Factors Influencing Mobile Telecom Service Access and Usage in Cape Coast, Ghana

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Abstract The study sought to investigate the factors influencing mobile telecom services access and usage in Cape Coast metropolis in the Central Region of Ghana by addressing the following question: What are the main factors that influence the access and usage of mobile telephone services? Primary data were collected from 200 subscribers and non-subscribers of mobile telecom services. The logit model was employed to identify the factors influencing mobile telecommunication services access. The results of the study showed that the probability that an individual will subscribe to a mobile telecom is dependent on income, price of mobile service, employment and education. It is recommended that a mobile number portability system should be introduced in the mobile telecom industry to reduce the lock-in effect currently prevailing in the industry. Also, efforts should be made to provide employment opportunities to individuals to enable them use more mobile telecom services.

Keywords Mobile telecom service, Access, Usage, Cape Coast

1. Introduction

Access to information and communication technology is considered important to a sustainable agenda of poverty reduction because it increases the efficiency and competitiveness of a country in the global economy, enables better delivery of health and education services and creates new sources of income and employment (World Bank, 2006). It has also been emphasized that mobile telecommunication is one of the most convenient means of communicating and transacting business. An effective mobile telecommunication system, in one way or the other, enhances development as it also boosts investor confidence and promotes business transactions (Gyimah-Brempong & Karikari, 2007).

In Ghana, reforms in the telecommunication sector carried out in the 1990s and 2000s contributed immensely towards the transformation of telecommunication services. The reforms were designed to introduce privatization, liberalization and competition into the telecommunication industry. They were also aimed at accelerating the modernization and the expansion of the industry as well as improve customer satisfaction through improvement in the quality of service and efficiency of the sub-sector (ISSER, 2001). As a result, mobile telecommunication network companies entered the telecommunication industry providing mobile telecommunication services.

The number of mobile telephone service subscribers has increased in recent times. From as low as 2,392,000 subscribers in 2005, mobile subscribers reached 15,108,916 in 2009 (National Communication Authority, 2010). Despite the increasing number of subscribers, the use of mobile telephone services in the country is still limited. Also, the phenomenon of multiple subscriptions whereby some people own more than one mobile line is common in Ghana.

Whereas the above analysis enriches our knowledge concerning subscription trend, studies into the demand for mobile telecommunication services in Ghana are scarce. Moreover, issues concerning subscription behaviour and consumers' expenditure on mobile telecom services have not been given much attention. This paper seeks to bridge this gap by addressing the following question: What are the main factors that influence the access and usage of mobile telephone services? The study will be useful to both the service providers and the regulatory authorities. It will help service providers to come to grips with the key factors that affect the demand for their services and therefore enabling them to tailor their services appropriately in order to increase their subscriber base as well as profits. The regulatory authorities will also be abreast with consumers' behaviour and perception towards mobile telecommunication services. This will enable them to come out with policies that promote the welfare of consumers and also ensure efficient and reliable telecommunication services delivery in the country.

The paper is organized as follows: Section 2 presents a review of related literature for the study. Section 3 discusses the methodology. In this section, we outline the main

analytical framework and the empirical model, estimation procedure and the data collection. Section 4 outlines and discusses the results from the statistical analysis. Section 5 concludes the paper and provides recommendations.

2. Literature Review

Individuals access mobile telecom service for personal communication and other uses. Usually, before mobile telecom service can be used, an individual has to subscribe to a telephone network. According to Verkasalo (2008), subscription to a mobile telecom network requires decision making on the part of the individual who decides whether or not to use mobile telecom service. The subscription decision is usually based on the perceived benefits and costs associated with subscription. It is assumed that when the perceived benefits associated with subscription are greater than the costs of subscription, individuals will subscribe and use mobile telecom service. However, if cost of subscription is more than the perceived benefits, individuals will not subscribe and use mobile telecom service. Verkasalo (2008) also indicated that the consideration to access mobile telecom service is based on how the service meets the needs of individuals. According to him, needs are inborn in individuals and they tend to direct their behaviour. One way of fulfilling these needs is to purchase a good or service and use it and in the case of mobile telecom services become subscribers and use the service. According to Loebbecke (1995), cost of using mobile service is critical factor that influences the use of mobile service. Costs of using mobile service include cost of acquiring the line, price of the mobile phone, and cost of usage per minute. Cost of mobile usage can also be viewed in terms of the price for calls within the same network and calls to other networks.

