

UNIVERSITY OF CAPE COAST

DETERMINANTS OF DEMAND FOR MOBILE TELECOM SERVICES IN  
CAPE COAST

BY

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## DECLARATION

### **Candidate's Declaration**

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature ..... Date.....

Name:.....

### **Supervisors' Declaration**

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature..... Date .....

Name:.....

Co-Supervisor's Signature..... Date .....

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## **ABSTRACT**

The study sought to investigate the determinants of demand for mobile telecom services by individuals in Cape Coast metropolis in the Central Region of Ghana. The logit model was used to identify determinants of mobile telecom services subscription. The mobile telecom subscription equation was estimated using the maximum likelihood estimation technique.

Data for the study were collected via survey of individual subscribers and non-subscribers of mobile telecom services. The questionnaire instrument was employed to collect data from respondents. The questionnaire was designed and administered to respondents to gather information on factors that determine subscription of mobile telecom services and choice of mobile telecom operator.

The outcome of the study shows that the probability that an individual will subscribe to mobile telecom service is dependent on income, price of mobile service, employment and education. The study also found that the probability of choosing a mobile operator depends on promotions, discount and special offers, service charges of the network and network effect (the effects of individual social network). It is recommended that mobile number portability be introduced in the mobile telecom industry. Also, reduction in mobile charges, more promotion and discount are necessary for mobile operators to acquire more subscribers. For mobile subscription to increase there should be effort to provide employment opportunities, increase education as well as growth of individuals' incomes.

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## **DEDICATION**

I dedicate this thesis to my parents, Mr. Joseph K. Tuah and Mrs. Margaret Kyeremaah and to my brothers, Prince and Vincent.

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## **LIST OF ACRONYMS**

ADP	Accelerated Development Plan
AMPS	Advanced Mobile Phone Service
CDMA	Code Division Multiple Access
CPP	Calling Party Pay
EA	Enumeration Area
FTP	First Telecom Project
GFRCB	Ghana Frequency Regulatory and Control Board
GIFTEL	Ghana Investment Fund for Telecommunication
GLSS	Ghana Living Standard Survey
GP&T	Ghana Post and Telecommunication
GSM	Global System for Mobile Communication
ICT	Information and Communication Technology
ISSER	Institute of Statistical, Social and Economic Research
ITU	International Telecommunications Union
MLE	Maximum Likelihood Estimation
MMS	Multimedia Messaging Services
MTN	Mobile Telecommunication Network
NCA	National Communication Authority
SIM	Subscriber Identification Module
SMS	Short Messaging Service
SOEs	State Owned Enterprises

SPSS	Statistical Product and Service Solutions
STP	Second Telecom Project
2G	Second Generation Mobile Telecom Services
3G	Third Generation Mobile Telecom Services

## **CHAPTER ONE**

### **INTRODUCTION**

#### **Introduction**

This chapter entails detailed introduction to the research undertaken. Among the topics discussed in the chapter are: background to the study, statement of the problem, objectives of the study, and the research hypotheses. The chapter also highlights on the significance of the study, limitations, and the organization of the study.

#### **Background to the Study**

Telecommunications have been recognized as a crucial element in development. The United Nations Millennium Declaration identified access to Information and Communication Technologies (ICT) in general and telecommunications in particular as a goal in itself and as an important vehicle to achieve some of the other goals (ITU, 2004). Thus, access to information and communication 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 telecommunication is one of the most convenient means of

communicating and transacting business. An effective telecommunication system, in one way or the other, enhances development as it also boosts investor confidence and promotes business transactions. Thus, the importance of telecommunication development to economic growth and development especially in the developing countries cannot be understated (Gyimah-Brempong & Karikari, 2007).

There have been remarkable transformations in the telecommunication services worldwide. These transformations were spurred by technological innovations. Innovations in telecommunication technology have immensely influenced the development of mobile telecommunication services. Actually, the worldwide breakthrough of mobile technology is associated with the commercial introduction of digital technologies in the 1990s.

Several reasons accounted for the success of digital mobile telephony. Firstly, by using limited radio spectrum, digital technology made the current levels of mobile telephony usage technically possible. Secondly, “combine with other industry development, digital telephony offered end users a more attractive bundle in terms of price, quality and services. Digital mobile telephony had advanced data transmission (short messaging service etc) and improved voice quality” (Rouvinen, 2006, P.47). Also, with lower power consumption of digital mobile telephony, smaller and lighter end user terminal (handsets) became available. Thirdly, with expanding user base, network effects and economies of scale in both production and use accumulated rapidly. In brief, with digitalization mobile telephony truly became a worldwide consumer market (Rouvinen, 2006).

In Ghana, various governments have adopted policies and measures aimed at making telecommunication services accessible to all the people in the country. Reforms in the telecommunication sector have been carried out. The telecommunication sector reforms contributed immensely toward the transformation of telecommunication services. The reforms were designed to introduce privatization, liberalization and competition into the telecommunication industry. Also, they were aimed at accelerating the modernization and the expansion of the industry as well as improve customer satisfaction by way of achieving improvement in the quality of service and efficiency of the sub-sector (ISSER, 2001).

Telecommunication services in the pre-reform era were very limited and concentrated in the cities and urban centres. It is evidenced that in 1992 only 3 out of 1000 people had telephones in their homes and businesses (Haggarty, Shirley & Wallsten, 2002). Fixed line services were the major telecommunication services available. Telecommunication services were handled solely by the Ghana Post and Telecommunication Corporation (GP&T). The corporation faced a number of problems that inhibited its operation and service delivery. Among them were financial and technical constraints, inadequate competent and qualified staff, out-of-date equipment and spare parts. As a step towards overcoming these problems and improving service delivery, the Ghana Post and Telecommunication Corporation was split into two entities, namely, Ghana Post and Ghana Telecom.

At the same time private participation in the provision of telecommunication services was encouraged. As a result, mobile

telecommunication network companies entered the telecommunication industry. Telecommunication services now have widened to include mobile telecommunication services. Players in the telecommunication industry, that is providers of fixed and mobile services, have increased. With single provider of fixed line services there are currently five mobile network providers in the country.

The number of telephone subscribers has increased in recent times. From as low as 250,000 subscribers in 1999, telephone subscribers reached 3 million in 2005. This shows a vast increase in telephone subscription. While total telephone subscription has increased remarkably in recent years much of the increase is associated with mobile telephone adoption and use. Mobile telecommunication services form the chunk of the growth in telecommunication services. For example, in 2004 mobile telephone subscribers formed 76.5 percent of total telephone subscribers (ISSER, 2005). Despite its higher share in total telecommunication, the use of mobile telephone services in the country is still limited. The World Bank (2007) stated that only 22 out of 100 people in Ghana subscribed to mobile telecom services in 2006. This was below the world average of 40 per 100 people (World Bank, 2007).

Several researchers have looked at demand for telecom services. However, studies on telecom service demand in Ghana are scarce. Narayana (2009) used household survey data to examine determinants of demand for telecom services. For all the variables included in the model, education, occupation, size of total income and location of friends and relatives were found



to be important determinants of demand for telecom services. The estimated coefficients of the variables were significant and positive. For instance, the estimated results of the income variable showed that a unit increase in income leads to 1.01 increase in the odds in favour of subscribing to telecom services.

Ahn (2001) observed that age, gender and education had significant impact on mobile telephone services subscription in Korea. However, Narayana (2005) had contrary results for age and gender in a cross-sectional household survey in India. The estimated results for age and gender were insignificant. He explained that being literate or educated was associated with a higher probability of subscribing to mobile telephone services.

Rodini, Ward and Woroch (2003) examined the demand for mobile telephone services in a discrete choice framework based on household survey data. They found that income, age, gender of the household head and size of household impact on mobile telephone services subscription. They observed that 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.

### **Statement of the Problem**

The telecommunication sector was liberalized in 1996 and since then there has been increasing private participation in the telecommunication services

delivery. Most of these private participations have occurred in the mobile telecommunication network development. There are five main mobile telecom services providers operating in the country. Mobile telephone services have boosted the telecommunication services accessibility in the country.

There has been tremendous growth in mobile telecommunication subscription in recent times. According to the National Communication Authority, from as low as 250,000 in 1999, mobile phone subscribers increased to 3 million in 2005. In 2007, mobile phone subscribers reached 7 million. Whereas the above analysis enriches our knowledge concerning subscription trend, studies into the demand for mobile telecommunication services in the country are scarce. Moreover, issues concerning subscription behaviour, consumers' expenditure on mobile telecom services and choice of operator have not been given much attention. The study seeks to fill this gap by addressing the following questions: What are the main factors that determine the demand for mobile telephone services? What are the factors consumers take into account when choosing a mobile operator? It is in this direction that the study seeks to find out the key determinants of demand for mobile telecom services and explore the factors that affect the choice of mobile operator by consumers.

### **Main Objective**

In general, this research seeks to investigate the determinants of demand for mobile telecommunication services among individuals in Cape Coast metropolis.

## **Specific Objectives**

The specific objectives of the study are to:

1. Identify the factors that affect individual mobile telecom service subscription.
2. Examine the factors that users take into consideration in their choice of mobile network provider.
3. Investigate how much consumers spend on mobile telecommunication services.
4. Make policy recommendations.

## **Hypotheses**

The specific hypotheses to be tested in this study are:

H<sub>0</sub>: There is no relationship between income and the demand for mobile telecommunication services.

H<sub>0</sub>: There is no relationship between the price of handset and the demand for mobile telecom services.

H<sub>0</sub>: There is no relationship between employment and the demand for mobile telecom service.

H<sub>0</sub>: Individual characteristics (education, sex, etc) do not influence demand for mobile telecom services.

H<sub>0</sub>: The choice of mobile telecom operator is not affected by characteristics of mobile network.

## **Significance of the Study**

This study seeks to examine, empirically, the main determinants of mobile telecommunication services subscription. The outcomes of 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, thus 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 toward 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.

Moreover, the study will add to the existing knowledge on the demand for telecommunication services. A good deal of studies on the demand for telecommunication services have analyzed the demand for fixed line services but very few studies have been done on the demand for mobile telecommunication services. In addition, most of these studies make use of time series data. This study uses consumer survey data to identify the main determinants of demand decision for mobile telecom services.

The study will also serve as a useful guide to policy makers in the telecommunication sector. Telecommunication services have been another source of revenue to the government with the introduction of communication services tax in 2007. An analysis of the demand for mobile telecommunication service will reveal important lessons to the government in the administration of the

communication service tax. Not only will this study be useful for policymaking but it is also going to be helpful for future studies in telecommunication.

### **Limitations of the Study**

This study seeks to find out the factors that influence demand for mobile telecom services among individuals in Cape Coast. Generally, case study research is limited by the extent to which generalization can be made from the findings of the sample to describe the entire population. However, if proper procedure is used to obtain sample the outcome of the study will reflect the true characteristics of the population.

This research is also limited by other factors. The first relates to the data collection. Poor record keeping, memory lapses, and unwillingness to disclose information on some key variables such as income and age by most people were common problems encountered during the data collection. These problems tend to affect the quality and accuracy of data. However, the results were not affected in any way since the findings are interpreted in the context of these setbacks.

The other handicaps for the study were resource and time constraints. Finance and material resources available for the study were inadequate. Time was also another limiting factor in this study. The study was conducted within limited academic time frame. This also did not allow us to sample a large number of individuals for the study that would permit wider generalization of findings and inferences from the sample about the population.

## **Organization of the Study**

The study is organized into five chapters. The first chapter covers introduction, which consists of the background to the study, statement of the problem, objectives of the study, research hypotheses to be tested, significance of the study, limitations and the chapter organization of the study. Chapter two presents the review of related literature, which comprises the overview of the telecommunication sector in Ghana, theoretical literature on mobile telecom subscription and empirical literature. Chapter three discusses the research methodology. The fourth chapter deals with empirical analysis and discussion of mobile telecom services subscription and usage. Chapter five covers the summary, conclusions and recommendations.

## **CHAPTER TWO**

### **REVIEW OF RELATED LITERATURE**

#### **Introduction**

This chapter presents the review of related literature for the study. The literature review is divided into three sections. The first section deals with the overview of the telecommunication sector in Ghana. The second section looks at the theoretical literature on telecommunication services subscription demand and the factors underpinning the choice of mobile telecom network operator. The third section presents the review of empirical studies on telecommunication subscription.

#### **Overview of the Telecommunication Sector in Ghana**

This section looked at the overview of the telecom sector in Ghana. It dealt with the historical development of the telecom sector as regards the various reforms that have been undertaken. The section also took a critical look at the various regulatory institutions in the sector as well as the various mobile telecom networks.

## **Historical Development**

The colonial administration laid down telecom infrastructure to enhance the economic, social and political administration of the colony. Thus the telecommunication system was established to facilitate the work of the colonial masters. Allortey and Akorli (1999) argued that the first telegraph line in Gold Coast (now Ghana) was installed in 1881. This line connected Cape Coast, the then capital of Gold Coast, and Elmina. This link was used by the Governor to transmit messages from Cape Coast to other people at the Elmina castle. The telegraph line was extended to Christiansborg castle in Accra and later extended still further to Aburi in the eastern part of the country.

In 1882, the first public telegraph line, stretching over a distance of 4 kilometers, was erected in Accra and extended to cover other coastal towns including Winneba, Saltpond, Sekondi and Shama. Most of the colonial castles and forts were built in these towns (Allortey & Akorli, 1999).

In an attempt to improve communications in the southern part of the country, the first manual telephone exchange was installed in Accra in 1892. Twelve years later a second manual exchange was installed in Cape Coast. By 1914, 170 telephone subscribers had been served. However, it was between 1914 and 1920 that the backbone of the main trunk telephone routes (Accra-Takoradi, Accra-Kumasi, Kumasi-Takoradi, and Kumasi-Tamale) was built using unshielded copper wires. By 1930, the number of telephone exchange lines had grown to 1560, linking the coastal region with the central and northern parts of the country. In 1953 automatic telephone exchange was introduced for the first time in the



country. The new exchange was installed in Accra to replace the old manual exchange. A second telephone exchange was installed in Accra in 1957 to link other cities in the country. All these telephone services were provided by the government's Post and Telecommunication Department (Allortey & Akorli, 1999).

After Ghana's independence in 1957, there was a new dynamism in telecommunication development. A Seven-Year Development Plan was launched just after independence. This plan led to the completion of a second automatic telephone exchange. The project improved telecommunication services and increased subscription. However, this positive development faded out. Telephone penetration rate (or teledensity) lingered around 0.3 mainlines per 100 inhabitants for many years (Falch & Anyimadu, 2003; Frempong & Henten, 2004). The low telephone penetration rate was due to a) obsolete equipment in most areas; b) theft of cable and wires mostly made of copper; c) inadequate skilled workforce; d) limited maintenance facilities; and e) inadequate financial resources.

