phones due to the long-lasting nature of their batteries (battery durability). One implication for this result is for cellphone marketing companies to shift attention to peri-urban markets for increased sales of smartphones and income. Socio-economic factors such as sex, marital status, nature of work, and peer influence (friends) do not significantly influence smartphone usage.

5. CONCLUSIONS AND POLICY IMPLICATIONS

This study has analysed the factors that influence smartphone usage in the Greater Accra Region of Ghana using a sample of 305 households collected from rural, urban and peri-urban locations. Smartphone use is on a growth trajectory and there is the need to understand the underlying factors that drive the increasing trends. By applying the probit model, various interesting results emerged which have implications for users, regulators and cell phone marketing companies. The results show convincingly that location matters in the use of smartphones. While the demand for smartphones appears to be growing more in peri-urban locations, there is contraction in urban locations, with insignificant effects in rural areas. The implication is that cell phone marketing companies need to adjust their marketing strategies and take advantage of the growing demand in peri-urban areas. This also has management implications for the companies in terms of minimizing their costs of outreach to rural areas. The probability of using smartphones is higher among urban and peri-urban dwellers. Furthermore, age, education, number of SIM cards used, affordability (income), access to mobile applications, and access to mobile money services are the main factors that significantly influence smartphone use.

These findings have implications for various stakeholders (smartphone users, cell phone marketing companies, regulators and policymakers). Smartphone manufacturing companies need to target differently by producing smartphone brands that are affordable to most rural dwellers to help stimulate the market. Targeting the youth in the smartphone industry is a meaningful strategy for improving sales. This should be complemented with education (point of sale, promotions) for greater impact. Regulatory agencies such as the National Communications Authority (NCA) should encourage mobile network service providers to expand the network coverage and improve the quality

of service delivery, especially in rural areas. This has the potential of stimulating smartphone use, broadening access to market information and mobile money services, and hence financial inclusion.

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APPENDIX

Table-A. Correlation matrix of regressors.

Variables	SEX	MRST	EDUC	NSIM	NOWK	AFFD	FASH	FRDS	APPS	MOMO	AGE
SEX	1.000										
MRST	-0.0588	1.000									
EDUC	0.0540	-0.0887	1.0000								
NSIM	0.0315	0.0337	0.1921	1.0000							
NOWK	0.0636	0.0973	0.0981	0.1607	1.000						
AFFD	0.0243	0.0511	0.0036	-0.0069	-0.0226	1.000					
FASH	-0.0352	-0.0446	0.0088	-0.0148	0.1137	0.0245	1.000				
FRDS	0.0166	-0.0125	0.0520	-0.0515	0.0759	-0.3391	-0.0218	1.000			
APPS	-0.0249	-0.0187	0.1486	0.0948	0.1687	-0.0959	-0.0111	0.3009	1.000		
MOMO	0.0317	-0.1288	0.2130	0.1703	0.1324	-0.1198	0.0974	0.0288	0.1007	1.000	
AGE	-0.0981	-0.5760	0.0769	-0.0018	-0.1235	-0.0710	0.0430	0.0430	0.0457	0.1155	1.000

Note: SEX= sex; MRST= marital status; EDUC= education; NSIM= number of active SIM cards used; NOWK= nature of work; AFFD= affordability; FASH= fashion; FRDs = peer influence by friends; APPS= access to mobile applications; MOMO= access to mobile money services; and AGE= age of respondent.