A number of studies have looked at the demand for access to telecommunication services, however much of these studies have focused on developed countries. One of the first studies on telephone demand was by Bell Canada (1986). The study examined household telephone demand using data collected by Statistics Canada. A set of economic, demographic and regional variables were included in the model estimated in the study. The main economic variables included in the model were price and income. The other variables considered in the study were age, education, employment and marital status. The results of the study showed that the likelihood of telephone subscription increases with individuals' income, age, education and self-employment. In another study in Canada, Bodnar, Dilworth and Iacono (1988) analyzed telephone service subscription using household level data. They employed the logit model to examine the relationship between telephone service subscription and socio-economic and demographic variables. The results from their study showed that the probability of subscribing to telephone services was related to a number of socio-economic and demographic factors. Access price, income, education and occupation were significant in explaining demand for access to telephone

service. The findings from this study confirmed the results of similar studies by Duffy-Deno (2001), Sung and Cho (2001), Rodriguez-Andres and Perez-Amaral (1998), and Salvason and Bondnar (1995). They found that income and education positively influenced household's telephone service subscription. The impact of access price on telephone service was negative. They argued that when access rates charged by telephone service companies are reduced more people get connected to telephone services. In the same vein, households with higher incomes were more likely to subscribe to telephone service than those with relatively lower income. They advocated that lower income earners should be given subsidies as a way to achieve universal telephone service.

In United Kingdom, Gassner (1998) estimated demand for access to telephone services based on household data. She modeled household telephone subscription decision in a discrete choice framework in which the telephone service decision was related to cost of connection, income and a host of other socio-demographic factors. The binary logistic regression approach was used. The study found that cost of connection, income, education and employment status significantly determined telephone subscription.

In Korea, Ahn (2001) investigated demand for subscribing to mobile network based on a survey data. The study analyzed the characteristics of mobile subscribers and how these characteristics influenced their mobile subscription decisions and intentions. He found that age, gender and education had significant impact on mobile telephone services subscription behaviour. Income was used as a control variable and for that matter its impact on mobile telephone service was not directly looked at in the study. The results for age and gender were in contrast to the findings of Narayana (2005) who found insignificant results for age and gender.

In a similar study, Rodini et al. (2003) examined the impact of individual household demographic profile on the demand for mobile telephone service in a discrete choice framework based on household survey data. Household mobile telephone service subscription was modeled using logistic regression. They found income, age, gender of the household head and size of household as important determinants of mobile telephone services subscription. For levels of income, individuals in the highest-income group had subscription rate of almost 40 percent higher than individuals in the lowest-income group. Also, women were 9 percent more likely to subscribe to mobile telephone services than men. They discovered that subscription probability among oldest households was 20 percent lower than for the youngest households.

Ida and Koruna (2005) studied demand for mobile telecommunication services in Japan using cross-sectional survey data. The study analysed consumer's revealed preferences regarding mobile telephone subscriptions with emphasis on the differences between two types of mobile telecom services: Second generation (2G) services and third generation (3G) services. Using discrete choice model

(mixed logit model), the study discovered that demand substitutability among alternatives was stronger within the provider nest category than within the standard nest category. In addition, substituting one service with another was more common within the same provider than another provider. They observed that many mobile telephone subscribers were less willing to change their current providers simply because of switching costs, which acted as a barrier to regular change of mobile network.

In Nigeria, Olatokun and Bodunwa (2005) analysed mobile telecommunication demand by examining usage of Global System for Mobile Communication (GSM), emphasizing the factors that promote or hinder its use, usage benefits and quality of services provided by operators. Using a sample of 456 staff and students of University of Ibadan, the study found that social activities (e.g. contacting friends and relations) accounted hugely for the use of mobile telecommunication services. Mobile telecom services were less used in research and academic activities. The study identified that limited network coverage and poor quality of service (i.e. unstable network and difficulty in making and receiving calls) inhibited effective use of mobile telecom services. The study concluded that mobile telecom networks that provided quality service to customers stand a better position to acquire more subscribers.

Another study by Huang (2007a) investigated demand for mobile telecommunication services under non-linear pricing in Taiwan. Using cross-sectional expenditure survey data, the impact of nonlinear price schedule on consumer behaviour was analyzed with preference-based structural model. The study found that consumers differed vertically in the utility of using cellular services even after controlling for income variations. Demand for mobile telecommunication services was found to be positively related to income.

Moreover, Barrantes (2008) examined mobile telecommunication services use, subscription and call patterns among the urban poor in three selected cities in Peru: Lima, Trujillo (north) and Puno (southern highlands). An individual utility maximization model was adopted to econometrically test reasons for mobile telecommunication services subscription and usage. The results showed that the probability that an individual will access and use mobile telephone service was explained by individual characteristics such as age, education, occupation and type of employment; characteristics of household and use (or non-use) of other communication technologies.