### **First and Second Telecom Projects**

Ghana embarked on two major rehabilitation projects in the 1970s and 1980s to develop and expand its telecommunication services. The projects were referred to as the First Telecom Project (FTP) and the Second Telecom Project (STP). These telecom development projects were aimed at building and improving the telecommunication system in the country with respect to infrastructure and service delivery. They were also to improve the organizational

aspects and administrative procedures of the Ghana Post and Telecommunication Corporation (Frempong & Henten, 2004).

The First Telecom Project was to revamp the telecom sector in the country. It constituted the first part of Ghana's telecom development programmes for the sector with the objectives, among others, to:

1. improve the quality of local, long distance and international telecom services.
2. extend the local and long distance services.
3. extend international telecom services.

The funding of the FTP came from bilateral and multilateral sources including the World Bank, Canada, the African Development Bank, Japan and the United Kingdom. The project was scheduled to be completed in 1980 but had to be extended to 1985 to enable physical targets to be achieved. The delay was caused by poor civil works, shortage of building materials, delays in raising counterpart funding and complicated procurement procedures. The achievements of the FTP included;

1. Ghana telephone line capacity increased by 50% through the installation of twelve new electronic exchanges to replace old and obsolete automatic and manual telephone exchanges;
2. The number of subscriber trunk dialing centers increased from 18 to 24;
3. The construction of tertiary exchange, a telex, a message switch in the capital, and an earth station in the country; and

4. The installation of microwave radio links for telephone and television transmission from the capital to the northern part of Ghana and initiating a second new microwave radio link.

The Second Telecom Project was initiated in 1987 with the objectives to:

1. Support the programme of institutional and management improvement for the telecom sector;
2. Improve the quality of services through the replacement of obsolete equipment; and
3. Improve financial performance of Ghana Post and Telecommunication Corporation.

Just like the FTP, the vast majority of funds for the second telecom project were from foreign sources. Although the completion of the second telecom project resulted in improvement in the telecommunication infrastructure and services, there was not much growth in the number of subscribers and expansion of services until the implementation of the telecom sector reform in the early 1990s.

### **The Telecommunication Sector Reform**

Telecommunication sector reforms marked the turning point of telecommunication services in Ghana. A number of factors, both internal and external, influenced Ghana to initiate reforms into the telecom sector in the early 1990s. The internal factors included poor services and limited access due to

inefficiency in the operation of the telecommunication system, the government's need for revenue and a desire to promote universal services.

Haggarty et al. (2002) described the telecommunication services prior to restructuring as very poor to the extent that only three out of every 1000 inhabitants had access to telephone in their homes and businesses. Furthermore, from 1983 to 1993 the number of telephone main lines increased by only 1000 a year and even declined in some years. Services were highly skewed towards Accra and other urban centres. Over 80 percent of all telephone lines were in the urban areas and 53.6 percent were in Accra in 1990 (ITU, 1994). The northern part of the country had only about one percent of the nation's telephones in 1993. Moreover, only 37 out of the 110 district capitals were connected indicating that large parts of the country were not connected to the communications grid.

Quality of service was far below expectation. On average, nearly 20 percent of all mainlines were not functioning at any time (Anderson, 1993). Only 47 percent of outgoing international calls were completed while just 21 percent of incoming calls got through in 1992 (World Bank, 1997). Domestic services were not different; less than 50 percent of long distance calls and local calls were completed in the same year.

The external factor was the pressure from the international institutions especially the World Bank and the International Monetary Fund to reform the sector when Ghana adopted the Structural Adjustment and Economic Recovery Programmes in 1983. These programmes enjoined governments to divest themselves from direct participation in the economic activities in their respective

countries especially the operations of the state owned enterprises (SOEs). Thus, governments were to divest their interests in the SOEs through the sale of their shares to the private sector. In the case of Ghana, the Ghana Post and Telecommunication Corporation was part of the SOEs that were to be divested to enable Ghana to access the financial packages which it urgently needed to resuscitate the economy which was in serious crisis.

The reforms began with the launch of the Accelerated Development Plan (ADP) for the telecommunication sector in 1994. This policy was meant to introduce privatization, liberalization and competition into the telecommunication industry with the intention of accelerating modernization and expansion of the industry. The specific objectives of the ADP were to:

1. ensure sustained improvement in the availability, reliability and quality of telecommunication services;
2. increase employment opportunities in the sector;
3. improve public access to telecom services in rural and urban areas through the provision of payphone and mobile phone facilities;
4. ensure affordable and competitive telecom prices; and
5. enhance Ghana's competitive advantage in the region through provision of high quality telecommunication services to businesses.

A number of policy measures were undertaken to achieve the objectives of the reform. The measures included:

1. Privatization of Ghana Telecom by securing a strategic investor to bring in needed financial, technological and human resources into the sector, as

well as, by providing investment opportunities for Ghanaians through a public sale of some of the shares of Ghana Telecom to expand ownership of the company;

2. Creating a competitive duopoly by licensing a national network operator with similar rights and obligations as Ghana Telecom;
3. Liberalization of the operations of value-added services including mobile (cellular) telecom services, data transmission, paging and pay phone services;
4. Establishment of a regulatory body to regulate the provision of services in the sector; and
5. Allow large corporate users to develop their own private networks.

The reform therefore entailed liberalization, privatization, creation of a duopoly and the establishment of a regulatory framework and agency. It is important to note, however, that Ghana's strategy was that of partial liberalization instead of complete liberalization.

The creation of a duopoly and a supplementary rural operator in the southern part of the country — and not full competition — was the preferred development mode. The reason behind such a strategy was to give the firms who had received license an advantage by way of exclusivity, as pertains in many other countries based on the assumption that it is the only way to attract foreign investments and that public requirement for network extension are more easily made in this situation.

Ghana maintained an incumbent in fixed line telephony by granting exclusivity periods to the companies that took over the fixed line system, including the second fixed line operator (Westel), which enjoyed the same exclusivity period as the newly privatized incumbent (Ghana Telecom). The decision to introduce a second fixed line operator, as well as to provide for a third network operator (Capital Telecom) for rural telephony, was a bold step giving Ghana one of the most competitive telecommunication market structures in the region. After the reform programme, the number of fixed line subscribers started to increase substantially compared with the previous periods. However, the performance of the networks was moderate, far below the goals set by the government in licenses issued to them.

Ghana Telecom was expected to provide 250,000 new lines while Westel was to provide 50,000 new lines in a 5-year period between 1997 and 2002. However, Ghana Telecom could only attain 65 percent of the target while Westel attained 6 percent during the period. Therefore, Westel could not reach its targets.

The distribution of telephone subscribers was skewed toward Accra and other urban centres. The regional distribution of Ghana Telecom telephone subscribers by the end of 2002 is depicted in the Table 1.

**Table 1: Distribution of Ghana Telecom Lines in 2002**

Region	Subscribers	Teledensity	% of country's Population
Greater Accra	184,526	6.0	15.4
Ashanti	27,947	0.7	19.1
Western	17,009	0.8	10.2
Eastern	10,057	0.5	11.1
Central	8,621	0.5	8.4
Northern	5,438	0.3	9.6
Brong Ahafo	6,808	0.4	9.6
Upper West	1,728	0.3	3.0
Upper East	4,084	0.4	4.0

Source: Ghana Telecom Ltd (now Vodafone), as in ISSER, 2003

Universal access was not a regulatory requirement for telecom operators, however, the ADP proposed one payphone for every village of 500 or more people, as a policy target. In 1998, the universal access target was revised to one payphone for every community of more than 250 people (Frempong, 2002). Payphones were thus seen as the tool to achieve universal access but responsibility for this was generally left to the two national fixed line operators (Ghana Telecom and Westel) and one specially licensed rural operator (Capital Telecom), with each being required to roll out a particular number of lines within a specified time period.



Payphone facilities were developed across the country but were concentrated in urban centres. Westel and Capital Telecom had little impact on the availability of payphone facilities. The regional distribution of Ghana Telecom payphones in 2002 is shown in Table 2.

**Table 2: Regional Distribution of Ghana Telecom Payphones in 2002**

Region	Number of Payphones
Greater Accra	2171
Ashanti	937
Eastern	485
Western	323
Central	241
Volta	218
Northern	190
Brong Ahafo	166
Upper East	155
Upper West	112
Total	4998

Source: Ghana Telecom Ltd (now Vodafone), as in Ahorator, 2003

## **Mobile Telecommunications in Ghana**

Mobile telecommunications experience in Ghana started in the early 1990s. Before then only fixed-line services were available in the country. Ghana Telecom had exclusive monopoly over telecommunication services. The policy reforms initiated in the telecommunication sector created a competitive environment that enabled mobile telecom network providers and other wireless service providers to operate. Initially, mobile entry was allowed without charge and with minimum regulation. This enhanced the provision of mobile telecommunication services in the country. Now the stage was set for a revolution in the telecommunication sector.

The first commercial mobile telecommunication network in Ghana was provided in 1992 by Millicom Ghana (mobitel), a subsidiary of Millicom International Cellular S.A. of UK/Luxembourg in 17 countries across Latin America, Africa and Asia. Millicom Ghana is therefore the first company to offer mobile telecommunication service in Ghana. The company started out using analogue network — the first generation mobile system. The network covered Accra and selected regional capitals. Limited number of people had access to the network due to frequency limitations. The following year, 1993, another mobile network operator, Celtel, commenced operation. Celtel also operated analogue using AMPS (Advanced Mobile Phone Service) system and could serve only small number of people particularly in Accra and its environs. In 1993, mobile subscribers were 170. Celtel was renamed Kasapa in 2003 to give it a local

identity, and has since then pursued a distinct strategy aimed at low-income subscribers.

The analogue networks were followed by digital networks, the global system for mobile communication (GSM), which started to provide services in 1996. The first company to operate digital network was Scancom Ghana limited. Scancom Ghana started operation in 1996 using GSM 900 technology with the brand name Spacefon. The GSM technology enabled Scancom to capture relatively larger share of the market. It soon became the market leader with increasing number of subscribers. The company was taken over by Investcom LLC and was renamed Areeba in 2005. Mobile Telecommunication Network group (MTN) acquired Investcom (Areeba) in 2006 and was renamed MTN Ghana in 2007. MTN, a South African-based mobile telecom network provider, operates in 21 countries in Africa and the Middle East.

The successful introduction of digital network by Scancom motivated the other companies to migrate from analogue to digital networks. In 2000, Millicom Ghana switched from analogue to digital under the name Buzz. The company name was again changed to *tiGo* in March 2006 to conform to a global branding strategy (Sey, 2008). Celtel went digital in 2005 and it happens to be the only mobile service provider using the CDMA (Code Division Multiple Access) standard.

In 2000, Ghana Telecom launched Onetouch that was to provide mobile services. The company was able to attract 60,000 customers within the first year of operation. The status of Onetouch, however, changed due to the acquisition of

70 percent shares of Ghana Telecom by Vodafone International in 2008. As a result, Ghana Telecom and Onetouch became Vodafone.

In 2008, another mobile operator entered the mobile industry. The fifth entrant into the mobile market was Zain. The company is a subsidiary of Zain International that operates in a number of African countries and the Middle East.

Expansion in mobile telecommunication networks in the country has created a competitive environment for the industry. Competition in the industry has led to reduction in prices of mobile telecom services. This has made it possible for a wide variety of individuals to become mobile telephone subscribers. Several people, both old and young, now depend on mobile services for communication. The benefits being enjoyed by subscribers originating from competition in the telephone industry in the country support the evidence provided by a great deal of research that competition in telecommunication improves performance over monopoly (Wellenius & Stern, 1994; Ros, 1999; Noll 2000; Li & Xu, 2001; Wallsten, 2001; Fink, Mattoo & Rathidra, 2002).

Ghana's mobile telecom industry is highly oligopolistic. The industry is made up of five main operators currently providing mobile telecom services to variety of subscribers. The sixth operator has acquired license but has not commenced operation. There is high competition for customers in the industry. Firms adopt various strategies to have competitive advantage in the market. They are expanding their networks to improve service quality so as to rope in more subscribers. Since firm's survival and growth are driven by customer loyalty and retentions which in turn are driven by customer satisfaction and value, delivering

quality service has been important goal and pursuit for each of the five expanding mobile telecom networks.

Mobile telecom service providers have universal access obligations which consist of paying 1 percent of their net revenue into a universal access fund, ensuring that their subscribers can make emergency calls, and expanding network coverage to all regions of Ghana.

The network coverage obligation has made providers to extend coverage to a lot of places. However, it must be noted that network coverage is concentrated in the south which is relatively more-developed part of the country. Mobile coverage is extensive in the southern and eastern Ghana (Greater Accra, Volta, Central, Western, Eastern, Ashanti and Brong Ahafo) and limited in the northern Ghana (Northern, Upper East and Upper West). Kasapa and Zain have limited coverage but they are expanding rapidly. MTN, Vodafone and Tigo have made significant progress in network coverage. They are in all the ten regions of the country.

### **Basic and Value-Added Services**

Mobile network providers in Ghana offer a variety of services for their subscribers, which are either voice or data services. These services can also be categorized into two, basic services and valued-added services. Basic services are targeted at the middle-and low-income earners. On the other hand, value-added services are normally targeted at the high-income individuals and organizations that need high-speed connections and high-end services. Examples of value-added

services include voicemail, conference calling, internet access, chat rooms, phone banking and multimedia services. The impact of value-added services on the industry has not been striking as those related to basic services probably because of their relatively high cost. However, they are provided as a way of meeting the telecommunication services need of all categories of users (Sey, 2008).

### **Billing and Pricing of Mobile Telecom Services**

Mobile network providers use the Calling Party Pay (CPP) method of billing. This strategy means that the person who initiates the call pays for the cost of the call, not the receiver. Initially some providers were billing in units while others were billing in currency (cedis). There is now a common billing for all providers. In order to ensure transparency they all have adopted currency billing. Competition in terms of pricing has resulted in the change from per minute to per second billing by all providers. This strategy is designed to help customers control their usage levels of mobile telecom services (Sey, 2008).

