UNIVERSITY OF NAIROBI

TOPIC: TELECOMMUNICATION AND ECONOMIC GROWTH, EVIDENCE FROM
KENYA (1980-2010)

MALA, HANNINGTONE OKENDO

X50/72277/2008

SUPERVISORS

1. DR.DANIEL.O.ABALA
2. MR.JASPER.A.OKELO

The research paper is submitted to the school of Economics in partial fulfillment for the
requirements of the award of a Master of Arts (M.A) Degree in Economics

i

UNIVERSITY OF NAIROBI

TOPIC: TELECOMMUNICATION AND ECONOMIC GROWTH, EVIDENCE FROM KENYA (1980-2010)

MALA, HANNINGTONE OKENDO

X50/72277/2008

SUPERVISORS

1. DR.DANIEL.O.ABALA
2. MR.JASPER.A.OKELO

The research paper is submitted to the school of Economics in partial fulfillment for the requirements of the award of a Master of Arts (M.A) Degree in Economics
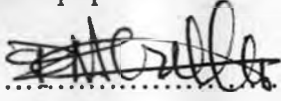
i

Declaration

This is my original work and has never been presented for any degree award in any other University

Signed..Date...... 27| 09 | 2011 ....

Mala, Hanningtone Okendo

This research paper has been submitted with our approval as University Supervisors

Signed.................................Date...... 29|09|2011 ....

Dr.Daniel.O.Abala

Signed.................................Date.. 29/09/2011 ....

Mr.Jasper.A.Okelo

Acknowledgment

I am greatly indebted to my supervisors Dr.Daniel Abala and Mr.Jasper Okelo for their valuable supervision without which I would have found it difficult to complete this study in time, more so for the way they sacrificed their time to go through the drafts and assess the final project. I would like to thank Mr.Simon Nyokabi for his assistance in data analysis. I also thank my friends for their co-operation during the period of the course. Special thanks to my family for their moral support through the academic period.

Dedication

This paper is dedicated to my wife Merceline, Son Seth and my Daughter Tristar for the support and co-operation they have always given me.

Abstract

This study seeks to investigate how telecommunication expenditure affects economic growth. The study use time-series data over the last thirty years (1980-2010). To estimate the time –series data, unit root tests were conducted to establish whether the variables were no-stationary or stationary. After determining the order of integration.Cointegration test was carried out and the test established that there is a positive relationship between telecommunication expenditure and economic growth. However, the Granger causality test failed to confirm bi-directional causality between GDP growth rate and telecommunication expenditure during the time under investigation. This is not entirely unexpected since most of the investments have been carried out by the private sector and not the government. It is therefore likely that the investments done by the government in the telecommunication sector were not high enough to cause major changes in terms of economic growth during period under investigation.

LISTS OF ACRONYMS AND ABBREVIATIONS

CCK: Communications commission of Kenya

EAC: East Africa Community

ICT: Information communication technology

ITU: International Telecommunication Union

GDP: Growth Domestic Product

EA: East Africa

CBS: central Bureau of statistics-Kenya

GOK: Government of Kenya

ERS: Economic Recovery Strategy

UNCTAD: United Nations Conference on Trade and Development

OECD: Organization for Economic co-operation and Development

Teledensity/telecommunications infrastructure: Total telephones per 100 population

Telephony:__Is the technology associated with the transmission of voice, fax or other information between distant parties

EAP&TC: East African Posts & Telecommunications Corporation

KPTC: Kenya Posts & Telecommunication Corporation

EXTECOMS: External Telecommunications

KENEXTEL: Kenya External Telecommunications

WTDC: world Telecommunications development Conference

UNEP: United Nations environmental program

ISPS: local internet service providers

Table of Contents

CHAPTER ONE

INTRODUCTION

1.1 Background

Economic growth is the increase of per capita gross domestic product (GDP) or other measures of aggregate income, typically reported as the annual rate of change in real GDP. Economic growth is primarily driven by improvements in productivity, which involves producing more goods and services with the same inputs of labor, capital, energy and materials. Economists draw a distinction between short-term economic stabilization and long-term economic growth. The topic of economic growth is primarily concerned with the long run. The short-run variation of economic growth is termed the business cycle. The long-run path of economic growth is one of the central questions of economics; despite some problems of measurement, an increase in GDP of a country greater than population growth is generally taken as an increase in the standard of living of its inhabitants. Over long periods of time, even small rates of annual growth can have large effects through compounding. Success in this process generates increased incomes which then increase demand and stimulate further economic growth.

Explaining the sources of economic growth has ranked amongst the most significant issues that economists have examined. Romer's 1986 work began a set of theoretical and empirical analyses focusing on the endogeneity of the growth process as compared to Solow (1956) neoclassical growth models which use an aggregate production function approach and exogenous technical

changes. Numerous papers since then have attempted to disentangle those elements of a national economy which create growth. Many of these papers have examined empirically whether economic growth is converging relative to the USA and what the forces are that may lead to convergence [Barro and Sala-i-Martin (1992);Mankiw, Romer and Weil (1992); De Long and Summers (1991, 1993). Grossman and Helpman (1994) survey the literature on the determinants of economic growth and divide these works into three types: one set considers the accumulation of 'broad' capital, including human capital and different types of physical capital. A second set of papers utilize spillovers or external economies, and finally a third set "cast industrial innovation as the engine of growth.

1.2 Kenya's economic growth pattern

Kenyan economy has had mixed experiences in terms of the growth rate in real Gross Domestic Product (GDP) since independence evidenced by the peaks and troughs. Growth in real GDP averaged 6.5 percent over the period 1964-67. This was considered an exceptional case among developing countries at the time. This growth momentum was dampened by the first oil crisis of 1972, and as a result, GDP growth rate decelerated to below 4 percent for much of the early 1970s until the 'unexpected coffee boom' of 1976 and 1977 when GDP growth rate averaged 8.2 percent. (GOK, 19 94). However, this boom was short-lived because of the second oil crisis of 1979 that pushed up inflation rate.