In India, Narayana (2009) studied determinants of demand for telecom services using household survey data. Demand for telecom services was estimated using binary logit model with socioeconomic and demographic data. For all the variables included in the model, education, occupation, size of total income and location of friends and relatives were found to be the important determinants of demand for telecom services.

The literature has shown that demand for access to mobile telecommunication network is influenced by cost of mobile telephone services and individual socio-demographic

characteristics.

3. Methodology

3.1. Analytical Framework and Empirical Model

The analytical framework for the analysis of mobile telecom service access and usage follows that of Taylor (2002). The framework is based on the consumer-choice problem and takes into account an externality that is associated with telecom service. Assuming a population is made up of M individuals, each having the utility function described by equation (1).

$$U_i = U\left(c_i, q_i, N\right) \qquad (1)$$

Where c_i is the demand for consumer i for a composite good that represents all other goods and services, q_i represents the demand for telephone service of consumer i, and N is the number of consumers connected to the telephone network. Equation (1) is based on assumption that the utility function, U_i, is increasing in c, q, and N. The variable N is introduced into the utility function to take care of the network externality associated with telecommunication service. The budget constraint of a consumer i can be expressed as follows:

$$p_a + p_u.q_i + P.c_i = I_i \qquad (2)$$

Where p_a is the price of access to the telephone network, P_u is the price of using telephone, p is the price of the composite good and I is disposable income of the consumer. The maximization problem of the consumer assuming he is on a telephone network is given as follows:

$$Max\ u\ (c_i,q_i,N)$$

$$Subject\ to\ \ p_u.q_i + P.c_i = I_i - p_a$$

Forming the Lagrange function and applying differentiation, we obtain the following first order conditions:

$$U_q - \lambda p_u = 0 \qquad (3)$$

$$U_c - \lambda p = 0 \qquad (4)$$

$$p_u.q_i + P.c_i = I_i - p_a \qquad (5)$$

The solution of equations (3), (4) and (5) yields the demand function for telecom service and the composite good as follows:

$$q_i = q(p_a, p, N, I_i - p_a) \qquad (6)$$

$$c_i = c(p_u, p, N, I_i - p_a) \qquad (7)$$

The demand for the two goods depends on income, relative prices and the number of subscribers. As noted by Chabossou et al. (2009), these functions are different from conventional demand functions in two respects: The budget constraint is $I-P_a$ rather than I, which reflects the conditionality of having to purchase access to telephone

network, and the demand functions depend upon the number of subscribers, which reflect access and usage externalities. Solving equation (7) for p_u, we derive an inverse telecommunications demand function and compute the consumer surplus, S_i.

$$p_u = p_u(q_i, p, N, R_i - p_a)$$

$$s_i = \left[\int_0^{q_i} p_u(z, p, N, I_i - p_a)dz \right] - p_u.q . \quad (8)$$

The consumer compares his surplus, S_i to the access price, P_a and if the surplus is greater than the access price, he subscribes to the telephone network and his demand is given as equations (6) and (7). On the contrary, if P_a is greater than S_i, the consumer will not subscribe.

In this paper, the logit model was employed to examine the factors influencing mobile telecom access and usage. The decision of an individual to access mobile telecom service is dichotomous, subscribe or not subscribe. Suppose the binary variable $Y = (0, 1)$ denotes the mobile subscription decision of the individual. Let y=1 if and only if the individual subscribes to mobile telephone service and y=0 if otherwise (i.e. no subscription). The probability of subscribing to mobile telecom service is expressed as:

$$p_i = (y = 1 | x_i) = \frac{\exp(x_i\beta)}{1 + \exp(x_i\beta)} \quad (9)$$

Where $\qquad X_i\beta = \beta_1 + \beta_2 X_2...\beta_k X_k$

From equation (9), the probability of not subscribing to mobile telecom service is expressed as:

$$1 - p_i = \frac{1}{1 + \exp(x_i\beta)} \quad (10)$$

Combining equations (9) and (10) we have

$$\frac{p_i}{1 - p_i} = \exp(x_i\beta) \quad (11)$$

By taking the natural log of equation (11) we obtain the logistic function

$$L_i = \ln\left(\frac{p_i}{1 - p_i}\right) = \alpha + \beta X_i + \varepsilon_i \quad (12)$$