Another form of billing distinguishes customers into prepaid and postpaid. Prepaid users have to load their mobile telephones with credits before any mobile service can be used. On the other hand, postpaid users are billed after using the service for a time period. Prepaid billing system was first introduced by Millicom in 1998. Other networks followed shortly after. The prepaid system opened up access to a larger and more heterogeneous population of users. Within two years of the introduction of prepaid billing mobile subscription caught up with fixed line subscription and a year later surpassed it.

It is instructive to note that the greater majority of mobile subscribers are prepaid. According to the NCA, Kasapa offers only prepaid accounts. Tigo subscriptions are 99.7 percent prepaid. Vodafone, MTN and Zain all have over 90 percent prepaid subscriptions. Postpaid subscriptions are largely associated with government departments, large businesses and agencies. Even in this case sometimes users have at least two accounts, one postpaid sponsored by their employer, and another prepaid for personal use. The advantage of postpaid account is that users make calls without having to recharge their accounts on frequent basis. But when it comes to management of the account it does not give the kind of flexibility associated with prepaid accounts.

The prepaid system has more flexibility built into it than does the postpaid system, not only for subscribers, but also for network providers. The prepaid system enables subscribers to manage their usage levels and control their expenditure. It is a way for subscribers to control their allocations of funds to the network providers. The system is designed to help network providers achieve business goals by compelling the subscribers into a certain pattern of use specifically to spend a minimum amount of money over a certain period of time and to maintain that minimum usage level over time. This is achieved by imposing a limit to airtime credits, airtime expiry dates, and subsequent account expiry dates. Network providers emphasize, for example, that before a call from prepaid mobile telephone is routed to the recipient, the system checks to see if the caller has enough funds to pay for a connection-hence, the need for the phone to have absolute minimum amount of airtime.

For postpaid subscribers, there is nothing like a minimum amount of pre-purchased airtime because, a subscriber is able to make calls without the system checking whether the subscriber has the ability or intention to pay.

Kasapa is the only mobile network provider which has no expiry dates for mobile phone accounts and for purchased airtime. All the other mobile network providers have expiry dates for mobile phone accounts and for purchased airtime. Initially, customers could not retrieve expired airtime but now all providers allow airtime to roll over if the subscriber recharges before the account expires (Sey, 2008).

### **Technological Standards in the Mobile Telecom Industry**

There are two technological standards in the mobile telecom industry in the country, namely GSM (Global System for Mobile Communication) and CDMA (Code Division Multiple Access). Kasapa is the only company that is currently using CDMA technology. All the other companies are using GSM technology. This is as result of decisions by individual network providers to use this standard when they started operations (Scancom, Vodafone and Zain) or when they were switching from analogue to digital technology (Millicom).

The main limitation of CDMA technology, as currently offered in Ghana, is the inability to freely switch between networks by changing SIM cards on the same handset (Sey, 2008). Thus, GSM has an advantage over CDMA in the context of changing networks at will by changing SIM cards without changing the



handsets. In addition, CDMA does not offer international roaming which is an advantage to GSM users.

Kasapa's choice of network technology has given it competitive advantage in some areas (e.g. differentiation, ability to subsidize handset sales because subscribers cannot migrate to other networks) but probably slowed its growth in others (the population is used to GSM). Technological difference continues to define Kasapa as it enables the company to pursue low-cost strategy without regard to the strategies of its competitors. Because of the inability for subscribers to switch SIM cards on the same technology and problems with handset quality as well as limited network coverage, Kasapa has not been able to use its low price strategy to increase its subscriber base considerably. In 2008, Kasapa had the lowest number of subscribers among all the telecom networks (NCA, 2008).

### **Market Share of Mobile Telecom Industry**

Ghana's mobile telecommunication industry is one of the most competitive industries in the country delivering services to customers throughout the length and breadth of the country. There are five main companies in the industry, each operating its own mobile telecommunication network. Mobile telecommunication services have increased remarkably over the years. Competition in the industry has also been intense. NCA 2008 annual report indicates that mobile telecom services subscription crossed the eleven million mark by the end of 2008. Mobile telephony remained the dominant mode of access that accounted for 98.8 percent of total access lines. It was reported that

MTN Ghana was the market leader with a share of 55.56 percent. This was followed by tiGo in the second position with a share of 24.9 percent. Vodafone had a market share of 13.76 percent to remain in the third position. Kasapa took the fourth place with a market share of 3.41 percent. Zain, which entered the industry in the fourth quarter of the year ended up with a market share of 2.31 percent. The regulator was optimistic that the trend would increase in the subsequent years because of the investments being made in the industry.

### **Regulation of Telecommunication Sector**

The telecom sector has been regulated over the years. The number of regulatory bodies and agencies as well as the mode of regulation have not been the same but varied over time. Before the sector was reformed, there were a number of institutions and agencies responsible for regulation. However, these institutions ceded regulation to the National Communication Authority after the reform.

Three different agencies, namely, the Ministry of Transport and Communication, Ministry of Finance and the Ghana Frequency Registration and Control Board (GFRCB) were in charge of the sector's regulatory activities. The Ministry of Transport and Communication had oversight responsibility for the allocation of licenses. The Ministry of Finance was in charge of service charges while the GFRCB was responsible for frequency allocation, regulation and charges. The Ministry of Transport and Communication and the GP&T allocated numbers while at the same time oversaw interconnection agreements.

These multiple oversight agencies were partly the cause of low performance of the GP&T in that they slowed procurement procedures, tariff adjustments and reduced accountability and transparency in decision making (Haggarty et al, 2002). The creation of a single regulatory agency was meant to bring to an end these negative effects of multiple regulatory institutions.

### **National Communication Authority (NCA)**

The National Communication Authority was established by Act 524 of 1996 as a central regulatory body to regulate the telecommunication sector and to ensure a level-playing field in the telecommunication industry for efficient service delivery and the attainment of public policy goals in telecommunication. The general objective of the Authority is to regulate communications by wire, cable, radio, television, satellite and similar means of technology for the orderly development and operation of efficient communications services in Ghana. The specific objectives of the NCA are the promotion of fair competition among the players, protection of operators and consumers from unfair conduct from other operators with respect to quality of service and payment of tariffs, and protection of consumers' interest, (Haggarty et al, 2002). To achieve these objectives, the NCA performs the following functions:

1. Set technical standards;
2. License service providers ;
3. Provide guidelines in tariffs chargeable for services;

4. Monitor the quality of service of providers and initiate corrective action where necessary;
5. Set the terms/guidelines for interconnections of different networks;
6. Considers complaints from telecom users and take corrective action where necessary;
7. Resolve disputes among service providers (in respect of interconnections, sharing facilities and utility installations) and between services providers and consumers(in respect of rates, billing, and provision of services, among others);
8. Control the numbering plan and the approval of equipment and
9. Advise the minister of communications on policy formulation and development strategies for the industry.

The Act that set up the NCA confers a number of powers to the authority in the regulation of telecommunication services. It also assigns a wide array of responsibilities to the Authority in ensuring efficient and reliable telecommunication service delivery to the good people of Ghana. In spite of the powers conferred on the NCA, it is argued that the independence of the authority is not properly guaranteed by the Act (Ahortor, 2003).

Three main things in the Act undermine the independence of the NCA and render it ineffective in the discharge of its functions and responsibilities. Firstly, all the members of the Board are appointed by the President of the Republic of Ghana. This means that the President can remove or dissolve the Board at any time for any reason deemed desirable (Republic of Ghana; Haggarty et al, 2002).

This clearly suggests that, there is the tendency for political interference in the activities of the board. Secondly, the Act subjects the NCA's functions to the directions of the Minister of Communications who also serves as the Chairman of the Board (Haggarty et al, 2002). Thirdly, the Act grants the NCA financial autonomy and this is likely to be an attractive target of meddling. In fact, the Act empowers the Authority to generate funds by requiring fixed percentage of total turnover of fixed and mobile telephone operators. The Authority collects a further 1% of operators' turnover for Ghana Investment Fund for Telecommunication (GIFTEL) (Haggarty et al, 2002) to promote rural telephony in particular and development of telecommunication in general. The use of these funds or the budget setting by the NCA has, however, not been specified in the Act apart from the annual report that the Board must present to the President through the sector Minister (Ahortor, 2003).

### **Theoretical Literature Review**

Generally, demand for telecom service is distinguished into two types, namely, demand for access and demand for usage. Access demand is demand for connection or subscription to telecom services while usage demand is the demand to make and receive calls once subscription has been made. However, before telecom service can be used there must be subscription to telecom network. This study examines demand for subscription to mobile telecom services.

Taylor (1994) put forward that telecom demand is distinct from demand for most goods and services in the sense that telecommunication services is not

consumed in isolation, a network is involved. He further stated that this gives rise not only to certain interdependence and externalities which affect how one models consumption but also a clear-cut distinction between access and usage. He considers a discrete choice framework in which access demand is assumed to be a zero-one random variable and depends on the difference between net benefits from telecom usage and price of access. Thus, access is a precondition for usage of telecommunication service.

Chabossou, Stork, Stork and Zahonogo (2008) noted that for telecom service a distinction is made between access cost (i.e. cost of a handset) and usage cost. They said that access telecom service provides utility to consumers in terms of the ability to make and receive calls.

Verkasalo (2008) indicated that subscription to mobile telecom requires decision making on the part of the individual. The individual has to evaluate the service and decide whether to adopt the service or not. This indicates that individual's decision to subscribe to telecommunication services depends on a careful consideration. The individual may evaluate this decision in terms of benefits and costs associated with subscription. The costs and benefits are often the marginal costs and marginal benefits arising from the use of the service. It is assumed that when the benefit associated with using the service is greater or more than the presumed cost then the individual will use the service.

Another motivation for adopting or subscribing is based on how the service meets a need. Thus there should be a match between individual's needs and services. Verkasalo (2008) argued that usually before the end-user considers

using a service she probably evaluates how the service matches her individual needs. According to him, needs are born in the individual and they tend to direct all behaviour. One way of fulfilling these needs is to purchase a good or service, thereby becoming a consumer and in the case of mobile telecommunication services becoming a subscriber or user of the services.

Gerpolt, Ram and Schnidler (2001) argued that the following four individual features are critical factors that affect customers' value of mobile telecom services:

- The network quality, which is reflected in excellent indoor and outdoor coverage and in the clarity of voice production without any connection breakdowns;
- The price paid for obtaining access to and using the network;
- Customer care which is seen in the quality of the exchange of information between customer and operators in response to customer's telephone enquiries in the course of interactive activities initiated by the network operator; and
- The personal benefits they obtain from the range of mobile telecommunication services.

According to Loebbecke (1995), cost of using mobile services and service quality are critical factors that influence the use of mobile service. Costs of using mobile service include cost of acquiring the line, the phone and the 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 significant phenomenon

prevailing in the mobile market is that charges for calls within the same network are relatively cheaper than calls to other networks because of connectivity fees (Laffront, Rey & Tirole, 1997).

Loebbecke (1995) indicated that the quality of mobile service is important in sustaining demand over time. Service quality is affected by network coverage and quality of mobile telecom network. Expanded coverage improves network quality which in turn enhances service quality for consumers. Network expansion drives demand for mobile telecom service because services are made available to previously uncovered people.

### **Mobile Telecommunication**

Mobile telecommunication refers to the exchange of information, ideas and thoughts through the medium of mobile phone, telephone or wireless network. A mobile telephone network is comprised of the physical components required to connect users. The basic physical components are the handset, base station and mobile service switching station (Gruber & Hornicke, 1999).

An area that is serviced by this network is divided geographically into cells. At the centre of each cell is a cell transmitter to which the mobile services in that cell sends and receives radio frequency signals. These transmitters are connected to a base station, and each base station is connected to a mobile telecommunication office (MTSO). The MTSO is the link between the cellular network and the wired telephone world and controls all transmitters and base stations in the mobile network.



## **Classification of Telecommunication Services**

Telecommunication services can broadly be categorized into two ways; basic and value-added telecommunication. Basic telecommunication includes all telecommunication both public and private that involve end-to-end transmission of customer-supplied information, that is voice telephone services, packet-switched data transmission services, circuit switched data transmission services., telex services, telegraph services, private leased circuit services and other services, such as analogue/ digital cellular/ mobile telephone services, mobile data services, paging among others.

Value-added telecommunication services are telecommunication for which supplier “add value” to the customer’s information by enhancing its form or content or by providing for its storage and retrieval, for instance on-line data processing, on-line database storage and retrieval, electronic data interchange, email and voicemail. It must be stressed that between the two main categorization of telecommunication, basic telecommunications, notably telephone services, are common in many African countries.

## **Network Effects and Mobile Subscription**

Telecommunication theorists widely believe that telecommunications are characterized by network effects. The literature distinguishes two types of network effects — direct and indirect. Direct network effects refer to the case where users benefit directly from the fact that there are large numbers of other users of mobile telecom networks. In mobile telecommunication, Birke and

Swann (2006) argued that direct network effect occurs when the user can contact a large number of people. This motivates other people to subscribe to mobile telecom networks. One reason to become a subscriber relates to the ability to communicate to a large number of users. Thus, non-users may decide to join the network because there are several people to whom they can make a call and from whom they can receive a call.

Indirect network effects, on the other hand, are created as a result of the availability of other services that complement voice telephony such as short messaging service (SMS), internet, and multimedia messaging service (MMS). With indirect network effects, the interest of the consumer is not in the direct interaction with others but rather in the availability of complementary services.

### **Factors Influencing the Choice of Mobile Telecom Network Provider**

The factors that influence the choice of mobile network can be categorized into two groups. These factors are the attributes of the mobile network and the characteristics of the mobile subscriber. Birke and Swann (2006), Corrocher and Zirulia (2008) and Svirgelj and Hrovatin (2008) identified several factors relating to the attributes of the mobile network as critical to the choice of mobile network. The factors include: prices of mobile telecom services (prices for calls within network and calls outside network); service quality (that is network quality); range of products; customer care; discount, promotion and special offers on calls, text messages and multimedia messages; advertisement; and network size.

Perceived quality of services affects the choice of mobile network in the sense that when customers perceive that a particular mobile operator offers quality services that network is more likely to be chosen compared to another network which provides poor quality of service. Improvement in the quality of service means that the network would become attractive to customers and hence its adoption.

According to Kim and Kwon (2003), consumers take into account network size when choosing mobile operators. They argued that larger mobile networks have advantage over smaller networks in acquiring subscribers because of intra-network-call discounts and quality-signaling effect. This view is shared by Birke and Swann (2006). According to them, mobile network with larger subscriber base attracts more subscribers because with rising number of users subscribing to a network it becomes more attractive to other people to subscribe to the same network. On their part, Corrocher and Zirulia (2008) maintained that the larger the customer base of mobile network the greater the benefits from adoption. The benefits, they argued, relate to intra-network call discounts. Normally calls that terminate within the same network are relatively cheaper than calls terminating in another network. Thus customers are likely to pay less for mobile service when the network size is large.