During most of the early 1980s, GDP growth rate remained below 5 percent and fell to below 1 percent in 1984. This was largely attributed to severe drought of

that year. Agriculture was the most affected; its contribution to GDP fell to -3.9 percent. However, there was a rebound of the economy in 1985-86; when growth rates of 4.8 percent and 5.5 percent respectively were realized. This was attributed to favorable weather conditions, government budgetary discipline and improved management principles (GOK, 1994).

GDP growth rate continued to slide in the 1990s falling to a mere 0.2 percent in 1993. Dismal performance of the economy during this period was attributed to decline in real output and value added in agriculture, due to below average amount of rainfall; sluggish growth in aggregate private domestic demand and foreign exchange shortages leading to reduced imports of intermediate goods as well as suspension of donor aid (GOK, 1994).

The economy registered its worst performance since independence in the year 2000 when the GDP growth rate was -0.2 percent. This dismal performance of the economy was largely attributed to the decline in agriculture and manufacturing which contributed to about a third of the GDP; both recorded growth rates of -2.4. After the economy registered a disappointing performance in the 1990's and early 2000, it resumed growth momentum again and there was a consistent increase in GDP growth rate from year 2002. The economy grew at a rate of 7.0 percent in 2007 compared to -0.2 percent in the year 2000. This could probably indicate that the Economic Recovery Strategy (ERS) adopted by the government in 2003 to guide the economy towards recovery was bearing fruits. However, this

growth momentum was slowed by post election violence of 2008, and the economy grew at a rate of 1.7% percent in 2008.

The relationship between telecommunication infrastructure and economic growth has been a key area of discussion in economic literature. Arguments are that the development of a modern nation to its full potential in contemporary world can never be attained without adequate telecommunications infrastructure. This implies that growth of telecommunication infrastructure will significantly boost economic growth. As such, telecommunication infrastructure investments are a priority for many governments and international agencies.

However the Sub-Saharan Africa has some of the lowest levels of infrastructure investment in the world. Merely 29 percent of roads are paved, barely a quarter of the population has access to electricity, and there are fewer than three landlines available per 100 people. Yet access to and use of mobile telephony in sub-Saharan Africa has increased dramatically over the past decade. There are ten times as many mobile phones as landlines in sub-Saharan Africa and 60 percent of the population has mobile phone coverage. Mobile phone subscriptions increased by 49 percent annually between 2002 and 2007, as compared with 17 percent per year in Europe (ITU, 2008; World Bank, 2009).

Mobile telephony has brought new possibilities to the continent. Across urban-rural and Rich-poor divides, mobile phones connect individuals to individuals, information, markets, and services. In Mali, residents of Timbuktu are able to call relatives living in the capital city of Bamako or relatives in France. In Ghana, farmers in Tamale are able to send a text message to learn corn and tomato prices

in Accra, over 1,000 kilometers away. In Niger, day laborers are able to call acquaintances in Benin to find out about job opportunities without making the US$40 trip. In Malawi, those affected by HIV and AIDS can receive text messages daily, reminding them to take their medicines on schedule. Citizens in countries as diverse as Kenya, Nigeria and Mozambique are able to report violent confrontations via text message to a centralized server that is viewable, in real time, by the entire world.

These effects can be particularly dramatic in rural Africa, where in many places mobile phones have represented the first modern telecommunications infrastructure of any kind. Mobile phones have greatly reduced communication costs, thereby allowing individuals and firms to send and to obtain information quickly and cheaply on a variety of economic, social and political issues. An emerging body of research shows that the reduction in communication costs associated with mobile phones has tangible economic benefits, improving agricultural and labor market efficiency and producer and consumer welfare in specific circumstances and countries such as Ghana and Niger (Jensen, 2007; Aker, 2008; Aker, 2010; Klonner and Nolen, 2008).

As telecommunication markets mature, mobile phones in Africa are evolving from simple communication tools into service delivery platforms. This has shifted the development paradigm surrounding mobile phones from one that simply reduces communication and coordination costs to one that could transform lives through innovative applications and services. The rapid adoption of mobile phones has generated a great deal of speculation and optimism regarding its effect on economic growth in Africa. Policymakers, newspapers and

mobile phone companies have all touted the poverty-eradicating potential of mobile phones (Corbett, 2008).

1.3 Evolution of Telecommunication sector in Kenya

Kenya's earliest Telecommunications connections to the outside world were the submarine cables linking Zanzibar, Mombasa and Dar es Salaam laid by the Eastern and South African Telegraph Company in 1888.Extension into the interior of the country began in 1896 in conjunction with the building of the railway system forming a dual "backbone" for Kenya's communication infrastructure. In 1908 the first public telephone network began service in Nairobi and Mombasa. In Nairobi that year, eighteen telephone subscribers were connected.

The historical evolution of the institutional structure of Kenya's telecommunications has been shaped by political developments in East African as a whole. During the 1920s and 1930s, the three East African countries were closely linked under the British colonial administration. By 1933, the postal and telegraph services had been fully amalgamated with a single post master general responsible for all three postal and telecommunications services continued through independence and other political changes until 1977.With the collapse of the EAC in 1977, the East African Posts and Telecommunications Corporation (EAP&TC) was disbanded and a separate Kenya Posts and Telecommunication Corporation was established (KPTC).KPTC was a wholly government owned enterprise intended to be run on a commercial basis.

Kenya's international telecommunications services in the colonial era were run by the cable and wireless company like in other British colonies. In 1964, control was passed to the External Telecommunications (EXTECOMS) jointly owned by the government of Kenya and cable wireless.EXTECOMS continued as a joint venture until 1974 and KPTC purchased the 40% share owned by cable and wireless and renamed the company Kenya External Telecommunications (KENEXTEL).In 1982 KENEXTEL was merged with KPTC, which became responsible for both national and international telecommunications.