Where ln represents natural logarithms; P_i denotes probability of subscribing to a mobile telephone service, defined in terms of cumulative logistic probability function; $(1-P_i)$ is the probability of non-subscription to mobile telephone service; X_i is a vector of explanatory variables; ε is a stochastic error term; and β is a vector of relevant coefficients to be estimated. The empirical model for mobile telecom subscription is specified as:

$$\ln\left(\frac{p_i}{1 - p_i}\right) = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_1 + \alpha_3 X_3 + \alpha_4 X_4 \quad (13)$$
$$+ \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \varepsilon_i$$

Where X_1 represents monthly income, X_2 is access price, X_3 is education of respondents, X_4 is household size, X_5 is a dummy for public sector worker, X_6 is a dummy for private sector worker, X_7 is a dummy for self-employed and X_8 is a dummy for sex and ε_i is the stochastic error term assumed to be independently and normally distributed with zero mean and constant variance. The definition and measurement of the variables included in the model are presented in Table 1.

Table 1. Definition and measurement of variables in included in the regression model

Variable	Measurement	Expected sign
Income	Monthly income in Ghana cedis	+
Household size	Total number of persons in the household	+
Education	Years of schooling	+
Access price	Average price of handset and SIM card	-
Sex	Female = 1, male = 0	+
Public sector worker	Public sector worker = 1, otherwise = 0	+
Private sector worker	private sector worker =1, otherwise = 0	+
Self employed	self-employed = 1, otherwise = 0	+

Note: All variables in the table are defined with respect to the individual except household size variable.

3.1.1. Justification of the Variables

Individuals' access to and usage of mobile telecom service are assumed to be influenced by a number of factors including income, household size, education, occupation, gender and price of access to mobile telecom network. We discuss below the justification of the main variables included in the regression model.

Income is measured as the monthly income of respondents. It indicates the individual's capacity to subscribe to and use mobile telecom services. Jha and Majumda (1999) argued that a greater income signify a greater affordability and so lead to an increased demand for mobile telecommunication service. The role of income in the demand for telecom service is well noted in the literature. Studies that find income to influence the demand for telecom services are Trotter (1996), Agiakoglou and Yannelis (2006), Lurdes and Martins (2003), Madden et al (2004), Garin-Munoz and Perez-Amaral (1998), Huang (2007b), Das and Srinivasan, (1999) also Iimi (2007) also argued that as income increases more people could afford telecommunication services. The coefficient of the income variable is expected to be positive. Theoretically, price variable should be one of the principal determinants of demand for a consumer good or service such as mobile telecommunication service. Mobile

telecommunication service use requires subscription to telephone network. Handset is an important factor in the access to mobile telecommunication network. For this reason, price of handset together with cost of SIM card is taken to be the cost of subscription to the mobile telecommunication services. Economists assume a relationship between price and demand for a good or service. As a result, we expect a negative relationship between price variable and mobile telecom service subscription.

The household size is the number of persons in a household. Household size is included in the model to examine the possible interactions among members of the household that facilitate or increase the need for communication. We assume that larger households would have a greater need for communication which could be satisfied through the use of mobile telecommunication services. Thus, the demand for mobile telecommunication service will be higher, the larger the household size. Huang (2007b), Narayana (2009), and Hausman (2002) are among the studies that included household size in their models for mobile telecom service use. Education of respondents is measured as years of schooling. The education variable is included in the model to examine whether educated individuals are more inclined to use mobile telecommunication services than less educated ones.

Education enlightens an individual and influences his or her consumption as well. It plays a vital role in dispelling a negative perception about a product or service thereby enhancing its adoption and use. In addition, most of the time, people get a lot of friends and other contacts in school and the need for communication become imperative. It has also been recognized that the higher the level of one's education the less likely he or she will be digitally poor. Therefore, we expect an education to impact positively on the adoption and use of mobile telecommunication services. Sex is included as an explanatory variable to examine the effect of sex on the demand for mobile telecommunication service. Studies have found that men and women adopt and use technology differently. Men's decisions to use technology are more strongly influenced by their perception of usefulness, while women's decisions are based more on perceptions of the technology's ease of use (Venkatesh & Morris, 2000). It is a dummy variable taking on the value of 1 if the respondent is a female and 0 if the respondent is a male. Ahn and Lee (1999) and Huang (2007a) are among the studies that included sex as a variable in the mobile telephone subscription model.

An employment type is included to examine the effect of one's work on the need to subscribe for mobile telecommunication services. The Ghana Statistical Service in its Ghana Living Standard Survey (GLSS) classifies an employment type as follows: public sector employee, private sector employee, self employed and unemployed. Three employment type categories: Self-employed, public-sector and private-sector workers, were used in the study to ascertain the category of workers that has the greatest likelihood of subscribing to mobile telecom services.