On the characteristics of the individual mobile subscriber, Birke and Swann (2006) indicated that individual social network (friends, family and partner) and income influence the choice of mobile operator. According to them, mobile subscribers try to avoid high mobile expenditure by coordinating operator

choice with their peers and family. This implies that the individual choice of mobile operator is influenced by the choice of their social networks. Moreover, Corrocher and Zirulia (2008) argued that network effects affect the choice of mobile operator. According to them, network effects are common in communication network where consumers primarily consider the pattern of adoption by agents in their social neighbourhood. These agents include family, friends and other social groups. They argued that network effects are explained by social networks of people.

### **Consumption Theories**

In what follows we discuss the theories relating to private consumption expenditure. It is believed that subscription to mobile telephone service entails some level of expenditure.

Household purchases of goods and services are referred to as private consumption expenditure. These services are numerous which may include telecommunication service. Telecommunication services subscription and use involve expenditure. Among the various theories of consumption expenditure are the absolute-income hypothesis, relative-income hypothesis, permanent-income hypothesis and life-cycle hypothesis.

### **Absolute-Income Hypothesis**

The absolute-income hypothesis was proposed by Keynes (1936). According to Keynes, several factors affect individual consumption and these

include income, wealth, interest rate, expectations and demographic factors but the basic relationship is that consumption is a function of income. This can be represented as

$$C = f(Y) \quad 1$$

Where C is real private consumption expenditure, Y is real consumer income and  $f$  denotes functional relationship. This relationship which is for the short-run is at the personal level and hypothesized between consumption and income. That is as income increases consumption also increases. But it must be stressed that the increase in consumption is less than the increases in income. This is known as Keynes fundamental psychological law and it states that "men are disposed as a rule and on average to increase their consumption as their income increases, but not by as much as the rise in their income" (Keynes, 1936, p. 96). Among the factors enunciated by Keynes to affect consumption that are of relevance to the study include income and other financial wealth as well as non-economic or demographic factors. The demographic factors that may affect the level of consumption are age, sex, size of the family (or household size), social pressures and population. Empirical evidence shows that demographic characteristics of individuals or households are important in the decision about subscription to mobile telecom service (Barrentes, 2008).

### **Relative-Income Hypothesis**

The relative-income hypothesis was postulated by Duesenberry in the late 1940s. This was the first attempt to derive the consumption function from a

maximization problem. He assumed that the consumer maximizes the utility function of the following form:

$$U = U \left[ \frac{c_0}{c_0}, \frac{c_1}{c_1}, \frac{c_2}{c_2}, \frac{c_3}{c_3} \dots \frac{c_n}{c_n} \right] \quad 2$$

Where the numerator is the individual's consumption at any point in time and the denominator is the weighted average of the consumption of the rest of the population. Following these, he came out with two hypotheses. The first is that in a cross section of the population, at any point in time, consumers put a premium not only on their absolute level of consumption but also on their level of consumption relative to the rest of the population. In other words, they will behave like the 'Jones', that is, imitating others. The second hypothesis states that over time along a trend, the individual present consumption depends not only on his present level of absolute and relative income but also on the level of consumption attained in the previous period (Acheampong, 2008).

### **Permanent-Income Hypothesis**

The permanent-income hypothesis was developed by Milton Friedman in 1957. He emphasized that people experienced random and temporary changes in their incomes from time to time. The part of income that people expect to persist into the future is referred to as permanent income and the other part that people do not expect to persist is termed transitory income. According to him, individuals plan their consumption in a steady state based on what they could maintain for the rest of their lives given the present wealth and income earned present and in the future. He assumes a consumption function of the form:

$$C^P = kY^P$$

3

Where  $C^P$  is permanent consumption,  $Y^P$  is permanent income and  $k$  is a parameter.  $K$  in equation (3) is not a constant but it is influenced by a number of factors including interest rate, demographic factors and tastes. This theory identifies that income and non-income variables affect private consumption of individuals. The implication is that individual subscription to mobile telecommunication services considered to be a component of private consumption will invariably be affected by these variables as well. Income has been found in empirical studies to be a significant factor in the subscription of mobile telecom services (Bell Canada, 1988; Ahn & Lee, 1999; Madden, Cobel-Neal & Dalzell, 2004; Iimi, 2005). This is not surprising since higher income offers an individual greater opportunity to demand variety of goods and services including mobile telecommunication services.

### **Life-Cycle Hypothesis**

The life-cycle hypothesis was developed by Ando and Modigliani in the early 1960s. According to Ando and Modigliani, individual consumption depends on factors such as resources available to the individual, rate of returns on his capital and age. The resources available to the individual consist of his existing net wealth and the present values of all his current and future labour income. The life-cycle hypothesis postulates that a rational consumer plans consumption on the basis of his resources and allocates his income to consumption over time so that he maximizes his total utility over his entire lifetime (Dwivedi, 2005). The basic

propositions of the life cycle theory of consumption can be summarized as follows. Firstly, the total consumption of a typical individual depends on his current physical and financial wealth and his life time labour income. Secondly, consumption expenditure is financed out of the lifetime and accumulated wealth. Thirdly, the consumption level of a typical individual is, more or less, constant over his life time. Fourthly, there is little connection between current income and current consumption. These propositions can be transformed into a consumption function expressed as

$$C = aWR + cYL \quad 4$$

Where  $W_R$  = real income,  $Y_L$  = labour income,  $a$  and  $c$  are parameters.

The consumption function above indicates that individual consumption depends not only on income but also wealth and for that matter changes in income and wealth affect consumption.

### **Empirical Literature Review**

A number of studies have looked at demand for access to telecommunication services. Much of these studies have been done in developed countries. Studies on demand for telecom services in developing countries are not many. Some research works in the literature are reviewed below.

Bell Canada (1986) conducted a household telephone demand analysis based on data collected by Statistics Canada. A binary logit model was estimated using 34168 observations. A set of economic, demographic and regional variables were included in the model. The main economic variables included in the model



were price and income. The other variables presumed to affect telephone subscription considered in the study were age, education, employment, marital status, among others. The results of the study showed that the likelihood of telephone subscription increases with income, age, education and self-employment. The implication from this study is that socio-demographic variables are as important as economic variables in telecom services subscription.

Using household level data, Bodnar, Dilworth and Iacono (1988) analyzed telephone service subscription in Canada. They employed the logit model to examine the relationship between telephone service subscription and socio-economic and demographic variables. Estimation of the model was executed using the maximum likelihood method. The results from their study showed that the probability of subscribing to telephone services is 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 results of similar studies by Duffy-Deno (2001), Sung and Cho (2001), Rodriguez-Andres and Perez-Amaral (1998), and Salvason and Bondnar (1995b). 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 a related study, Salvason (1997) empirically examined telephone subscription in Canada using the generalized extreme value model. The model was used to analyze the relationship between demand for telephone service and price of telephone service, socio-economic and demographic characteristics of heads of household. The study used survey data on a sample of 37000 households from Statistics Canada's 1994 Household Income Facility and Equipment Micro Data File. The parameters of the model were estimated using maximum likelihood estimation. The results from the study showed that the probability of telephone service subscription was positively related to income and educational level of the household head. He discovered a negative relationship between installation price and subscription to telephone services.

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

Ahn and Lee (1999) investigated the determinants of demand for mobile telecommunication services using a cross-sectional data of 64 countries. They observed that country-specific factors explained mobile telephone services demand. These factors included existing tariff systems, national wealth, level of technological development and industrialization and fixed network facilities. They found that the probability of subscribing to mobile services was positively related to income and the number of fixed lines per person. The positive relationship between fixed lines per persons and mobile services subscription indicated that mobile services act as substitutes to fixed lines services. Similar study by Benerjee and Ros (2004) confirmed the findings of this work. Based on data from a number of developing and developed countries, Benerjee and Ros discovered the main factors that determine the demand growth of mobile telecommunication services. These determinants include income, service price structures and levels and consumers' tastes and preferences. The implication from their findings is that increasing income increases the probability of mobile telecom subscription.

In Korea, Ahn (2001) investigated demand for subscribing to mobile network based on survey data. The study analyzed the characteristics of mobile subscribers and how these characteristics influence 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 contradict the

findings of Narayana (2005) in India. Using a cross-sectional household survey, Narayana (2005) found insignificant results for age and gender. Education, however, was significant. He reported that literate or educated people were associated with a higher probability of subscribing to mobile telephone services.

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. The maximum likelihood estimation technique was used to estimate the model for the study. They found income, age, gender of the household head and size of household as important determinants of mobile telephone services subscription. They observed that 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.

Madden and Coble-Neal (2004) estimated demand for mobile telephone services based on panel data from 56 countries. They modeled optimizing economic agent behaviour directly in order to derive mobile demand equation for estimation. They discovered that mobile network subscription depends on the size of the network and price of mobile services. Thus expanding the size of mobile network and reduction in the mobile service prices enhance mobile service subscription.

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. Switching costs, therefore, act 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. The study adopted descriptive survey design. A two-stage stratified sampling technique was employed for selecting 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. They said that since the study was carried out in university it was expected that the mobile telecom services would have been used extensively for research and academic activities but was found to be the contrary. Mobile telecom services were less

used in research and academic activities. The study identified that limited network coverage, poor quality of service (i.e. unstable network and difficulty in making and receiving calls) inhibit effective use of mobile telecom services. The implication of the findings is that mobile telecom network that provides quality services stands a better position to acquire more subscribers.

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. One critical revelation from the study was that demand for mobile telecommunication services is positively related to income. This confirms theory and findings from similar studies. He observed that consumers in a wealthy households used more mobile telecommunication services than those from poor homes.

Huang (2007b) used data from the 2003 survey of expenditure and income in Taiwan to examine intra-household effects on the demand for telecommunication services. The study estimated demand for fixed-line services and mobile telephone services using discrete choice model with individual and household variables. He found that there was consumption externality among people who lived in more than one person households. Restricting the work to household with two members, the study found that on average the marginal intra-household effect increases the probability of mobile telephone subscription by 35

percentage points while that of fixed-line services increases the probability by 8 percentage points. This study identifies household size as a crucial determinant of telephone subscription in general and mobile telecom service in particular.

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). He framed an individual utility maximization model to econometrically test reasons for mobile telecommunication services use and subscription. He found that the probability of both telephony use and subscription was significantly 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. The study revealed that mobile telephony served as a substitute service for fixed telephony in poor urban sectors.

Narayana (2009) studied determinants of demand for telecom services in India using household survey data. Demand for telecom services was estimated using binary logit model and 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 estimated coefficients of the variables were significant and positive. For instance, the estimated results of income variable showed that an increase in income leads to 1.01 increase in the odds in favour of subscribing to telecom services. The findings are consistent with Chabossou et al. (2008) in Africa. Chabossou et al. studied the factors that influence the probability

of an individual subscribing to mobile telecom services using a discrete choice mode based on cross-country data in 17 Africa countries. They found that income and education enhanced mobile telecom services subscription in these countries.

In recent years, there have been a large number of telephone demand studies that emphasize the substitution or complementarity of fixed and mobile telephone services. Mobile telephone services complement fixed-line services in the developed countries but in the developing countries, they are substitutes (Minges, 1999; Hamilton, 2003). Hamilton (2003) analysed whether mobile services are substitutes or complements for fixed services using data for several African countries. Given the idea that mobile and fixed telephony are complementary in developed countries, she established that they seem to be substitutes in developing countries where access to fixed-line networks is low or non-existent. She suggested that mobile telephony operates as competitive force that encourages providers of fixed-line services to improve access to their networks. She reported that mobile and fixed services are sometimes substitutes, and at other times complements, even where access to fixed network is relatively low.

Recent studies on the choice of mobile telecom network using individual surveys demonstrate that characteristics of mobile telecom network are important determinants of consumer choice (Ofitel, 2002; Svirgelj & Hrovatin, 2008). These characteristics include mobile service charges (on-net and off-net prices), service quality and network coverage. Ofitel (2002), for example, found that in United Kingdom majority of consumers (59%) declared that the cost of mobile services is



that main choice factor, followed by the reception quality and geographic coverage (21%).

Svigelj and Hrovation (2008) investigated choice of mobile operator in Slovenia. A conditional-choice model was used to examine empirically the factors that users take into account when choosing their mobile operator. Characteristics that describe the attributes of the users and the operators were incorporated in the model. Attributes of the mobile operators included in the model are average cumulative number of subscribers, average market share, gross value of advertising expenditure and network prices (on-net and off-net). On the users, some of the variables considered in the model are average monthly income, age and average monthly expenditure for mobile services. Two set of data, time series and cross-sectional, were used in the estimation of the models in the study. The study revealed that monthly income of users, number of subscribers (the network effect), market share and on-net prices of operators significantly affect the probability of choosing a mobile operator.

In Italy, Corrocher and Zirulia (2008) studied determinants of choice of mobile operator. Survey data from a sample of 193 mobile consumers was used. Using factor analysis, the study revealed a number of factors that are important in the choice of mobile telecom operator. They found that network quality, network effects (reflecting friends, family and partner on the same network), and tariffs determine consumers' adoption of mobile operator. They argued that these factors are particularly important for users who are concerned mostly with service quality and costs when selecting mobile operator. Regarding network effect, 61.8 percent

of respondents rated friends' operator as important or very important. About 48.4 percent of respondents rated family's operator as important for the choice of mobile telecom operator. Also, 48.75 percent of respondents rated partner's operator as important when it comes to the choice of a specific mobile operator. Based on the findings they said that network effect is very important in the choice of mobile operator. They observed that consumers who were more interested in local network effects were typically sophisticated users, who used intensively voice services and who were early adopters. Also, consumers who paid attention to local network effects ended up spending relatively little in proportion to their intensity of use.

## **Conclusion**

In this chapter, we looked at the overview of telecommunication sector in Ghana as well as theoretical and empirical literature on mobile telecommunication subscription. The literature was reviewed to identify the key variables for the analysis of mobile telecom subscription and choice of mobile telecom operator.

It was realized from the sectoral review that telecommunication in Ghana for a long time was state-owned and monopolized. Access to telephone services was limited and there was a huge gap between demand and supply of telecom services. Reforms were carried out in the sector to make telecom services more accessible in the country. Moreover, the inability of the state-owned fixed-line company to expand its network served as an advantage for mobile telephone network providers. They entered the market and attracted considerable customers.