Kenya's inland network in 1990 was very small with 184,583 working exchange lines in use. The network more than doubled between 1983 and 1993 due to installation of digital switches and establishment of digital microwave transmission "backbone" between Nairobi, Mombasa and North East Kenya. However, the long distance network remained congested and only 48.1% of long distance calls attempts were being completed successfully. The main challenge facing the sector was that the rate of traffic growth could not be matched with adequate expansion of capacity (Tyler and Jonscher, 1983).

By the end of 1982, five years after the break-up of the EAC, Kenya had 88,100 lines or a penetration rate of 0.51% which was inadequate to satisfy potential consumers' needs. At the time, international trends placed pressure on governments to expand telecommunications access. By 1993, there were only 426,000 telephone sets connected to the public network in Kenya, yielding a density of about 1.58 telephones per one hundred inhabitants indicating that network penetration was very low compared to 40 lines per hundred inhabitants which was considered as universal service (ITU, 1991)

In 1982, Kenya hosted the first International Telecommunications Union (ITU) plenipotentiary conference in Sub-Saharan Africa that recognized the critical inadequacy of telecommunications in Africa .The conference established a commission to study identify and recommend ways of stimulating the expansion of telecommunications across the world. Tanzania hosted a global conference on telecommunications: The first world telecommunications development conference (WTDC) to evaluate and make recommendations on the way forward based on the commission's report. The countries involved made a declaration to ensure that there was a telephone within easy reach by the early part of the 21st century (ITU, 1991)

In its drive to modernize,KPTC focused too much on additional hardware, thus overextending its investment resources and did not sufficiently develop the softer elements of customer service,marketing,preventive maintenance, repair and staff training which would have enhanced revenue growth and reduced costs. This resulted in inadequate services to the users of telecommunications. Some important cases to note was the severe network congestion that characterized Nairobi's industrial area and the Jomo Kenyatta international airport area in the 1980s and early 1990s.the significance of these problems featured prominently in the 1990s controversy over the proposal to relocate the world headquarters of the United Nations environmental program (UNEP) from Nairobi to Geneva. With inadequate telecommunications infrastructure the government embarked on a policy reform predicated on a new framework for the supply of telecommunications services. This called for a shift from government institution as the only supplier of telecommunications services to the private sector operators based on competitive market forces. The reform process brought with it new technologies and services while the fast changing

market and policy reform has expanded the volume and access to services in the country. The key components of the strategy were to commercialize the provision of telecommunications service and provide for a multi-operator environment, replace the public sector as the engine of development with growth anchored on competition. This strategy was appealing to many developing countries and several governments stated the reforms in 1980s.

Compared with other countries even within the East Africa region itself, Kenya was the last to adopt reforms in the sector. But despite this, it has witnessed the fastest and the highest growth of the sector within the region. The main policy objective of sector liberalization in Kenya is to optimize contribution to development of the Kenyan economy as a whole by ensuring the availability of efficient and affordable communications services throughout the country. The policy launched in 1997 and the regulatory framework was established in 1999 compared to Tanzania's 1993 and 1994 and Uganda's 1996 and 1997(Muriuki, 2002)

Under the Kenya communications Act of 1998 which became effective in July 1 1999 the government dissolved the Kenya Posts and Telecommunications corporation(KPTC).This was succeeded by three separate entities namely Telecom Kenya(Telecommunications)the communications commission of Kenya(the regulatory body) and the Postal Corporation of Kenya (Postal services).

Liberalization of the telecom sector in Kenya began 10 years ago to attract private sector capital and increase efficiency by allowing competition in certain crucial areas.Telcom Kenya was granted a five year monopoly (1999-2004) in segments

of the market. However, this exclusivity ended in June 2004 and the institution was expected to commence the privatization programme.local internet service providers (ISPS) are linked to the rest of the world through Telkom. Two mobile phone operators, Safaricom and Ken cell communications have over two million subscribers between them. Their coverage has improved substantially and their networks now cover most of the regions in Kenya.

The companies were issued with regional telecommunication operator licenses in June 2002 to compete with Telkom Kenya in provision of fixed line services in other regions excluding Nairobi at the end of the five-year exclusivity period. The rollout of mobile phone networks covering most of the country makes the viability of regional operators questionable. Since the introduction of private operators' in1999 the mobile cellular services have advanced beyond imaginations in terms of coverage, services, technology, handsets and regulation. The number of mobile subscribers has also outpaced the number of fixed line subscribers. The internet has also grown at an astounding pace. The explosive growth of internet is driving demand for access at higher speeds.

With liberalization the focus of the growth of the telecommunications sector was based around basic access to the internet initially through dial-up services. Today satellite communications linking small earth stations (VSAT), optical fibre links capable of servicing the largest users and digital radio technologies are growing at an astounding pace.

The government continues to liberalize the telecommunications sector the challenges facing telecommunications sector in Kenya are exceptionally demanding. Despite the productive, technological management and other

inefficiencies that are well entrenched in the telecommunications industry, the government of Kenya has been hesitant to open public infrastructure to competition. This is because as in many developing countries, the state-owned companies that control infrastructure are considered strategic enterprises. For this reason the reform and partial privatization of telecommunications, power and rail has fallen behind schedule and many have opted to retain state monopolies. Also there are many other countries who are wary about liberalizing their telecommunications sector believing that liberalized market are untested in telecommunications. Policy makers also worry that such reforms could lead to higher consumer prices and those competitive markets could under-serve rural areas.

1.4 Mobile and fixed subscription growth in Kenya

1.4.0 Mobile Growth

Since the Commission issued the two mobile licenses in 2000, the mobile telecommunication has continued to lead the voice telephony market by having more subscriptions as compared to fixed network in the country. Over the last seven years the sub sector has registered over 60% annual growth with over 19.9 million subscribers at the end of March 2010 representing a penetration of 51.0 %. From the last seven years mobile penetration has registered an exponential growth from 4.95 in 2003 to 51.0 in 2010. The increase in mobile penetration can be attributed to a number of factors. First, the reduction in the value of calling cards from the lowest of Kshs 250 in 2003 to Kshs 10 by March 2010 has made calling cards affordable to low income earners thus stimulating this positive trend. Secondly, the average costs of making calls has declined from Kshs 20.18 to Kshs 1.00 to the same network and from Kshs 32.38 to Kshs 3.00 when calling

another mobile network between 2004 and 2010. This has led to increased uptake of mobile phones as costs of calls become affordable thus increasing subscription rates and penetration. International call charges, on the other hand, have not changed much over the period. Third, even as the mobile operators adjust their tariffs, the mobile coverage has also increased with services now available to a higher population.