Barrantes (2008) and Huang (2007b) are among the studies that used an employment as a variable in their models for telecommunication service subscription.

3.2. Estimation Procedure

The commonly used technique for estimating models with a binary dependent variable such as logit is the Maximum Likelihood Estimation (MLE). This technique was employed to estimate the parameters in the logistic regression model. The method of the maximum likelihood consists of estimating the unknown parameters in such a manner that the probability of observing the dependent variable is as high as possible (Gujarati, 2006). It is possible to show that unique maximum exist for the binary logit model. Pindyck and Rubinfield (1991) argued that a Maximum Likelihood Estimation yields consistent parameter estimators. Thus, the MLE would produce the most likely value to the parameters given our sample data. The marginal effects of the explanatory variables on the dependent variable were determined after the estimation of the parameters. These effects enabled us to identify the variables that had the greatest influence on mobile telecommunication subscription at the margin.

3.3. Data Collection

The data used for the study were mainly primary data collected from individuals randomly selected from Cape Coast Metropolis. The main instrument used for data collection was questionnaire. The questionnaire was structured with open and closed-ended questions to ensure that sufficient responses were collected from respondents. The instrument was chosen because it is less expensive to administer and could be self-administered or presented in an interview format to offer respondents the opportunity to respond to the questions at their own convenient time. It could also be used to generate both qualitative and quantitative data and assures respondents of anonymity. The instrument was pretested on 10 individuals and the responses led to the revision of some of the questions in the instrument.

In all, 210 questionnaires were sent out but 200 were completed and retrieved from the field given a response rate of 95%. The high response rate achieved was due to frequent visits to the field. Information was collected on income, employment type, education and other socio-economic variables, cost of subscription and monthly expenditure on mobile telecom service. The data were collected using four weeks from the second week in June, 2009 to the middle of July, 2009. The Statistical Product and Service Solution (SPSS) version 16.0 and Stata version 10 were used to organize and analysed the data.

4. Results and Discussion

This study used primary data collected from individual subscribers and non-subscribers of mobile telecom services in Cape Coast Metropolis. Information on individual

characteristics including age, sex, educational level, type of employment, levels of income, among others were collected and analyzed in the study. The results in Table 2 show that males (112) were more than females (88). From Table 2, about 42% of the respondents in the age group 21-30 were females while the males in the same age group constituted 28.6%. The age group less than 20 had the lowest number for both males (3.6%) and females (3.4%). Generally, majority of the respondents fall into the young adult and an economically active age group from 21 to 40 representing 73.5%. The age groups 21-30 and 3l-40 had the highest number for females (42%) and males (33.9%) respectively. The mean age for a male respondent was 34 while that for a female respondent was 32.

Table 2. Age group by sex of respondents

Age Groups	Female	Sex Percent	Male	Percent
<20	3	3.4	4	3.6
21-30	37	42.0	32	28.6
31-40	33	37.5	38	33.9
41-50	11	12.5	32	28.6
>50	4	4.5	6	5.4
Total	88	100.0	112	100.0

Source: Field survey, 2009

On education, about 5% of the individuals in the study had no formal education. As Table 3 shows, about 27.5% of the respondents had education up to the tertiary level while those with education up to the secondary level constituted 32.5%. Of all the levels of education, the basic level had the highest number of respondents representing 35%. The tertiary level includes the university, polytechnic, college, and other post-secondary education. The gender distribution for the tertiary level favoured males. About 25.7% of the respondents with tertiary education were males while 17.5% were females. It can be seen from Table 3 that about 38.6% of the respondents with secondary education were females while males with the same education were 27.7%. It is clear that majority of the respondents, 95% were educated or literate. The uneducated or illiterate respondents were very few. This may be due to the fact that Cape Coast is noted for having well-developed educational institutions of all type and also being an urban centre majority of the people understand education and would want to get at least a basic education.

Table 4 displays the frequency of an average monthly income of the respondents. About 35.5% of the respondents earned between 100 and 300 Ghana cedis per month. The income bracket GH¢ 301-500 had the highest number of respondents representing 37%. Given the current national daily minimum wage of 3.11 Ghana cedis, the results show that majority of the respondents had relatively higher incomes. In fact, they can be classified as being above the poverty threshold of 90 Ghana cedis per annum. About 1.5% of the respondents earned above 1000 Ghana cedis.