It was noted from the literature that for telecom service a distinction is made between access demand and usage demand. Access demand is demand for subscription to telecom services while usage demand is demand to make and receive calls once subscription has been made.

Also, it was identified in the literature that economic and socio-demographic variables influence the demand for mobile telecom services. These variables include income, price charged for subscription (access price), education, employment and sex. Also, it was realized that the choice of mobile telecom operator is influenced by network effects( i.e. social network effect), network prices for on-net and off-net calls, service quality, and other attributes of mobile telecom network as identified by Birke and Swann (2006), Corrocher and Zirulia (2008) and Svigelj and Hrovatin (2008).

It was noted from the empirical literature that discrete choice models are extensively used by researchers to analyse mobile telecom demand. Among the discrete choice models reviewed, logit model was employed to examine subscription decision of individuals to mobile telecom services.

## **CHAPTER THREE**

### **METHODOLOGY**

#### **Introduction**

This chapter discusses the research methodology for the study. It describes the study area, study design, population, sampling of respondents, sources and type of data collection and the research instrument used. It also discusses the econometric model, estimation technique, justification of variables, testing of hypotheses and method of data analysis.

#### **The Study Area**

The area for the study covered the Cape Coast metropolis of the Central Region. Cape Coast is the capital of the Central Region brimming with educational institutions and economic activities. As an educational capital, Cape Coast can boast of a university, a polytechnic, a college of education, a nursing training college, ten senior high schools, one technical school and four vocational schools. The population of Cape Coast is estimated to be 118,106. Out of this number 60,741 are females and 53,755 are males. The proportion of the population above 15 years is 64 percent (Population and Housing Census, 2000).

The people in the area are engaged in the education sector, public sector, private sector, agriculture and self employment. About 9.8 percent of the

population is engaged in the education sector. Farming and fishing are also important occupations for the people. About 15 percent of the economically active populations are engaged in farming and fishing. The rest of the populations are into public and private sector employment. It is imperative to note that all the mobile telephone networks have wide coverage of the entire metropolis.

### **The Study Design**

This study adopted the survey study design to determine the factors that affect subscription demand for mobile telecommunication services by individuals in the Cape Coast metropolis in the Central Region. According to Singleton, Straits and Straits (1993), the major strength of the survey approach is that it can be used for both descriptive and exploratory purposes and allows for direct contact between the researcher and the respondents in the process of collecting data for the study. Another advantage of this approach is that it can be used to obtain detailed and precise information about different groups of people.

However, the main weakness of survey design, as compared to other designs, relates to the possibility of respondents not giving out true nature of events or state of affairs. This is due to the fact that in survey design the researcher depends on reports of behaviour rather than observation of behaviour. The consequence of this is that of measurement error “produced by respondents’ lack of truthfulness, misunderstanding of questions, and inability to recall past event accurately and by the instability of their opinions and attitudes” (Singleton et al, 1993, P. 255).

## **Population**

The target population for the study comprised actual and potential subscribers of the mobile telecommunication networks in the Cape Coast metropolis in the Central Region who were within the selected strata. The study considered all individual subscribers and non-subscribers of mobile telecom networks within the selected areas. The population was made up of heterogeneous groups of individuals.

## **Sample Size and Sampling Procedure**

The records of the number of mobile telecom subscribers in Cape Coast were not available. Neither the mobile networks in Cape Coast nor the National Communication Authority (NCA) had records of the total number of mobile telecom subscribers in Cape Coast. What was available at the NCA office was the total number of subscribers for the various mobile networks for the country as a whole. As a result, the sample for the study was drawn using multistage-sampling technique. The selection of the study sample was based on probability and non-probability methods. The list of the Enumeration Areas was obtained from the Ghana Statistical Service regional office in Cape Coast and out of that a total of 191 Enumeration Areas (EAs) were identified in the Cape Coast metropolis. In the first stage, we randomly selected 10 large EAs from the list of the Enumeration Areas in the metropolis. The 10 EAs are representative of most mobile telecom subscription conditions in the study area. In the second stage, 20 individuals were randomly selected from each EA to ensure fair representation of

each EA in sample for the study. Also, there was not much difference between the EAs in terms of population size. In all, 200 individuals were selected to form the sample for the study. A number of factors were taken into consideration in the selection of the sample. These were cost, time and resource availability.

### **Source and Type of Data Collection**

The data used for the study were mainly primary data. Cross-sectional data were collected through a field survey of individuals in the study population who were selected to form the study sample. Information was collected on income, employment, education and other socio-economic variables, cost of subscription, expenditure on mobile telecom services, and operator-choice variables such as service quality, network effects, number of services, advertisement, network prices and discount, promotions and special offers.

### **Research Instrument**

The main instrument used for the collection of primary data for the study was questionnaire. The questionnaire was structured with open and closed ended questions to ensure that sufficient responses were collected from respondents. The choice of the instrument was based on the fact that i) it can be used to generate both qualitative and quantitative data from respondents, ii) it can be self-administered or presented in an interview format, iii) it offers respondents the opportunity of responding to the questions at their own convenient time and also

assures respondents of anonymity and iv) it is less expensive and less cumbersome to administer.

The questionnaire was designed for all categories of the individuals selected to form the study sample. For the illiterate respondents the questionnaire was used as interview guide to interview them to collect information for the study. The questionnaires were administered by the student researcher and two other trained field assistants. All the questionnaires were retrieved from the field. We were able to retrieve all the questionnaires because of frequent visits to the field.

### **Data Collection Procedure**

The data collection process started with a pilot survey. The pilot survey was carried out in the study area which was not included in the main sample to ensure that the research instrument designed for the fieldwork was appropriate and comprehensive enough as well as safeguard the validity, unbiasedness and reliability of the data that would be collected for the study.

Two research assistants were recruited and trained to ensure speedy and smooth collection of data. They were selected based on their educational background, proficiency in the local language and understanding of this kind of survey. The research assistants were trained on operational definition of terms, relationships between respondents and research assistants, the general attitude to people, and how to deal with difficult respondents. The research assistants were involved in the pilot survey to enable them to be abreast with what was expected



ahead of the fieldwork to ensure consistency and accuracy in the recording of responses from the respondents.

In all, ten questionnaires were administered for the pilot exercise. This was done to check the appropriateness of the questions and responses (Anaman, 2003). The pilot survey revealed some inaccuracies and inconsistencies in the responses which indicated that some of the questions were not framed or structured well to elicit the appropriate responses from the respondents. These mistakes were noted and the necessary corrections made. This made the main fieldwork relatively fast.

Data for the study were collected after the pilot survey. The fieldwork took a maximum of 4 weeks. Two hundred questionnaires were administered. The respondents were given the choice to fill the questionnaires by themselves or have their responses filled for them.

### **Analytical Framework**

Analytical framework for the analysis of telecommunication demand is given by Taylor (1994, 2002). The model takes into account the network-externality feature of telecommunication. Assume the population is made up of  $M$  individuals, each having the utility function described by equation 5.

$$U_i = u(c_i, d_i, q_i, d_i, N) \quad 5$$

Where  $c_i$  is the demand of consumer  $i$  for a composite good,  $q_i$  represents the telecommunication demand of consumer  $i$ ,  $N$  is the number of consumers connected to the telephone network, and  $d_i$  is a dummy variable that takes the

value 1 if the individual is on the telephone, and 0 otherwise. Equation (5) is based on the following assumption: the utility function  $u_i$  is increasing in  $c$ ,  $q$ , and  $N$ , and that it is strictly increasing for  $c$ ,  $d.q$  and  $d.N$ . The variable  $N$  is introduced in the utility function of individual  $i$  to take the network externality into account.

The budget constraint of consumer  $i$  is expressed as follows:

$$p_a + p_u \cdot q_i + P \cdot c_i = R_i \quad 6$$

Where  $p_a$  is the price of access to the telephone network,  $P_u$  is the price of use of telephone,  $p$  is the price of the composite good and  $R$  is the disposable income.

The maximization problem of the consumer assuming he is on a telephone network is given as follows.

$$\text{Max } u(c_i, q_i, N)$$

$$\text{Subject to } p_u \cdot q_i + P \cdot c_i = R_i - p_a$$

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

$$U_q - \lambda p_u = 0 \quad 7$$

$$U_c - \lambda p = 0 \quad 8$$

$$p_u \cdot q_i + P \cdot c_i = R_i - p_a \quad 9$$

The solution of equations (7), (8) and (9) yield the telecommunications and the composite good demand equations as follows:

$$q_i = q(p_a, p, N, R_i - p_a) \quad 10$$

$$c_i = c(p_u, p, N, R_i - p_a) \quad 11$$

The demand for the two goods depends on income, relative prices and the number of subscribers. Solving (11) for  $p_u$ , we derive an inverse telecommunications demand function, so we can compute the consumer surplus,  $S_i$ .

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

$$s_i = \left[ \int_0^{q_i} p_u(z, p, N, R_i - p_a) dz \right] - p_u \cdot q_i \quad 12$$

The consumer compares his surplus  $S_i$  to the access price  $P_a$ . If the surplus is greater than the access price, he subscribes to the telephone network and his demand is given as expressions (10) and (11). On the contrary, if  $P_a$  is greater than  $S_i$ , he will not subscribe.

### Model Specification

Two models were estimated to examine mobile telecommunication services subscription. The first model was for mobile telecommunication services subscription. The second model was for the choice of MTN network.

According to Doganoglu and Grzybowski (2005), demand for mobile subscription is described by a discrete choice model. Indeed, a number of studies on mobile telecommunication subscription have used discrete choice models (Ida & Kuroda, 2005; Barrantes, 2008). Following these studies, a binary logit model was considered for the estimation of individual demand for mobile telecom services.

Individual mobile telecom subscription decision 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

$$p_i = (y = 1 | x_i) = \frac{\exp(x_i \beta)}{1 + \exp(x_i \beta)} \quad 13$$

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

Equation (13) indicates that the probability of not subscribing to mobile telecom services can be stated as:

$$1 - p_i = \frac{1}{1 + \exp(x_i \beta)} \quad 14$$

We can, therefore write

$$\frac{p_i}{1 - p_i} = \exp(x_i \beta) \quad 15$$

By taking the natural log of equation (15) we obtain the logistic function

$$L_i = \ln \left( \frac{p_i}{1 - p_i} \right) = \alpha + \beta X_i + \varepsilon_i \quad 16$$

Where  $\ln$  = natural logarithms;  $P_i$  = Probability of subscribing to a mobile telephone service, defined in terms of cumulative logistic probability function;  $(1-P_i)$  = Probability of non-subscription to mobile telephone service;  $X_i$  = vector of explanatory variables;  $\varepsilon$  = Random disturbance term;  $[\alpha, \beta]$  are the intercept and slope parameters to be estimated.

The empirical model for mobile telecom subscription is specified as:

$$\ln \left( \frac{p_i}{1 - p_i} \right) = \beta_0 + \beta_1 \text{income} + \beta_2 \text{phoneprice} + \beta_3 \text{hsiz} + \beta_4 \text{educ} + \beta_5 \text{Worker\_pubsector} + \beta_6 \text{worker\_privsector} + \beta_7 \text{worker\_self} + \beta_8 \text{sex} + u_i \quad 17$$

Where *income* is monthly income, *phoneprice* is expenditure on handset, *educ* is education of respondents, *hsize* is household size, *worker\_pubsector* is a dummy for public sector worker, *worker\_privsector* is a dummy for private sector worker, *worker-self* is a dummy for self-employed and *sex* is a dummy for sex and  $u_i$  is the error term. The expected signs of the coefficients are:  $\beta_1 > 0$ ,  $\beta_2 < 0$ ,  $\beta_3 > 0$ ,  $\beta_4 > 0$ ,  $\beta_5$ ,  $\beta_6$ ,  $\beta_7 > / < 0$ ,  $\beta_8 > 0$ . The definition and measurement of the variables in model 1 are presented in Table 3.

**Table 3: Definition and Measurement of Variables in Model 1**

List of variables	Definition and measurement of variables
Income	Monthly income in Ghana cedis (GH¢)
Household size	Total number of persons in the household
Education	Years of schooling
Phoneprice	Average expenditure on handset and SIM card
Sex	1 if female, 0 if male
Worker_pubsector	1 if working in public sector, 0 if otherwise
Worker_privsector	1 if working the private sector, 0 if otherwise
Worker_self	1 if working as self-employed, 0 if otherwise

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

A further step is taken to investigate the main factors that affect individual choice of mobile network provider. The study is delimited to the choice of one of

the mobile network providers, MTN Ghana. The idea behind this is that mobile network providers in Ghana provide virtually the same services and products. So identifying the factors that affect the choice of one provider can be extended to cover the other providers.

In order to achieve this purpose a second model was considered. Based on the works of Svigelj and Hrovation (2008) and Doganoglu and Grzybowski (2005) we incorporate into the model attributes of MTN perceived by the mobile user. The model postulates that the choice of MTN network is dependent on the characteristics of MTN itself. The model can be specified below:

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 Neteffects + \beta_2 Discount\_promo + \beta_3 Serquality + \beta_4 Netprices + \beta_5 advert + \beta_6 Nservices + u_i \quad 18$$

Where *Neteffects* depicts network effects; *Discount\_promo* represents promotions, special offers and discounts; *Serquality* is the perception of service quality; *Netprices* is the network prices (on-net and off-net charges) *Nservice* is the number of services or products; *advert* represents advertisement and  $U_i$  is the stochastic disturbance term. The expected signs of the coefficients are:  $\beta_1 > 0$ ,  $\beta_2 > 0$   $\beta_3 > 0$   $\beta_4 < 0$ ,  $\beta_5 > 0$   $\beta_6 > 0$

The dependent variable in the second model is choice of MTN network which takes on the value of 1 if the individual chooses MTN network and 0 if otherwise. The explanatory variables in the second model were rated on four-point likert-type scale. On the likert scale the variables were scored as very important (4), moderately important (3), less important (2) and not important (1).

The mean values of the scores were considered in the estimation of the model parameters.

### **Estimation Technique**

The commonly used technique for estimating models with binary dependent variable such as logit is the Maximum Likelihood Estimation (MLE). This technique is employed to estimate the parameters in our logistic regression models.