1.4.1 Mobile phones coverage in Kenya

The coverage and trends in the mobile phones service in Kenya can be analyzed in three distinct periods covering 1992 to 2010. The first period covers 1992-99 within which the service was introduced into the country with the accessibility dominated by the wealthiest. The second period, which covers 2000-02, saw the entry of a second network provider in 2000, bringing in competition in the industry. This development resulted in increased accessibility of the services mainly by the middle income groups within the country. The low income groups were still excluded as the relatively high charges on the services and prices of handsets remained beyond their capability.

The third period covers 2003-010. The period is characterized by intensive competition and lowering of Prices of the services and equipment. This saw the subscription level rise steadily to reach 19.9 million by 2010 (UNCTAD 2010). At the beginning of this period, entrepreneurial use of the mobile phones downstream services emerged starting with payphones and phone repair in 2003, the former spreading fast in both rural and urban areas (GoK 2008a).

Data from ITU indicates that the Kenya's subscription rate is about 30.48 subscribers per 100 people. This compares with the Sub-Saharan Africa Coverage of 18.28 subscribers per 100 people and the whole of Africa at 27.48. While the subscription level remains low, data from CCK (2008) indicates that the national coverage stands at 75% of the total population. This is attributed to shared use of mobile phones mainly through payphones. The geographic coverage however stands at 27% implying that many parts of the country are still not covered

1.4.2 Mobile Revenue and Investment

The total amount of revenue by mobile communication services has been directly proportional to the number of subscribers in this sector. The Average Revenue per User (ARPU) has however dropped by an average of close to 23% annually for the last four years. This could be attributed to an increase in subscription among low income earners with low usage of the services. It is envisaged that the upward trend in total revenue and investment levels will continue as the operators expand their networks to cater for increasing demand for mobile services. This can be seen from the subscriber growth recorded as at the end of 2010 (CCK 2010)

1.5   Statement of the problem

The 'Kenya Vision 2030' covering period 2008-2030, aims to transform Kenya into a newly industrializing, middle-income country providing a high quality life to all its citizens by the year 2030 (GOK, 2007). The vision is based on three pillars, economic, social and political. The economic pillar aims at achieving an average GDP growth rate of 10 percent per annum beginning 2012.

Economic growth rate is a primary aim of developing countries all over the world. One key theme in the development literature is the role of telecommunication infrastructure in the process of economic growth ((Roller and Waverman, 2000 &2001, Kata et al 2008, Enowbi 2008). In Kenya the subscription has increased from 17,000 in 2000 to 20.1 million mobile subscribers as at end of March 2010, representing a 1.2 per cent growth. (CCK, 2010) while the mobile penetration has registered a high growth from 4.95 in 2003 to 33.65 in 2007 and 49.7 in 2009. However, previous studies on the impact of telecommunication infrastructure on economic growth focuses on developed countries such as France, and Germany.

Furthermore studies where Kenya was included used a cross-country panel analysis; where it was assumed that countries grouped in the study had similar social economic settings and characteristics. Since countries have different social - economic and political set-ups the grouped study assumptions also raises some questions. The comparison between developed and developing countries in the literature also is worth investigating. Telecommunications infrastructure may have various effects for economies at different stages of economic growth as a result, the recommendations drawn from studies in developed countries may

have little relevancy to developing countries. In Kenya there is lack of information on the relationship between telecommunication infrastructure and economic growth, therefore this study seeks to establish the effects of telecommunication infrastructure on economic growth as well as determining the direction of causality between telecommunication infrastructure and economic growth.

1.6. Objectives of the study

The overall objective of this study is to investigate the relationship between the penetration of telecommunication services and economic growth rate in Kenya: The specific objectives are:

1. To establish the effects of telecommunication infrastructure on economic growth.

2. To establish the direction of causality between telecommunication infrastructure and economic growth.

3. On the basis of the study findings, draw conclusions and make recommendations on how to enhance telecommunications infrastructure in Kenya

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter first examines the theoretical relationship between telecommunication infrastructure and economic growth. It then reviews the empirical literature on the relationship between telecommunications and economic growth.

2.2 Theoretical literature review

Governments and public agencies in most countries spend large sums of money on infrastructure for instance Kenya already spends a sizable amount ($1.6 billion per year) to meet its infrastructure needs of which about 65 percent of the total is allocated to capital expenditure and 35 percent to operating expenditures. The purpose of infrastructure expansion is to positively influence economic activity in terms of value added, productivity, employment, capital formation and income. Telecommunications are basic infrastructure industry, providing services that are regarded as necessities by consumers and virtually all businesses. In recent years many countries have implemented reforms in their telecommunications sector. The primary goal of the reforms in developing countries has been to increase availability of telecommunications services across a greater percentage of the population (Li and Xu., 2002).

Theoretically it is assumed in economic literature that most infrastructure investments can positively affect the economy in three ways. First, it can reduce

the cost of production. Second, it can increase revenues. Third, it can increase employment through both direct and indirect effects (Alleman *et al.*, 2002). Similar to other infrastructure investments, investing in telecommunication will increase the demand for goods and services used in production and increase total national output as well as facilitating trade through easier and cheaper communications. The reason is that much of the benefits of increased telephone services are derived from increases in information and knowledge. Increases in information and knowledge result in more efficient cooperation and coordination.