Table 3. Educational level by sex of respondents

Educational Level	Female	Sex Percent	Male	Percent
None	5	5.7	5	4.5
Basic	34	38.6	36	32.1
Secondary	34	38.6	31	27.7
Tertiary	15	17.5	40	35.7
Total	88	100.0	112	100.0

Source: Field survey, 2009

Table 4. Average monthly income of respondents

Income Level	Frequency	Percent
< GH¢ 100	16	8.0
GH¢100-300	71	35.5
GH¢ 301-500	74	37.0
GH¢ 501-700	19	9.5
GH¢ 701-1000	17	8.5
>GH¢ 1000	3	1.5
Total	200	100.0

Source: Field survey, 2009

Table 5 depicts the various types of employment of individuals selected for the study. Most of the respondents were workers, representing about 88%, of which 33.5% were self-employed, 28.5% were employed in the private sector and 26% were working in the public sector. About 12.0 % of the respondents were not in any form of employment. In other words, they were unemployed. The self-employed category had the highest number of respondents.

Table 5. Employment type of respondents

Employment Type	Frequency	Percent
Unemployed	24	12.0
Self-Employed	67	33.5
Private sector worker	57	28.5
Public sector worker	52	26.0
Total	200	100.0

Source: Field survey, 2009

The level of income is considered as a factor that determines demand for mobile telecom services. A great deal of studies on demand for mobile telecom services, both in developed and developing countries, have established that income vastly enhances the probability of subscription to mobile telecom services (Ahn & Lee, 1999; Ahn, 2001; Narayana, 2009). Given this insight a cross tabulation of mobile telecom service subscription by income was constructed and the results are presented in Table 6. From Table 8, non-subscribers of mobile telecom services among those with monthly income less than GH¢ 100 were 12 (48%) while the subscribers were 4 (2.3%). Also, majority of those with monthly income level above GH¢ 500 were subscribers of mobile telecom services numbering 38 (21.7%). This observation is not surprising since higher income offers an

individual the leverage to consume a variety of goods and services including telecommunication services. The poor, on the other hand, have limited choices. It is only prudent for such group of people to satisfy their most pressing basic needs of which mobile telecom service may not be part. The common reason given by most non-subscribers was that mobile telecom services are expensive. These people hold the perception that mobile telecom services are beyond their means.

Table 6. Mobile telecom subscription by level of income

Mobile subscription	Income Level			
	<GH¢100	GH¢100-300	GH¢301-500	>GH¢500
No	12 (48%)	7 (28%)	5 (20%)	1 (4%)
Yes	4 (2.3%)	64 (36.6%)	69 (39.4%)	38 (21.7%)

Source: Field survey, 2009

It is argued that income determines a person's purchasing capability for goods and services. Iimi (2007) notes that as income increases more people could afford telecommunication services. This view is shared by Jha and Majumda (1999). They pointed out that greater income signifies greater affordability and so lead to an increased demand for mobile telecommunication service. In another work in Ghana, Overa (2005) reported that income is one of the decisive factors of access to telecommunication, emphasizing that where incomes are low not many people may have access to telecommunication services.

The education variable examines whether educated individuals are more inclined to use mobile telecommunication services than less educated ones. Generally, education is expected to have an impact on the subscription to mobile telecom services. More specifically, a positive effect of education on an access to mobile telecom service is expected. Table 9 shows the frequency of mobile subscription by level of education. The results show that education actually affects one's decision to subscribe to mobile telecom services.

From Table 7, it can be seen that non-subscribers among individuals with education up to the tertiary level were the lowest (8%). This is understandable because getting to the tertiary level one must have had a lot of friends and contacts through schooling and therefore the need for communication becomes imperative. Moreover, with the expansion of

mobile telecom services to include more data transmission services like internet, multimedia messaging and the like, mobile service use has become diversified. The educated individual cannot afford to stay unhooked to mobile telecom services. This is in consonance with the hypothesis that the higher the educational level of the individual the less likely he or she will be digitally poor. This work is consistent with the study by Narayana (2009) in India. Narayana found a significant result for higher education variable. He concluded that education, particularly higher education, significantly influences individual subscription to telecommunication services.

Table 7. Mobile telecom subscription by level of education

Mobile subscription	Level of education			
	None	Basic	Secondary	Tertiary
No	5 (20%)	9 (36.5%)	9 (36.5%)	2 (8%)
Yes	5 (2.9%)	61 (34.9%)	56 (32%)	53 (30.3%)

Source: Field survey, 2009

Employment type defines the sector in which an individual is engaged as far as occupation is concerned. In this research, we classified an employment type into four: unemployed, self-employed, private sector employee and public sector employee.