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 (maximum) as possible (Gujarati, 2006). It is possible to show that unique maximum exist for the binary logit model. Pindyck and Rubinfeld (1991) argued that Maximum Likelihood Estimation yields consistent parameter estimators. Thus, the MLE would produce the most likely value to the parameters given our sample data. The likelihood function can be expressed as

$$L(\beta|y) = \prod_{i=1}^n [F(\mathbf{X}'_i\beta)]^{y_i} [1 - F(\mathbf{X}'_i\beta)]^{1-y_i} \quad 19$$

Where  $\beta$  is a vector of parameters of the model. The log-likelihood function is then written as

$$\ln L(\beta|y) = \sum_{i=1}^n \{y_i \ln F(\mathbf{X}'_i\beta) + (1 - y_i) \ln [1 - F(\mathbf{X}'_i\beta)]\} \quad 20$$

Maximization of the log-likelihood function (20) yields the maximum likelihood estimator for the vector  $\beta$ . It is instructive to note that many statistical packages are available for the estimations of this model.

### **Marginal Effects**

The marginal effects of the explanatory variables on the dependent variable were determined after estimation of the parameters. These effects would actually enable us to identify the variables that have the greatest influence on mobile telecommunication subscription at the margin. Marginal effects of the logit refer to the change in predicted probability associated with changes in the explanatory variables (Anderson & Newell, 2003; Greene, 2003). Following Greene (2003) the marginal effects for the logit model are given as

$$\partial E[y|X] / \partial X = (\beta'x)[1 - \Lambda(\beta'x)]\beta \quad 21$$

Where  $y$  is the choice variable;  $x$  is a vector of explanatory variables;  $\beta$  is a vector of parameter estimates and  $\Lambda$  is the logistic distribution function. Equation (21) therefore is the procedure for finding the marginal effects of the independent variables in the logistic regression model.

### **Goodness of Fit and Testing of Hypotheses**

When estimation of the regression model has been accomplished, it is necessary to determine how effective the model is at predicting the dependent variable. This process is referred to as goodness-of-fit. Unlike the linear regression model, the Pseudo  $R^2$  is adopted to determine the significance or



goodness-of-fit in logistic regression. A high Pseudo-R<sup>2</sup> indicates that the model is of good fit and a low value means that the model does not fit the data well. However, it must be recognized that low Pseudo R<sup>2</sup> does not necessarily mean that the model is not of good fit. McFadden (1979) provides that even Pseudo-R<sup>2</sup> values of between 0.2 and 0.4 represent a good fit of the model.

Hypotheses test about the coefficients in a logit model can be executed using three alternative tests. These are the likelihood ratio test, Wald test and score test. This study adopted the likelihood ratio test in testing hypotheses about the parameters in our regression models. The likelihood ratio test can be expressed as

$$LR = -2(LL_R - LL_{UR}) \quad 22$$

Where  $LL_{UR}$  and  $LL_R$  denote the values of the unrestricted and restricted log-likelihood. The test statistic is asymptotically distributed as  $\chi^2$  (chi-squared) with  $r$  degrees of freedom. The degrees of freedom equal the number of parameters being estimated. The likelihood ratio test is carried out to test the null hypothesis that all the coefficients except the constant are zeros. The null hypothesis is rejected if the critical value of the  $\chi^2$  distribution is less than the test statistic which implies that the coefficients are different from zeros.

### **Justification of the Variables**

Mobile telecom subscription and use are assumed to be influenced by individual economic and socio-demographic variables namely income, price of

handset, household size, education, occupation and gender. We discuss below the justification of the main variables included in the regression models.

### **Income**

Income is measured by the monthly income of respondents. It measures the individual's capacity to subscribe to and use mobile telecom services. Jha and Majumda (1999) argued that greater income signify greater affordability and so lead to 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) and Huang (2007b). Das and Srinivasan (1999) also found a positive effect of income on the demand for telecom services. Iimi (2007) also argued that as income increases more people could afford telecommunication services. The coefficient of the income variable therefore is expected to be positive.

### **Price**

Theoretically, price variable should be one of the principal determinants of demand for any consumer good or service. Mobile telecommunication service use requires subscription to the network. Handset is an important factor in the access to mobile telecommunication networks. In this regard, price of handset is taken to be the cost of subscription to the mobile telecommunication services. Thus price

variable used in the study is represented by the amount paid for access to mobile telecom services. Economists assume that the relationship between price and demand for a good or services is negative. As a result, we expect a negative relationship between price variable and mobile telecom service subscription.

### **Household Size**

Household size represents the number of persons in a household. Household size is meant to capture the possible interactions among members of the household that facilitate or increase the need for communication. It is hypothesized 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 (2005, 2009), and Hausman (2002) all observe that household size has a positive effect on the demand for telecom services.

### **Education**

Education of respondents is measured by years of schooling. Education variable examines 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 also develops individual's skills, competence and knowledge which facilitate his or her chance of securing a job and getting higher income. It also plays a vital role in dispelling

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 hypothesized that the higher the level of one's education the less likely he/she will be digitally poor. Therefore we expect education to impact positively on the adoption and use of mobile telecommunication services.

### **Sex**

Sex is included as explanatory variable to examine the effect of sex on the demand for mobile telecommunication services. 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 female and 0 if male. Ahn and Lee (1999) and Huang (2007a) are among the studies that found significant relationship between sex and mobile telephone subscription.

### **Employment Type**

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 employment type as follows: public sector employees, private sector employees, self employed and

unemployed. Three 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. Dummy variable was used to capture them. Barrantes (2008) and Huang (2007b) are among the studies that used employment as a variable in models of telecommunication service subscription.

### **Heteroscedasticity Test**

Test for heteroscedasticity was conducted since the data for the study was cross-sectional. It has been observed that the problem of heteroscedasticity is usually associated with cross-sectional data than time series data (Gujarati, 2006). The reason is that in cross-sectional data we generally deal with members of a population at a given point in time, such as individual users and non-users of a particular service or household consumers. These individuals may be of different levels of income such as low, medium and high income. In other words, there may be scale effect. The presence of heteroscedasticity renders the usual hypothesis-testing routine unreliable, raising the possibility of drawing wrong conclusions (Maddala, 1992).

A number of tests have been developed for detecting the presence of heteroscedasticity. These include Goldfield-Quandt test, Breunsch-Pagan test, Spearman's rank correlation test, Glejser test, Park test, and White test. Most econometric software packages have some of these tests incorporated in them and as such are able to detect heteroscedasticity in data. The heteroscedasticity test

was carried out using some of these packages. The test showed that there was no problem of heteroscedasticity in our data.

### **Errors in Data**

Like all household surveys, a number of factors limit the quality of the data collected for the study. Many individuals especially those in the informal sector do not keep record of their activities. In the light of this, approximations have to be made for most of the variables of interest. In cases of some variables like income, age and mobile service usage level, there was no option than making approximations for most individuals. However, such approximations if not done with caution can have some negative effects on the estimation and the results.

Another factor worthy of mention is language. Translation of the items in the questionnaire from English to the local language of the people can pose a problem concerning accuracy and quality of data when translation is not done properly.

### **Method of Data Analyses**

The data were edited to ensure consistency and accuracy of responses obtained from the field. The data were then coded and inputted into the computer. The Statistical Product and Service Solution (SPSS) and Stata were employed to organize and analyse the data. The data were used to run the econometric model to get the estimates of the parameters. Descriptive statistics were used to establish

relationship among the variables. The results of the study have been presented in the form of tables, percentages and frequencies.

### **Conclusion**

This chapter discussed the methodology for the study. The descriptive study design was adopted for the study. Primary data were collected through survey of individuals in Cape Coast. The data collection started with a pilot survey. The study employed questionnaire instrument for data collection. The study adopted the analytical framework developed by Taylor (1994 and 2002) for the analysis of the demand for access to mobile telecom services. Since telecom subscription decision is dichotomous the logit model was employed to estimate the mobile telecom subscription equation.

## **CHAPTER FOUR**

### **RESULTS AND DISUSSION**

#### **Introduction**

This chapter presents the empirical analysis of mobile telecom services subscription and use. Among the sub-topics discussed in the chapter are: socio-economic characteristics of respondents, monthly expenditure on mobile telecom services, switching patterns in mobile telecommunication, determinants of demand for mobile telecom services and factors affecting the choice of mobile telecom network operator.

#### **Socio-Economic Characteristics of Respondents**

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 occupation, levels of income, among others were used and analyzed in the study.

Two hundred individuals were sampled for the study. Out of these, 112 representing 56% were males and 88 or 44% were females. From Table 4, about 42% of respondents in the age group 21-30 were females while males in the same age group constituted 28.6%. The age group < 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 economically active age group from 21 to 40 representing 73.5%. The age groups 21-30 and 31-40 had the highest number for females (42%) and males (33.9%) respectively. The mean age for a male respondent is about 34 while that for a female respondent is about 32.

**Table 4: Age Group by Sex of Respondents**

Age Groups	Sex			
	Female	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

About 5% of the individuals in the study had no formal education. As Table 5 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 respondents with tertiary education were males

while 17.5% were females. It can be seen from Table 5 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 people understand education and would want to get at least a basic education.

**Table 5: Educational Level by Sex of Respondents**

Educational Level	Sex			
	Female	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 6 displays frequency of average monthly income of 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 respondents earned above 1000 Ghana cedis.

**Table 6: 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 7 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 7: 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

### **Income and Mobile Telecom Services Subscription**

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, 2005, 2009). Given this insight a cross tabulation of mobile telecom service subscription by income was constructed and the results are presented in Table 8. From Table 8, non-subscribers of mobile telecom services among those with monthly income less than GH¢ 100 were 12 (48%) while 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 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 held the perception that mobile telecom services were beyond their means.

**Table 8: 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 signify greater affordability and so lead to 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.

## Education and Mobile Telecom Subscription

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 access to mobile telecom service is expected. Table 9 shows frequency of mobile subscription by level of education. The results showed that education actually affects one's decision to subscribe to mobile telecom services.

**Table 9: 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

From Table 9, 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 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.

### **Employment Type and Mobile Telecom Subscription**

Employment type defines the sector in which an individual is engaged as far as occupation is concerned. In this research employment type was classified into four: unemployed, self-employed, private sector employee and public sector employee. Table 10 displays the descriptive statistics for mobile telecom subscription by type of employment. It can be realized that majority of individuals who were nonsubscribers of mobile telecom services fall into the unemployed category representing 56%. On the other hand, public sector employees were the dominant subscribers of mobile telecom services. Only one person or 4% had not subscribed to mobile telecom services. Also, private sector workers were important group of individuals as far as mobile telecom service subscription was concerned.

**Table 10: 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 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. The study reveals 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.

In Ghana, Overa (2005) observed that 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.



### Monthly Expenditure on Mobile Telecom Services

Table 11 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 11 that majority of respondents (74%) spent between GH¢ 5 and GH¢ 30 per month on mobile telecom services.

**Table 11: Frequency of Monthly Expenditure on Mobile Telecom Services**

Amount	Frequency	Percent
Less than GHC 5	24	12.0
GHC 5-10	53	26.5
GHC 11-15	30	15.0
GHC 16-20	34	17.0
GHC 21-30	31	15.5
GHC 31-40	13	6.5
GHC 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 tend to spend more on

mobile telecom services. However, there were some respondents who indicated that they spent less on mobile telecom services not because they used less of mobile telecom services but rather other people paid the costs of their mobile telecom services. 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.

### **Switching Patterns in Mobile Telecommunication**

The issue of switching mobile network is critical among mobile telecom service subscribers. When respondents were asked whether they had changed mobile network since they subscribed to mobile telecom services, the results are presented in Appendix E. It can be seen from Appendix E that 83 respondents representing 41.5% have changed their mobile network while 117 (58.5%) respondents have not switched mobile network. The results showed that most of the respondents were satisfied with their mobile network and decided to remain loyal rather than change mobile network. According to these individuals, the decision not to change mobile network was based on the desire to leave mobile number unchanged. Another factor cited by respondents for not changing mobile network was switching cost. They indicated that by switching network, they would lose contact with friends, relatives and other people. Switching cost therefore creates lock-in effect in mobile telecommunication. For some of these people they would prefer adding another network to their existing network instead

of defecting entirely to a new network. The reasons given by respondents for switching mobile network are represented in Table 12.

**Table 12: Reasons for Switching Mobile Network**

Reasons	Frequency	percent
Unattractive tariff level	65	78.3
Poor service quality	55	66.3
Limited network coverage	45	54.2
Family use different network	57	68.7
Friends use different network	51	61.5

Source: Field Survey, 2009

Table 12 displays the reasons for switching mobile networks by subscribers. It is clear from Table 12 that 68 out of 83 (that is, 78.3%) respondents mentioned that they changed mobile network because of the ‘unattractive tariff level’ of mobile network. This implies that satisfaction with price level of mobile telecom service is a major factor that influences subscriber churn. Another reason for defecting was poor service quality. Respondents who cited this reason were 55 out of 83 representing 66.3%. Service quality is reflected by level of call drop, call quality (clearness of sound, call completion rate). Persistence of low quality of mobile telecom services creates frustration and subscribers are more likely to defect to a network which offers relatively better service.

In addition, limited network coverage influenced subscribers to defect. About 45 out of 83 respondents representing 54.2% mentioned limited network coverage as the reason why they changed mobile network. To these people the inability to make calls to a lot of places not covered by their previous mobile network caused them to defect to another network with relatively wider coverage.

Moreover, the need to use the same network that relatives and friends use was also a major reason why some mobile subscribers would switch mobile network. According to these individuals using the same network with friends and relatives has some benefits. The benefits relate to having to pay less for calls and messages since calls within the same network are often cheaper than calls to another networks. The results have implications that mobile telecom companies should pay attention to quality of service and price of services. Attractive tariff level and improved service quality are critical factors for customer retention and loyalty.

### **Determinants of Demand for Mobile Telecom Services**

Based on the literature a number of economic and socio-demographic variables were identified and incorporated into the mobile telecom subscription equation. The variables were income, access price, education, family size, sex and employment dummies. The coefficients of the variables were estimated by the maximum likelihood estimation method using Stata (2000). The results of estimation are presented in Table 13. A greater number of the 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. The coefficient of family size was expected 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 family size would be higher the larger the family size. Also, gender was expected to take a positive sign because it was noted from the literature that women were more likely to subscribe to mobile telecom services than men. This is confirmed by Rodini et al. (2003).

The goodness-of-fit of our model is judged by the likelihood ratio test. The test statistic is chi-square distributed. At 1 percent level the chi-square test was significant which indicates that the estimated model was significantly different from the null or intercept only model. In addition, the Pseudo- $R^2$  shows that the model was of good fit and predicts well the individual decision to subscribe to mobile telecom service.