The greater reliance on private capital has been necessitated by the need for greater flexibility in order to adapt to rapid technological advances such as the internet and voice over Internet protocol telephony. Given the sector's economic and technological importance policy reforms affecting the sector have often been controversial. This is the reason that countries use reforms in the sector as a signal to the international community of their seriousness about instituting pro-market reforms (wallsten, 2001)

Many developing countries are pursuing universal service policies basing their telecommunication development strategies on the policies followed by developed nations. In developed nations with mature telecommunications infrastructure, universal service usually implies nationwide availability non-discriminatory access and widespread affordability of telecommunication services. Adopting similar goals in developing countries may pose potential problems because the goal of affordability may conflict with the goal of raising sufficient revenues to support investment in network expansion (Wallsten., 2001)

Hardy (1980) suggested that Telecommunication infrastructure is a little different from other infrastructure, as a determinant of economic growth because of the existence of network externalities, a phenomenon that increases the value of a service with increase in the number of users. Because of this, the impact of telecom infrastructure on economic growth is more pronounced as compared to other traditional infrastructure. This phenomenon has been demonstrated by (Kim *et. al.*, 1997) in the analysis of online service competition. Norton (1992) showed that convergence could occur if developing countries could add to their stock of telephones rapidly, since they reduce transaction costs.

Garbade and Silber (1978), find strong statistical support for the hypothesis that the two innovations in communication technology – the telegraph and Trans-Atlantic cable led to efficient market places worldwide through significant and rapid narrowing on inter-market price differentials. The research by Bayes *et. al.* (1999) finds that half of all telephone calls involved economic purposes such as discussing employment opportunities, prices of the commodities, land transactions, remittances and other business items. They also noted that, the average prices of agricultural commodities were higher in villages with phones than in villages without phones. Leff (1984) argues that firms can also have more physically dispersed activity with increased telecom services (for instance, encourage telecommuting of their employees) and enjoy economy of scale and scope.

Strong connection between investment and productivity growth in developing countries, has been established which imply that developing economies have to import and install machinery and equipment, in order to grow based on several

regressions and instrumental variable methods, Using the Peterson Index, (De Long and Summers,1993)

2.3 Empirical literature review

Empirical estimations have tended to focus attention on the direction of causality between telecommunications and economic growth using Granger causality tests. Cronin et al (1991, 1993b) and Wolde-Rufael (2007) confirmed a causal relationship in the U.S. between telecommunications infrastructure investment and economic growth. In a similar study, however, (Beil et al., 2005) conducted Granger-Sims causality tests for a time series of 50 years in the U.S., and suggested a one-way causality from economic growth to telecommunications investment. Dutta (2001) applied Granger causality tests for a cross section of 30 developing and industrialized countries in three different years, and found a bi-directional causality for both developing and industrialized countries. (Perkins et al., 2005) also identified a bi-directional causality in South Africa using a PSS F-test (Pesaran et al., 2001).

This reverse causality has also been further investigated by Cronin *et.al* (1993a) employ the Granger- Sims and modified Sims tests to confirm the existence of feedback process in which economic activity and growth stimulates demands for telecommunication services. As the economy grows, more telecommunications facilities are needed to conduct the increased business transactions. Cronin *et. al.* (1993a) investigate this relationship at the state and sub-state levels. This study confirms at both the state and county levels, using data from the state of Pennsylvania, U.S., and finds that telecommunication investment affects

economic activity and that economic activity can affect telecommunications investment.

On the other hand, a few studies have attempted to quantify the impact of Telecommunications on economic growth by incorporating telecommunications infrastructure investment explicitly into a macro (aggregate) production function or a cross-country growth framework. Madden and Savage (2000) extended Mankiw et al. (1992) to develop a supply-side growth model where teledensity (the number of main telephone lines per 100 persons) and the share of telecommunications investment in national income were controlled for as telecommunications capital proxies.

In another study, Roller and Waverman (2001) endogenized telecommunications infrastructure into aggregate economic activity. They first specified a micro model of the demand for and supply of telecommunications infrastructure, and jointly estimated the micro model with the macro production function. They found a significant causal relationship between telecommunications infrastructure and aggregate output. Similarly, Datta and Agarwal (2004) extended the cross-country growth framework of Barro (1991) and Levine and Renelt (1992) to examine the effects of telecommunications infrastructure on economic growth. In a dynamic panel model built upon Islam (1995), they found a bi-directional causality in their results between telecommunications infrastructure and economic growth.

Kala et al (2008) investigated the relationship between telecommunications and economic growth using data for developing countries. , they estimated a system of equations between economic growth and telecom penetration (respectively

production function and demand for telecom services), along with supply of telecom investment and growth in telecom penetration. They estimated this system of equations separately for main telephone lines and cell phones. The results show that while traditional economic factors explain demand for main line phones, they do not explain demand for cell phones. They also find significant impacts of cellular services on national output. Similarly, Enowbi (2008) empirically examined the role of telecommunication infrastructures on long-run economic growth in 40 African countries, for the span of time from 1984 to 2005. Using a panel data approach model, the findings indicate a significant and positive correlation between telecommunication infrastructures and regional growth in Africa, after controlling for a number of other factors. Results also show that investment in telecommunications is subject to increasing returns.

Other studies are those of Saunders, Warford and Wellenius (1994) and the World Bank report (1994) which examine the role of telecommunications in economic growth, and find some positive and significantly robust effects, noticing that the investment in telecommunication infrastructure enhances economic activity and growth, part of the consequence of this growth results are spent on telecommunication services which will stimulate further telecommunication investment.. Consequently, there are many recent empirical studies evidencing the positive relationship between telecommunication infrastructure and aggregate output. Some of these studies applied different estimation methods. Easterly, (2001), reports that a measure of telephone density contributes significantly to explain the growth performance of developing countries over the last two decades. Furthermore, Loayza, Fajnzylber, and Calderon, (2003), find that the same telecommunication indicators are

vehemently related to growth in a large panel data set including both industrial and developing countries.