Table 8 displays the descriptive statistics for mobile telecom subscription by type of employment. It can be realized that the majority of individuals who were nonsubscribers of mobile telecom services fall into the unemployed category. On the other hand, public sector employees were the dominant subscribers of mobile telecom services. Only one person (4%) had not subscribed to mobile telecom services. Also, the private sector workers were important group of individuals as far as mobile telecom service subscription was concerned.

In his work, Intra-Household Effects on Demand for Telephone services: Empirical Analysis, Huang (2007b) showed that occupation significantly affect demand for telecommunication services. This study supports his finding revealing that employment underscores the need to subscribe to telecommunication services. Put differently, whether one is working or not to a greater extent explains mobile telecommunication subscription.

Table 8. Mobile telecom subscription by type of employment

Mobile subscription	Employment type			
	Unemployed	Self-employed	Private sector employee	Public-sector employee
No	14 (56 %)	7 (28%)	5 (12%)	1(4%)
Yes	10 (5.7%)	60 (34.5%)	54 (30%)	51 (29.1)

Source: Field survey, 2009

In Ghana, Overa (2005) observed that an increasing use of mobile telecom service for trade related-activities among market women is driving more traders to get access to mobile telecom services. The study reported that traders use mobile telephone to get supplies of goods from producers in different locations and also alert customers of new supplies. In the clothing industry, for example, the changing pattern of designs and their associated impact on customer taste means that cloth traders need to make a lot of contacts for a new release of design to get a competitive advantage in the market place.

Table 9 shows monthly expenditure by respondents on various mobile telecom services. About 12 percent of respondents spent less than GH¢ 5 on calls, messages and other services. It can be seen from Table 9 that majority of respondents (74%) spent between GH¢ 5 and GH¢ 30 per month on mobile telecom services.

Table 9. Frequency of monthly expenditure on mobile telecom service

Amount	Frequency	Percent
Less than GH¢ 5	24	12.0
GH¢ 5-10	53	26.5
GH¢ 11-15	30	15.0
GH¢ 16-20	34	17.0
GH¢ 21-30	31	15.5
GH¢ 31-40	13	6.5
GH¢ 41 and above	15	7.5
Total	200	100.0

Source: Field survey, 2009

About 28 or 14% percent of respondents spent above 30 Ghana cedis per month on call, messages and other services. The monthly expenditure on mobile was influenced by the income level of respondents. Those who earned less spent less on mobile telecom services while high income earners spent more on mobile telecom services. However, there were some respondents who indicated that they spent less on mobile telecom service not because they earned less or used less mobile telecom service but rather other people paid for their mobile telecom service use. Majority of these people were women. Respondents used mobile telecom services to maintain relationships by contacting friends, family members and partners. Mobile telecom services were also used by respondents for business contacts and to access the internet.

The estimated results of the logit model are presented in Table 10. Most of the estimated coefficients were significant and had the expected signs except the coefficients of gender and family size variables. The coefficients of gender and family size variables were negative contrary to our expectations. We expected the coefficient of family size to be positive because it is assumed that larger family size would have a greater need for communication which could be satisfied through the use of mobile telecom service. Thus subscription to mobile telecom service would be higher the larger the family size. Also, gender was expected to take a positive sign because literature suggests that women were more likely to subscribe to mobile telecom services than men.

The Likelihood Ratio (LR) test statistic is 59.08 and it is χ^2 (8) distributed under the null hypothesis that all the variables together have no significant impact on mobile telecom service subscription. The critical value from the χ^2 distribution table is 20.090. Clearly, χ^2 (8) value of 59.08 is greater than the critical value of 20.09. Therefore, the null hypothesis is rejected implying that all the variables together have a significant impact on mobile telecom service subscription.

The estimated coefficient of income was positive and significant at 1 percent level. This indicates that an increase in income enhances the odds in favour of subscribing to mobile telecom service. Table 10 shows that a unit increase in the monthly income leads to an increase of 1.0066 of the odds that the individual will choose to subscribe to mobile telecom services. The finding is consistent with Ahn and Lee (1999), Ahn, (2001) and Narayana, (2009).