On the notion that mobile telecom is a normal service the sign of the estimated coefficient of income was predicted to be positive. The estimated coefficient of income was positive and significant at 1 percent level. This indicates that income variable has the predicted sign and significance. The hypothesis that income does not influence mobile telephone subscription is rejected. An increase in income enhances the probability or the odds in favour of subscribing to mobile telecom services.

From Table 13, it can be realized that an 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. It stands to reason that income is an important determinant of demand for access to mobile telecom service

**Table 13: Mobile Telecom Subscription: Logit Results**

Variable	Coefficient	Odds Ratio	z-value	P> z
Income	0.0066**	1.0066	2.92	0.004
Education	0.1820 **	1.1996	2.66	0.008
Priv_sector worker	1.8440 **	6.3218	2.46	0.014
Pub_sector worker	3.3062**	27.2813	2.64	0.008
Self_worker	1.4261*	4.1624	2.32	0.020
Familysize	-0.0557	0.9458	-0.42	0.673
Sex	-0.2851	0.7519	-0.54	0.592
Accessprice	-0.0145*	0.9856	- 2.41	0.016
Constant	-3.7548	0.0234	2.72	0.007
LR chi2 (8)	=	59.08		
Pseudo R <sup>2</sup>	=	0.3920		
Log likelihood	=	-45.816161		
Prob > chi2	=	0.000		
Number of observations	=	200		

Source: Field Survey, 2009

Note: \*\* and \*denote statistical significance at 1% and 5% levels respectively.

The estimated results corroborate the observation on the cross-tabulation of mobile telecom subscription by income presented in Table 13. We gained a little insight into the relationship between income and demand for access to mobile telecom service from the results of the cross-tabulation. Several works support the fact that income affects the probability of subscription to mobile telecom services (Ahn & Lee, 1999; Ahn, 2001; Narayana, 2005, 2009).

A look at the results in Table 13 reveals that the variable relating to education of the individual is significant at 1 percent level and has the expected sign. Education was measured in terms of years of schooling completed by the individual. The positive sign of education variable indicates that the more individuals get educated the higher the likelihood that they will choose to subscribe to mobile telecom service. The penchant to use mobile telecom by the educated individual stems from the fact that these individuals more often than not have considerable communication need that can be fulfilled by mobile telecom service. There is strong evidence to reject the null hypothesis that education does not influence individual's decision to subscribe to mobile telecom services.

The estimated coefficient of the education indicates that a unit increase in the years of schooling of the individual leads to an increase of 1.1996 of the odds that an individual will subscribe to mobile telecom service. Thus, education is another important determinant of demand for access to mobile telecom services. The outcome of this study is consistent with Narayana (2005) in India. He discovered that education impacts positively on mobile subscription. Educated individuals had a higher probability of subscribing to mobile telephone services.

In Peru, Barrantes (2008) reported that education significantly explains use and non-use of mobile telephone services.

The three dummies used to capture employment were all significant. Separate estimations were done for self-employed, public-sector and public sector workers because we wanted to determine the category of workers that had the greatest likelihood of subscribing to mobile telecom services. The dummies for public and private sector workers were significant at 1 percent level while the dummy for self-worker was significant at 5 percent level. On the assumption that employment influences the demand for access to mobile telecom service, the estimated results showed that employment dummies have correct signs. All the three coefficients have positive signs. The coefficient of public sector worker dummy was significant and positive. Thus individuals employed in the public sector have 27.2813 times higher odds in favour of subscribing to mobile telephone services than non-public sector workers. It is instructive to note that public sector worker dummy had the highest odds ratio as compared to the odds ratios of the other variables. Regarding individual working in the private sector, the estimated results showed that private sector worker dummy has 6.3218 times higher odds in favour of subscribing to mobile telecom services than other individuals. The estimated coefficient for the self-worker dummy was positive and significant. Thus, individuals who are self-employed have 4.1624 odds in favour of subscribing to mobile telecom services as compared to other individuals. It is apparent from the results that employment has significant and positive impact on demand for mobile telecom services. A number of studies have



reported that employment influences the demand for mobile telephone services (Barrantes, 2008; Huang, 2007b). These studies corroborate our results on the impact of employment on the demand for mobile telecommunication services.

At 5 percent level of significance we observed that variables relating to household size (or family size) and gender of individual are not considered significant for demand for mobile telecom service. The results suggest that females had lower odds in favour of subscribing to mobile telecom services. The odds of a female subscribing to mobile telecom services were 0.7519 times lower than the odds of a male. The z-ratio associated with gender variable was low and not significant. As a result, the null hypothesis that gender does not affect demand for mobile telecom services is accepted at 5 percent. There is not enough evidence for the null hypothesis to be rejected. The study supports the findings by Narayana (2005, 2009) in India but contrary to Ahn (2001) in Korea and Rodini, Ward and Woroch (2003). In these studies, gender variable was found to be significant in determining subscription to mobile telephone services. Rodini et al. (2003) observed that women were 9 percent more likely to subscribe to mobile telecom services than men.

The family size variable captures the impact of number of persons in a household on the demand for mobile telecom services. It is presumed that demand for mobile telecom services is higher if the family size is bigger. In the light of this, family size variable was predicted to take a positive sign. However, the estimated results produced negative coefficient. The implication is that, other things being constant, an increase in family size by addition of one person would

result in a decline in the odds that individuals within the family will choose to subscribe to mobile telecom service. That is, a unit change in the family size variable leads to a decrease of 0.9458 in the odds in favour of subscription to mobile telecom services. The z-ratio associated with family size variable is very low and insignificant. This implies that there is not enough evidence to reject the null hypothesis that family size variable does not influence demand for mobile telecom service.

From theory, 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. She indicated that expansion in subscription of mobile telecom service calls for reduction in prices of mobile telecom services.

To account for price variable in the demand for mobile telecom equation, the cost of handset was considered as proxy for price for mobile telecom services. At 1 percent level, access (handset) price was significant and had predicted sign. The estimated coefficient indicates that increase in the price of mobile telecom service leads to decrease in the odds in favour of demand for mobile telecom services. More specifically a unit increase in the price of mobile telecom service results in a decrease of 0.9856 in the odds that individuals will choose to

subscribe to mobile telecom service. This implies that reduction in access cost lead to increase in mobile telecom services subscription.

Another estimation was done to generate the marginal effects of the estimated variables. The estimated results of the marginal effects are displayed in Table 14. The marginal effects measure the change in the predicted probability for a unit change in the independent variable. The sign of the marginal effect must be the same as the sign of the estimated coefficient.

**Table 14: Marginal Effects for Mobile Telecom Subscription**

Variable	$\partial y/\partial x$	z-value	$P> z $
Income	.0003	2.82	0.005
Education	.0073	2.12	0.034
Familysize	- .0022	-0.42	0.673
self_worker	.0489	1.85	0.065
privsector_worker	.0569	2.02	0.043
pub_worker	.0909	2.22	0.026
sex	-.0112	-0.56	0.587
Acessprice	- .0006	- 2.41	0.016
<hr/>			
Y = Pr(mobilesubs) (predict) = .95835773			

Source: Field Survey, 2009

As seen in Table 14 the marginal effects of access price, family size and gender variables are negative just as their estimated coefficients while the

marginal effects of the other variables are positive. In addition, when the estimated coefficient of an independent variable is significant at 5 percent level its marginal effect will also be significant at the same significance level.

It can be seen from Table 14 that the marginal effects of income, education, employment dummies and access price are significant. The first estimation generated significant coefficients for these variables. The results of the marginal effects are interpreted as follows. Firstly, 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. Thirdly, 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.

### **Determinants of Choice of Mobile Telecom Network Operator**

Based on the empirical and theoretical literature on the choice of mobile telecom operator a number of variables were identified and included in the regression model. The variables were: network effect (neteffect), services quality (serquality), promotions, discounts and special offers (discount\_promo), network prices (netprices), advertisement (advert) and number of services (Nservices). Two types of estimation were carried out. The first was the estimation of the

coefficients of the variables. The second estimation generated the marginal effects of the estimated variables. The value of the Pseudo-R<sup>2</sup> showed that the model is of good-fit. The likelihood test statistic shows that the estimated model is significantly different from the intercept-only model.

The estimated coefficients of the variables are displayed on Table 15. With the exception of number of services, advertisement and quality of service of the provider, the rest of the variables were significant and had predicted signs. However, the result for service quality variable was not what was expected. We expected service quality to be significant in determining the choice of mobile telecom operator. In fact, when subscribers of mobile telecom network begin to complain about poor quality of service, it sends a signal to potential subscribers that they would not get value for their money. This therefore deters others from joining that network. On the other hand, when services received by subscribers are of good quality others would be more than willing to join such a network.

Table 15 indicates that at 1 percent level, discounts and promotion variable is significant and positive. The positive sign of the estimated coefficient implies that more promotions, special offers and discount increase the odds in favour of choosing a mobile telecom provider. From Table 15, additional promotion and discounts leads to an increase of 1.9615 in the odds that an individual will choose MTN as compared to any other mobile network. Ghanaian mobile telecom market is replete with promotions, discounts and special offers. MTN in particular offers up to 99 percent discount for its subscribers for calls

within the network. This strategy is designed to retain existing customers and attract non-subscribers to join the network.

**Table 15: Determinants of Mobile Telecom Network Operator Choice**

Variable	Coefficient	Odds Ratio	z-value	P> z
Nservices	0.2084	1.2317	0.78	0.438
Neteffect	0.5827*	1.7908	1.93	0.053
Discount_promo	0.6737**	1.9615	2.88	0.004
Netprices	-0.7588 **	0.4682	- 2.43	0.015
Serquality	0.0744	1.0772	0.24	0.812
Advert	0.1452	1.1563	0.51	0.611
Constant	-4.2043**	0.01493	-3.69	0.000
LR chi2 (6) =	75.47			
Prob > chi2 =	0.0000			
Log likelihood =	-65.056826			
Pseudo R2 =	0.3671			
Number of observations =	200			

Source: Field Survey, 2009

Note \*\* and \* indicate statistical significance at 1% and 5% levels respectively

Mobile operators use promotions and discounts to increase subscription by giving their branded phones and SIM cards to people for free or at reduced costs. What is significant in such cases is that the phones can only be used for their

networks. The phones do not work on other networks because the phones are free or offered at reduced cost consumers in the low income bracket participate more in such promotions and special offers to enable them get connected to mobile telephone network.

A look at the results in Table 15 reveals that network effects variable is positive and significant. The results suggest that network effect is important for mobile telecom operator choice. This means that consumers take into account the choice of household members, friends or relatives when choosing mobile telecom operator. This is consistent with the findings of Bryce, Moore and Rutter (2004) and Birke and Swann (2006). They found that majority of mobile users choose their mobile operator because friends or family use the same mobile operator.

A study by Corrocher and Zirulia (2008) in Italy reported that network effect is an important factor affecting the choice of a mobile operator. They came out with the finding that friends, family members and partners play important role in determining the adoption of mobile network operator. It was revealed that 61.8% of respondents rated friends' operator as important or very important, while this percent was 48.41% for family's operator and 48.75% for partner's operator.

Consumers would want to choose the operator of their social networks so that they pay less for calls, text messaging and other services. This is due to termination based price discrimination in mobile telecommunications. With this practice, calls within the same network are cheaper than calls to other networks. For instance, a minute call from MTN to MTN costs 14 pesewas while the same

call to any other network costs 18 pesewas. For those in the MTN zone they can enjoy discount up to 99 percent for calls within the network but no discount for calls outside MTN network. This suggests that consumers stand to gain when they pay attention to network effects in their choice of mobile network operator. This is consistent with what Corrocher and Zirulia (2008) have come out with. They argued that consumers who pay attention to local network effects end up spending relatively little in proportion to their intensity of use. Birke and Swann (2006) have argued that not only do network effects play important role in the choice of mobile operator they also affect the use of mobile telecom service.

Table 15 indicates that the estimated coefficient of netprices variable is statistically significant at 1 percent level. This means that the probability that an individual will choose a mobile operator, *ceteris paribus*, is significantly dependent on price level (the price charged for calls and other services) of that mobile operator. Network prices are the prices charged by a mobile telecom network provider for on-net and off-net calls.

It can be seen from Table15 that an increase in network price leads to a decrease of 0.4682 in the odds that an individual will choose MTN as compared to any other mobile network. The results show that individuals take into account prices charged for mobile network operators in their choice of mobile operator. This is consistent with the findings of Corrocher and Zirulia (2008) in Italy and Birke and Swann (2006) in UK who found that tariffs determine the choice of mobile operator. Iimi (2005) indicated that consumers view mobile phone charges as important in choosing an operator.



After the estimation of the coefficients of the variables in the model for the choice of mobile operator, attempt was made to estimate marginal effects of the explanatory variables. The results of the marginal effects are presented in Table 16. The marginal effects indicate the predictive power of the independent variables.

**Table 16: Marginal Effects for Choice of Mobile Telecom Network Operator**

Variable	$\partial y/\partial x$	z-value	P> z
Nservices	0.0247	0.77	0.444
Neteffects	0.0691	1.88	0.060
discount_prom	0.0798	2.85	0.004
Netprices	-0.0899	-2.34	0.019
Serquality	0.0088	0.24	0.811
Advert	0.0174	0.50	0.615
y=pr(mtnuser) (predict)= .86260403			

Source: Field Survey, 2009

It can be seen from Table 16 that the marginal effects of netprices, discount\_prom and neteffects variables are statistically significant as their corresponding coefficients presented earlier in Table 15. The marginal effects of the other explanatory variables are not significant the same as their estimated coefficients. The marginal effect of discount\_prom variable is 0.0798. This means that the probability of choosing a mobile operator increases by

approximately 8% when discount and promotion increase. The implication is that mobile telecom service provider that runs more promotions and gives offers as well as discounts/bonuses will increase its subscription rate much higher than another mobile operator which does not.

Looking at values of the marginal effects in Table 16, it can be observed that the service charges of mobile operator (Netprices) have the biggest marginal effect. The implication is that service charges have a stronger impact on the individual choice of mobile telecom operator.

### **Hypotheses Test**

In our bid to test the null hypothesis that all the coefficients of the explanatory variables are zero in the logit models the likelihood ratio test was used.

The likelihood ratio tests for estimation are reported for both mobile subscription and mobile operator choice models (model (1) and (2) respectively) as shown in Table 17. The likelihood ratio tests reject the hypothesis that the coefficients of the explanatory variables are all zero at 1% level.