Apart from these studies there have been empirical studies looking at the returns to public infrastructure investment, as indicated by Roller and Waverman (2000), which evidence how telecommunication infrastructure is characterized by network externalities and that the positive growth effects of investment in this sector become a critical mass in a given country's communication infrastructure. They achieved these results using the sample of 21 OECD countries over a 20-year period to estimate a micro-model for telecommunication using a macro production function. Another part of the study looked for the direction of causality, which exists between these variables, accepting Jipp's curve as a stylized fact, taking into consideration whether its economic growth, which causes the growth of the telecommunication sector or vice versa. For example, Lee (1994) analyses the relationship of South Korean main lines growth, number of telephone sets, gross capita investment expenditure, and gross investment for 1963 to 1988 and finds a positive effect. The inferred process is that increased telecommunication infrastructures stimulate economic growth by providing the necessary infrastructure for business.

Madden and Savage (1998) empirically examined the relationship between telecommunication infrastructure investment, gross fixed investment and economic growth for a sample of transitional countries of Central and Eastern Africa. The results of their estimation show a strong association between the two variables, but they did not establish a causal relationship.

Cronin, Colleran, Herbert and Lewitysky (1993) conducted some comparable work for the U.S market using input-output economics covering the period 1963-1991.Their empirical findings suggest that telecommunications investment is casually related to the nation's total factor productivity and that telecommunications contribution to aggregate and sectoral productivity growth rates are both quantifiable and substantial. Their study however contains no real methodological observation, so a detailed comparison with the approach employed in this paper cannot be made. It is possible to say, nonetheless that their study covers a substantial time-span which no doubt contained large dynamic effects. This appear however not to be included in the analysis and so their study should be viewed with caution.

Jensen (2007) and Aker (2008, 2010) both exploit the introduction of mobile phone coverage to estimate the impact of mobile phones on agricultural markets in developing countries. Examining the effect of mobile phones on the fisheries sector in Kerala, India, Jensen finds that the expansion of mobile phone coverage leads to a significant reduction in the dispersion of fish prices across markets, as well as a decline in waste. He shows that this leads to important welfare improvements for both fishermen and consumers; fishermen's profits increased by 8 percent, consumer prices declined by 4 percent and consumer surplus increased by 6 percent. With improved access to information via mobile phones, fishermen are better able to take advantage of spatial arbitrage opportunities, thereby improving efficiency.

Examining the impact of mobile phones on grain markets in Niger, Aker (2010) finds that the introduction of mobile phones reduces dispersion of grain prices

across markets by 10 percent. The effect is stronger for those market pairs with higher transport costs, namely, those that are far apart and linked by poor quality roads. The effect is also stronger over time, suggesting that there are networks effects similar to those found by Brown and Goolsbee (2002). While the effect is smaller in magnitude as compared to Jensen (2007), it is perhaps more surprising, because grains are a storable commodity. The primary mechanism through which mobile phones improve market efficiency is a change in traders' (middlemen) marketing behavior: grain traders operating in mobile phone markets search over a greater number of markets, sell in more markets and have more market contacts as compared with their non-mobile phone counterparts (Aker, 2008).

Aker (2008) also finds that the introduction of mobile phones is associated with increased trader and consumer welfare. The introduction of mobile phones led to a reduction in the intra-annual coefficient of variation, thereby subjecting consumers to less intra-annual price risk. Mobile phones also increased traders' welfare, primarily by increasing their sales prices, as they were able to take advantage of spatial arbitrage opportunities. The net effect of these changes was an increase in average daily profits, equivalent to a 29 percent increase per year. However, the impacts of mobile phones upon farmers' welfare were not measured. In other studies Muto and Yamano (2009) estimated the impact of mobile phones on agricultural markets in Uganda, focusing on farmers' market participation rather than market efficiency. Using a panel dataset on farm households between 2003 and 2005, they find that mobile phone coverage is associated with a 10 percent increase in farmers' probability of market participation for bananas, although not maize, thereby suggesting that mobile phones are more useful for perishable crops.

Using econometric modeling and input-output analysis, Lisa Correa (2003) investigates the relationship between telecommunications infrastructure competition, investment and productivity, the analysis examines and measures the extent to which telecommunications has contributed to national and sectoral productivity performance. The findings suggest that most industries benefited from the incorporation of advances of telecommunications technology, the analysis further demonstrated that telecommunications investment may have wide-reaching consequences for not only the telecommunications industry but also the economy as a whole.

2.4 Overview of the literature

The review of empirical literature shows that there is no consensus regarding the relationship between telecommunications and GDP growth. At the centre of this debate is the question of the causality direction between telecommunications and growth. Previous empirical studies have produced mixed and conflicting results on the nature and direction of the causal relationship between telecommunications and growth. Most of the studies on the causal link between telecommunications and economic growth have been carried among the developed countries than in developing countries.

However a close look at the literature shows empirical evidence that investment in telecommunications enhances the efficiency of economic activity which improves productivity and at the same time economic growth stimulates the demand for telecommunication, as argued by Lisa (2003) who holds that when a

nation's telecommunication sector grows faster than the overall rate of economic growth, it promotes the nation's productivity in a way in which the telecommunication sector is a leading sector. Countries as those of East Asia could be taken as an example of a nation in which the fastest growing telecommunications sector leads the economy by speeding up the diffusion of information and creating the formation of skilled labor which in turn affects the productivity and the growth of the nation.

However, while previous studies attested to the fact that telecommunications infrastructure investment is positively correlated with economic growth, far fewer studies have investigated how mobile telecommunications specifically have played a role in economic growth, especially in Kenya where there is an exponential mobile telecommunications growth relative to the level of land-line telephony.

Therefore, this paper departs from the existing studies in the literature in the following ways. First, we focus on Kenya where mobile telecommunications have expanded quickly, while the number of land-lines has remained low - and establish telecommunications and economic growth relationship in Kenya.

3.1. Introduction

This chapter presents the theoretical framework meant to capture the relationships between the dependent and the independent variables. Also included is the empirical model to be estimated and data sources.