Table 10. Estimated results of the logit model

Variable	Coefficient	Odds Ratio	z-value	P>|z|	Marginal effects
Income	0.0066**	1.0066	2.92	0.004	0.0003
Education	0.1820 **	1.1996	2.66	0.008	0.0073
Employment type					
Private sector worker	1.8440 **	.3218	2.46	0.014	0.0569
Public sector worker	3.3062**	27.2813	2.64	0.008	0.0909
Self- employed	1.4261*	4.1624	2.32	0.020	0.0489
Family size	-0.0557	0.9458	-0.42	0.673	0.0022
Sex	-0.2851	0.7519	-0.54	0.592	-0.0112
Access price	-0.0145*	0.9856	- 2.41	0.016	- 0.0006
Constant	-3.7548	0.0234	2.72	0.007	
LR χ^2 (8)	59.08				
Pseudo R^2	0.3920				
Log likelihood	-45.8161				
N	200				

Source: Authors' estimation from field survey, 2009. ** and *denote statistical significance at 1% and 5% levels respectively.

The estimated coefficient of education is positive and significant at 1 percent level suggesting that the more individuals get educated the higher the likelihood that they will subscribe to mobile telecom service. The desire to use mobile telecom by the educated individual stems from the fact that these individuals most often have considerable communication need that can be fulfilled by mobile telecom service. The results indicate that a unit increase in the years of schooling of an individual leads to an increase of 1.1996 of the odds that the individual will subscribe to mobile telecom service. The results show that education is an important determinant of demand for access to mobile telecom service. The outcome of this study is in line with Narayana (2005) and Barrantes (2008) who found a positive relationship between education and mobile telephone subscription.

The three dummies used for employment were significant at 1 percent level for respondents working in public and private sectors and 5 percent level for self-employed respondents. The estimated coefficient of public sector worker was positive and showed that individuals employed in the public sector had 27.2813 times higher odds in favour of subscribing to mobile telecom service than workers in other sectors. Similarly, the estimated coefficient for private sector worker was positive and showed that respondents working in the private sector had 6.3218 times higher odds in favour of subscribing to mobile telecom service than other individuals working in other sectors. Also, the results showed being self-employed has 4.1624 odds in favour of subscribing to mobile telecom services. It is clear from the results that employment has positive impact on demand for access to mobile telecom services. This is consistent with the works of Barrantes (2008) and Huang (2007b)

From theoretical perspective, price is one of the factors assumed to determine the demand for any good or service. Omission of price variable renders incomplete analysis of demand for a good or service. Price variable was included as explanatory variable to evaluate the sensitivity of individuals to price in the demand for telecom services. Overa (2005) argued that price is one of the decisive factors in the demand for access to telecommunication services. In this paper average price of handset and cost of line was used as proxy for access price of mobile telecom service. At 1 percent level, access price was significant and had predicted sign. The estimated coefficient indicates that a unit increase in the access price of mobile telecom service leads to a decrease of 0.9856 in the odds in favour of accessing mobile telecom services. This implies that reduction in access cost lead to increase in mobile telecom services subscription.

The estimation of the logit model also generated marginal effects for the variables included in the model. The marginal effects measure the change in the predicted probability for a unit change in the independent variable. The marginal effect of 0.0908 means that the individual public sector worker has 0.0908 higher chance of subscribing to mobile telecom services as compared to non-public sector worker. Secondly, the marginal effect for self-worker dummy is 0.0489. This indicates that the probability of mobile telecom subscription increases by about 4.9 percent for individuals who are self-employed. The marginal effect for private sector dummy is 0.0569. This implies that a private sector worker has about 0.0569 higher chance of subscribing to mobile telecom service than non-private sector worker.

5. Conclusions and Recommendations

The focus of this research was to identify the factors influencing mobile telecommunication service access and usage. The findings from the study showed that mobile telecommunication service use is explained by individual socio-economic and demographic characteristics. It was realized, consistent with literature, that demand for mobile telecom service was dependent on income, employment, education and access price. We found mobile telecom service use to be positively related to income, education, and employment type and negatively related to access price. The amount individual spent on mobile telecom serves was determined by their levels of income. Individuals used mobile telecom services to maintain relationship by contacting friends, family and partners and also used for business purpose and accessing internet. However, the use of mobile services for internet purpose was very limited and a few people used their phones to access internet. On the basis of the findings from the study, the following recommendations are made to relevant stakeholders in the telecommunication industry. Firstly, there is the need for the Ministry of Communications to reduce switching cost in the mobile telecom industry by introducing mobile number portability system. This will go a long way to reduce the lock-in effect prevailing in the mobile telecom industry that does not allow consumers to easily switch to other networks. The introduction of the mobile number portability system will also make mobile service providers to improve their service delivery to customers. Also, efforts should be made by mobile telecom service subscribers to form strong customer unions to protect their interests in the telecom industry. The formation of such unions will inure to their benefit since they can demand better services from mobile service providers. In addition, efforts should be directed at creating employment opportunities for individuals to enable them use mobile telecom service.

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