**Table 17: Log Likelihood Ratio Tests**

	Model 1 (Mobile subscription)	Model 2 (Mobile operator choice)
Restricted log likelihood (A)	-75.35	-102.79
Unrestricted log likelihood (B)	-45.81	-65.06
Log likelihood ratio statistic [-2(A-B)]	59.08	75.47
Degrees of freedom	8	6
Critical value from $\chi^2$ table	20.090	16.812
Hypothesis: All coefficients of the explanatory variables equal zero	Rejected	Rejected

For model 1 the restricted log likelihood is -75.35 and the unrestricted log likelihood is -45.81. The  $\chi^2$  statistic is therefore 59.08. With 8 degrees of freedom, the critical value from the  $\chi^2$  table is 20.090 so the joint hypothesis that the coefficients of the explanatory variables in model 1 are all zero is rejected. Similarly, for model (2) the restricted log likelihood is -102.79 and the unrestricted log likelihood is -65.06. The  $\chi^2$  statistic is 75.47. With 6 degrees of freedom, the critical value from the  $\chi^2$  table is 16.812. Therefore, the joint hypothesis that the coefficients of the explanatory variables in model (2) are all zero is rejected.

### Conclusion

This chapter presented the empirical results of the demand for mobile telecom services. It was observed that income, education, occupation

(employment) and prices of mobile telecom services significantly influence demand for mobile telecom services. For the choice of mobile network operator, the factors to consider are network effects, network prices (on-net and off-net charges) and promotions, discounts and special offers.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **Introduction**

This chapter presents the summary of the research undertaken on the determinants of demand for mobile telecom service in the Cape Coast metropolis. It also outlines the main conclusions derived from the empirical results and findings. The chapter also discusses the policy implications of the study.

#### **Summary**

Telecommunication has been recognised as important for national development. That is why the government deregulated the telecommunication sector so that telecommunication services can be made accessible to all Ghanaians.

The study looked into the development of telecommunication in Ghana from the colonial period through post independence era when the state was the main provider of telecom services to the post telecom reform period and the structure of mobile telecom industry.

The purpose of the study was to investigate the determinants of individual demand for access to mobile telecommunication services. The multi-stage

sampling method was used in the study. The sample was 200 individuals in the Cape Coast metropolis. The questionnaire instrument was employed to collect data for the study. Data on socio-economic and demographic characteristics of individuals were obtained.

Two logit models were estimated using individual-level data for the study. The dependent variable for the first model was mobile subscription. Income, education, mobile service price and a host of other individual characteristics were regressed on mobile subscription. In the second model the dependent variable was choice of MTN network. Service quality, network charges, advertisement, number of services, network effect, discount, promotions and special offers were the independent variables in the second model.

## **Conclusions**

From the perspective of the objectives the following conclusions are made. In the first place, mobile telecom services subscription and usage at the individual level were explained by socio-economic and demographic characteristics. It was realized, consistent with literature, that demand for mobile telecom service is dependent on income, employment, education and access (handset) price. It was found that monthly income explains the probability that an individual will choose to subscribe to mobile telecom service. This implies that growth of income is necessary to promote access demand for mobile telecom services. Again, education impacted positively on mobile telecom subscription. Also, employment in general was found to determine subscription to mobile

telephone services. The implication is that the more people get employed the higher the likelihood that they will choose to subscribe to mobile telecom services. In addition, a negative relationship existed between access (handset) price and mobile telecom subscription. This means that a reduction in the cost of subscribing to mobile services, all other things equal, leads to an increase in mobile telephone subscription.

Individual choice of mobile telecom network was found to depend on promotions, discount and special offers, prices of services and network effects. Most consumers took into account the choice of their social networks (friends and family) when choosing mobile telecom network. The perception on prices level of mobile services affects individual's choice of mobile telecom operator. Again, promotions and discounts had a positive impact on the individual choice of mobile operator. Moreover, it was discovered that individual decision to switch mobile network is contingent on quality of service and tariff level of mobile telecom network. There were different reasons why some customers would not wish to change mobile telecom network. The reasons were switching costs and the desire to leave mobile number unchanged.

Individual expenditure on mobile telecom services was influenced by level of income. It was observed that a positive relationship existed between income and mobile telecom service expenditure. Consumers used mobile telecom services to maintain relationship by contacting friends, family and partners. Mobile telecom services were also used for business purpose and for accessing

internet. However, the use of mobile services for internet purpose was very limited. Few people used their phones to access internet.

### **Recommendations**

On the basis of the findings of the study the following recommendations are made to mobile service providers and other stakeholders in the telecommunication industry.

There is the need for the Ministry of Communications to reduce switching costs in mobile telecom industry by the introduction of mobile number portability. This will go a long way to reduce the lock-in effect prevailing in the mobile telecom industry and gives customers flexibility of choice. The introduction of the mobile number portability will also make mobile service providers to improve their service delivery to customers.

Also, efforts should be made by mobile subscribers to form strong customer unions to protect their interests in mobile telecom industry. The formation of such unions will inure to their benefit since they can demand better services from mobile service providers.

Moreover, mobile service providers should reduce service charges to acquire more subscribers since the study revealed that mobile users viewed tariff levels as important in choosing mobile operator. For a given operator to acquire more subscribers its services must be offered at reasonable and attractive prices. In that way most of the people in the lowest income bracket can afford to subscribe to such mobile networks.



In addition, efforts should be directed toward creating employment opportunities for individuals to increase mobile telecom subscription. The ministry of employment can take up the challenge to create formal sector employment avenues for people or provide the congenial environment for private businesses to thrive since the study revealed that employment in general vastly enhances mobile telecom subscription.

### **Areas for Future Study**

This study has revealed some areas for future study in telecommunications. Firstly, future research can look at the determinants of customer loyalty and subscriber churn in mobile telecom industry. Also, a regional or national level study would be useful to establish the generality of the results. Moreover, a study can be carried out on the contribution of mobile telecom services to economic growth and development.

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**APPENDICES**

**APPENDIX A**

**Logit Results for Mobile Telecom Subscription**

logit mobilesubs sex income familysize accessprice self\_worker educ  
privsec\_worker pub\_worker

Iteration 0: log likelihood = -75.354032

Iteration 1: log likelihood = -56.487486

Iteration 2: log likelihood = -49.088437

Iteration 3: log likelihood = -45.899931

Iteration 4: log likelihood = -45.816849

Iteration 5: log likelihood = -45.816161

Iteration 6: log likelihood = -45.816161

Logistic regression                      Number of obs =     200  
LR chi2(8)     =     59.08                      Prob > chi2     =     0.0000  
Log likelihood = -45.816161                      Pseudo R2     =     0.3920

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mobileuse	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Sex	-.2850549	.5314135	-0.54	0.592	-1.326606	.7564965
income	.0066499	.0022804	2.92	0.004	.0021804	.0111193
familysize	-.0556845	.1319149	-0.42	0.673	-.314233	.202864

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accessprice	-.0144789	.0060109	- 2.41	0.016	.0026978	.0262601
self_worker	1.426062	.6150174	2.32	0.020	.2206501	2.631474
educ	.1819868	.068523	2.66	0.008	.0476841	.3162895
privsec_wor	1.844054	.7497916	2.46	0.014	.3744896	3.313619
pub_worker	3.30629	1.250655	2.64	0.008	.8550518	5.757528
_cons	-3.754791	1.382154	-2.72	0.007	-6.463764	-.045818

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## APPENDIX B

### Marginal Effects for Mobile Telecom Subscription

. mfx compute, dydx at(mean)

Marginal effects after logit

$$y = \text{Pr}(\text{mobilesubs}) (\text{predict}) = .95835773$$

---

variable	dy/dx	Std. Err.	z	P> z	[	95% C.I.	]	X
income	.0002654	.009	2.82	0.005	.0081	.045		412.95
Sex*	-.0112279	.02064	-0.54	0.587	-.051689	.029233		.56
education	.0072628	.00343	2.12	0.034	.000535	.01399		11.57
accessprice	-.0005778	.00024	-2.41	0.016	.000109	.001047		104.285
self_worker*	.0489207	.02649	1.85	0.065	-.003	.100842		.335
privsector_worker r*	.0569712	.02815	2.02	0.043	.001798	.112144		.285
pub_wo~r*	.090864	.0409	2.22	0.026	.010705	.171023		.26
familysize	-.0022223	.00526	-0.42	0.673	-.012537	.008092		5.645

---

(\*) dy/dx is for discrete change of dummy variable from 0 to 1

## APPENDIX C

### Logit Results for Choice of Mobile Telecom Operator

logit mtnuser Nservices neteffect discount\_promo Netprices Serquality, advert

Iteration 0: log likelihood = -102.79133

Iteration 1: log likelihood = -67.528668

Iteration 2: log likelihood = -65.128663

Iteration 3: log likelihood = -65.056963

Iteration 4: log likelihood = -65.056826

Logistic regression	Number of obs = 200
LR chi2(6) = 75.47	Prob > chi2 = 0.0000
Log likelihood = -65.056826	Pseudo R2 = 0.3671

---

mtnuser	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Nservices	.2084359	.2686386	0.78	0.438	-.3180862	.7349579
Neteffect	.5827673	.3013369	1.93	0.053	-.0078422	1.173377
discount_p~o	.6737803	.2337698	2.88	0.004	.2156	1.131961
Netprices	-.7588984	.3118293	-2.43	0.015	.1477242	1.370073
Serquality	.0744233	.3123935	0.24	0.812	-.5378568	.6867033
Advert	.1451928	.2850876	0.51	0.611	-.4135685	.7039542
_cons	-4.20438	1.137947	-3.69	0.000	-6.434715	-1.974045

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## APPENDIX D

### Marginal Effects for Choice of Mobile Telecom Network Operator

. mfx compute, dydx at(mean)

Marginal effects after logit

y = Pr(mtnuser) (predict) = .86260403

---

Variable	dy/dx	Std. Err.	z	P> z	[	95% C.I.	]	X
Nservices	.0247035	.03224	0.77	0.444	-.038481	.087888		2.68
Neteffect	.0690686	.03671	1.88	0.060	-.002873	.14101		2.97335
disc_prom	.0798553	.02798	2.85	0.004	.025014	.134696		2.15
Netprices	.0899434	.0385	2.34	0.019	.014478	.165409		2.735
Serquality	.0088205	.03696	0.24	0.811	-.063615	.081256		3.035
Advert	.0173926	.03454	0.50	0.615	-.050305	.08509		2.245

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## APPENDIX E

### Switching of Mobile Telecom Networks

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Response	Frequency	percent
No	117	58.5
Yes	83	41.5
Total	200	100.0

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Source: Field Survey, 2009

**APPENDIX F**

**Survey Questionnaire**

**UNIVERSITY OF CAPE COAST**

**DEPARTMENT OF ECONOMICS**

**Introduction**

I am conducting a research on the extent of mobile telecommunication service use in Ghana in an attempt to enhance mobile telecommunication services demand. Please provide your input by completing the following survey. The information you provide would be treated as confidential. Thank you in advance for your contribution. Kindly tick/select/give responses you consider appropriate.

**A. Individual Characteristics**

1. Age .....
2. Marital status: Single [ ], Married [ ], Divorced [ ], Separated [ ], Widowed [ ]
3. Sex: Male [ ] Female [ ]
4. Educational level: None [ ], Basic [ ], Secondary [ ], tertiary [ ]  
Other, specify.....
5. Years of schooling.....
6. Occupation: Unemployed, [ ], self employed [ ], private sector employee [ ], public sector employee [ ] other, specify.....
7. What is your average monthly income.....
8. What is your average annual income?.....
9. How many members are you in the family?.....

**B. Mobile Telecommunication Service Subscription**

10. Do you use mobile telecom services: Yes [ ], No [ ]

11. If no, what are the reasons for not using mobile telecom services.....  
 .....  
 .....

12. How many mobile telephone service providers do you subscribe? One [ ], two [ ], three [ ] four [ ], five [ ]

13. How relevant are the following factors in your mobile telecommunication service subscription decision?

Factors	1 Not important	2 Less important	3 Moderate Important	4 very important
Income				
Educational level				
Employment				
Cost of Handset				
Age				
Family size				

14. How much did you purchase your handset?.....

15. How much did you buy your subscriber identification module (SIM) card or starter pack? .....

16. How long have you been using mobile telecom services? Less than a year [ ], 1-2 years [ ] 3-4 years [ ], more than 5years [ ]

17. What kind of mobile telecom services do you use regularly? Voice Service [ ], Short Messaging Services [ ], Multimedia Messaging Services [ ], Internet Browsing [ ]

**C. Intensity of Mobile Telecommunication Service Use**

18. How much money do you spend per month on mobile telecommunication services? Less than GHC 5 [ ], GHC 6-10 [ ], GHC 11 – 15 [ ], GHC 16 -20 [ ], GHC 21- 30[ ], GHC 31- 40 [ ] GHC 41 and above [ ]
19. How many minutes per week do you spend on mobile telephone calls? Less than 5 minutes [ ], 6-20 minutes [ ], 21-20 minutes [ ], 41-60 minutes [ ], more than 60 minutes [ ]
20. How many text messages/ multimedia messages do you send per week to different people? Less than 5 [ ], 6-10 [ ], 11-20 [ ], 21- 30 [ ], more than 30 [ ]
21. What do you think are some the importance of mobile telecommunication services to you? Internet browsing [ ], maintain relationship [ ], Family contact [ ], friends contact [ ], Business contacts [ ] other, specify.....

**D. Switching Behaviour in Mobile Telecommunications**

22. Have you changed mobile network since your first adoption of mobile telecommunication services? Yes[ ], No [ ]
23. If yes, what influenced you to switch mobile network?  
.....  
.....
24. If yes, what network were you using before the switch? MTN [ ], Kasapa [ ], Tigo [ ] Onetouch [ ]
25. How important do the following factors influence your decision to switch mobile network?

Item	1 Not important	2 Less important	3 Moderate Important	4 Very important
Family use different network				

Friends use different network				
Unattractive network prices				
Limited network coverage				

**E. Determinants of choice of MTN Network**

26. Are you currently MTN subscriber? Yes[    ], No [    ]

27. How long have you been using MTN services?.....

28. To what extent are the following factors important in influencing your choice of MTN services?

Factors	1 Not Important	2 Less Important	3 Moderate Important	4 Very Important
Network quality				
Network prices				
Advertisement				
Range of services				
Network coverage				
Friends use the same network				
Family use the same network				
Partner use the same network				
Customer				

services				
Special offers/ promotions				

29. Perceptions about MTN and its services

Item	1 Strongly Agree	2 Agree	3 Disagree	4 Strongly Disagree	5 Uncertain
MTN offers quality services					
MTN provides innovative services					
MTN offers affordable network prices					
MTN provides good customer care					
MTN services are country wide					