3.2. Theoretical Framework

Two directions have dominated the theory of long-run economic growth. The traditional neoclassical growth model was developed by Solow and Swan in the 50s (Agénor et al., 1999). They specified a model based on a constant return to scale production function. There are two inputs, capital and labour, the latter with diminishing marginal return. The rates of savings and population growth are taken as exogenous, and these variables are postulated to explain the steady-state level of income per capita. Technology is also assumed to progress at an exogenous rate. The standard Solow Cobb-Douglas production function is given by:

$$Y = AK^a L^{1-a} \dots\dots\dots\dots 1$$

Where Y is output, K is the stock of capital, L is labour, and A gives the starting position of a society's technology level. An implication of the model is the concept of convergence, stating that poor countries tend to grow faster than rich

ones, and in the long run eventually catch up with them. Due to the diminishing marginal return to capital, countries with low levels of capital stock will have higher marginal product of capital, and thereby grow faster than those with already high levels of per capita capital stock, given similar saving rates.

However, empirical research has given little support to the theory of convergence. It can only be found within the OECD area. Mankiw, Romer and Weil (1992) have introduced an extended Solow model, the augmented Solow model. They aim to explain why convergence has failed to appear, and introduce the notion of 'conditional convergence'. They argue that Solow did not predict that all countries would reach the same level of per Capita income, but rather their respective steady state. Convergence is indeed found, as long as differences in the steady state across countries have been controlled for.

Still, the neoclassical theories have been attacked for failing to appreciate technological progress as an important input for economic growth. They do point out that it is important, but treat technological progress as exogenous. As a result, a new direction in growth theory has emerged. This new direction has been called the endogenous growth theories, and dismisses the concept of convergence entirely. Endogenous growth theories are based on either constant or increasing returns to scale in capital, postulating a growth in the gap between rich and poor countries. The model is based on the standard Cobb-Douglas production function given above, but the focus is directed to the technological progress, given by the A.

Bernard and Jones (1996) emphasize a model of indigenized technological change, where each country's composition of products and industry, and its

ability to adapt the leading technology, determine its long run growth. Similar population growth and investment rates across countries have no impact on the relative position between them. Similar steady state outcomes are the exceptions rather than the rule. It is technology that determines the countries' rate of convergence, or lack of convergence, to their own steady state. By studying 14 OECD countries Bernard and Jones discovered that there is a substantial variation in technology across countries, and that this variation in magnitude corresponds roughly with the variation in labour productivity. They also find that the dispersion of labour productivity over time corresponds closely to the change in dispersion of technology.

According to Bernard and Jones (1996) the highest convergence rates are found in the service sector, when it comes to both labour productivity and multifactor productivity. Labour productivity is said to be an important input for economic growth, indicating that telecommunications, as part of the service sector, might lead to economic growth.

Romer (1986) has been another important contributor to the endogenous growth theory. He has specified an equilibrium model of endogenous technological change. Crucial in the model is the departure from the assumption of diminishing returns to capital. Romer argues that the rate of investment and the rate of return on capital may increase rather than decrease with a rise in the capital stock. The reason is externalities, an important notion within the endogenous growth theories. Increased investment and capital stock lead to productivity gains that offset any tendency towards diminishing returns. If an increase in the investments rate generates strong externalities, the output elasticity, a, in the Solow model grows to be one, and we are left with the model

$Y = AK$ (Pack, 1994). A competitive equilibrium with externalities is present in the model. The equilibrium is not Pareto optimal, but according to Romer is capable of explaining historical growth in the absence of government intervention.

The model applied in this study is an endogenous growth model. As a result, an increasing return to capital is assumed, and we expect to find divergence between the growth rates of the respective countries. This implies that countries with low initial capital, in this case the stock of telecommunications, will grow at a slower rate than countries with a high stock of telecommunications.

3.3. Empirical Model

Most of the studies evaluating the relationship of telecommunications infrastructure or investment to economic activity for example Madden and Savage (1998) and Röller and Waverman (2002) have employed panel data consisting of many countries; but neither study considers the unique relationship within Kenya where telecommunications investment is majorly done by the private sector.. Average effects measured using many diverse economies may not hold for any particular economy in the sample. A Kenyan specific analysis focused on telecommunications investment made by telecommunications firms can provide more insight for domestic policy purposes.

This study will follow closely the methodology adopted by Ayanwale (2007) who had adopted it from Borensztein et al (1998). The model that will be estimated is as follows:

$$\ln GDP_t = \beta_0 + \beta_1 \ln K_t + \beta_2 \ln HC_t + \beta_3 \ln Tel \exp_t + \varepsilon_t \qquad \qquad 3$$

Where:

Ln= natural logarithm;

GDP_t=Growth rate of GDP at time t;

$Telexp_t$=Telecommunication expenditure at period t;

HC_t=Human capital in period t;

K_t= Gross capital formation;

β_0-β_3 are coefficients to be estimated.

3.4. Description of Variables

The dependent variable in this study is the economic growth rate (%) and the independent variables include the following:

Gross capital formation: - was obtained from the economic surveys for Kenya and in Kshs.

Telecommunication infrastructure: - is measured by the level of investment in telecommunication in Kshs.

Domestic environment such as the quality of human capital influences the effectiveness of telecommunication. In this study, importance of human capital will be captured by the ratio of secondary and tertiary education enrolment in

the population. Human capital development contributed significantly in the economic development of the newly-industrialising countries (NICs).

3.5. Data Sources

The study used Secondary data in the analysis. Data on investment in telecommunication was obtained from government printed estimates, while Data on GDP and secondary and tertiary education enrolment in the population was obtained from Kenya National Bureau of Statistics (KNBS) statistical abstracts. The study covered 1980-2010 periods.

3.6. Investigating Time-Series Properties

To eliminate the possibility of spurious regressions and erroneous inferences, the first stage of the testing procedure involved determining the order of integration through unit root tests. To test the order of integration of the variables, Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were used. Unit roots were investigated using ADF test in this study. The aim was to determine whether the variables follow a no-stationary trend and are of the order one $1(1)$ or whether the series are stationary, that is, of the order 0 denoted as $1(0)$.

After determining the order of integration, the next step was to find out whether the variables were cointegrated. Cointegration test requires that variables involved be integrated of order one. All the variables should be stationary in first differences but not in levels. Dickey and Fuller (1979, 1981) provide one method of determining the order of integration for individual series. Two variables, x

and y are said to be cointegrated of order one if both are integrated of order one and there exists a linear combination of the two variables that is stationary, $1(0)$. Cointegration can be used to establish whether there exists a linear-term economic relationship among the variables (Johansen, 1991). Cointegration also helps us in pointing out whether there exists disequilibrium in various markets (Pesaran and Shin, 1996). Furthermore, cointegration allows us to specify a process of dynamic adjustment among the cointegrated variables (Johansen, 1991). Testing for cointegration was done by the use of Johansen Maximum Likelihood procedure.

After determining whether the variables are cointegrated, causality test was done using the Granger (1969) causality approach; a variable y, in this case, economic growth is caused by x, telecommunications. Granger causality test was used to indicate the direction of causality; whether it is uni-directional or bi-directional.

CHAPTER FOUR

4.0 DATA ANALYSIS AND DISCUSSIONOF RESULTS

4.1 Introduction

In this chapter, descriptive statistics are provided; unit root test results,

cointegration test results and Granger causality test results.

4.2 Descriptive Statistics

Table 2 shows descriptive statistics of the variables included in the study, the

main objective is to determine whether the dataset is normally distributed.

Table 2: Descriptive Statistics

	GDP (%)	Telecommunication Expenditure (Kshs)	Human Capital (%)	Physical Capital (Kshs)
Mean	3.540	25485.670	744.771	2.758
Median	3.900	805.100	641.000	1.260
Maximum	7.000	101773.000	1701.500	27.800
Minimum	0.100	57.500	399.000	-20.800
Std. Dev.	1.937	34993.930	322.802	9.658
Skewness	-0.252	1.033	1.479	0.149
Kurtosis	1.921	2.617	4.610	3.717
Jarque-Bera	1.832	5.698	14.643	0.778
Probability	0.400	0.058	0.001	0.678
Sum	109.700	790055.800	23087.900	85.510
Sum Sq. Dev.	112.574	3.67E+10	3126024.000	2798.261
Observations	31	31	31	31

Source: Author's Computation from Economic Surveys (Various)

In normally distributed dataset, the mean, the median should be equal, and in this study, none of the variables possesses this characteristic meaning that the variables are not normally distributed.

4.3 Unit Root Tests

Many economic and financial time series exhibit trending behavior or non-stationarity in the mean. An important econometric task is determining the most appropriate form of the trend in the data. All the data must be transformed to stationary form if not stationary prior to analysis. If the data are trending, then some form of trend removal is required. Two common trend removal or de-trending procedures are first differencing and time-trend regression. First differencing is appropriate for I(1) time series and time-trend regression is appropriate for trend stationary I(0) time series. Unit root tests can be used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary. Moreover, economic and finance theory often suggests the existence of long-run equilibrium relationships among non-stationary time series variables. If these variables are I(1), then cointegration techniques can be used to model these long-run relations. Hence, pre-testing for unit roots is often a first step in the cointegration modeling.

Table 3: Unit Roots Test Results

Variable Name	Unit Roots at Levels		First Difference	
GDP	ADF Statistic	-3.547	ADF Statistic	-6.552
	Test Statistic		Test Statistic	
	1%	-3.670	1%	-3.679
	5%	-2.964	5%	-2.968
	10%	-2.621	10%	-2.623
Telecommunication Expenditure	ADF Statistic	-2.340	ADF Statistic	-4.108
	Test Statistic		Test Statistic	
	1%	-3.670	1%	-3.680
	5%	-2.964	5%	-2.968
	10%	-2.621	10%	-2.623
Human Capital	ADF Statistic	4.745	ADF Statistic	-1.271
	Test Statistic		Test Statistic	
	1%	-3.670	1%	-3.689
	5%	-2.964	5%	-2.972
	10%	-2.621	10%	-2.625
Physical Capital	ADF Statistic	-3.253	ADF Statistic	-5.789
	Test Statistic		Test Statistic	
	1%	-3.679	1%	-3.689
	5%	-2.968	5%	-2.972
	10%	-2.623	10%	-2.625

Source: Author's Computation

For all the series, the ADF statistic is greater than the critical values. We fail to reject the null hypothesis of a unit root in the GDP, telecommunication expenditure, human capital and physical capital. This means that these series have at least one unit root and differencing is required to make them stationary. Variables GDP, telecommunication expenditure and physical capital become stationary after differencing once meaning that they are integrated of order one (that is, I(1)), while on the other hand, human capital become stationary after differencing twice, meaning that it is integrated of order two, (that is, I(2)). After testing for the order of integration, the next step is to test for cointegration of the variables, that is, to test whether there exists a long-run relationship among the variables in question. This is implemented in the next step.

4.4 Cointegration Test

Table 4: Cointegration Test Results

Series: GDP TELEXP HC K

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.638495	64.84604	47.85613	0.0006
At most 1 *	0.509288	35.33911	29.79707	0.0104
At most 2	0.388925	14.69405	15.49471	0.0658
At most 3	0.014055	0.410499	3.841466	0.5217

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.638495	29.50693	27.58434	0.0280
At most 1	0.509288	20.64506	21.13162	0.0584
At most 2 *	0.388925	14.28355	14.26460	0.0496
At most 3	0.014055	0.410499	3.841466	0.5217

Max–eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's Computation

Has shown in table 4, there is one cointegrating equation using unrestricted cointegration rank test (maximum Eigenvalue). This cointegrating equation is presented below:

GDP= 0.0001 TELEXP + 0.009 HC + 0.238 K 4

From equation 4, there is a positive relationship between telecommunication expenditure, human capital and physical capital and economic growth. These results do not contradict theoretical expectations.

4.5 Granger Causality Test

This study's Granger test which employs 30 years of data (1980 to 2010) on GDP growth rate and real telecommunication expenditures, human and physical capital. Based on the ADF test, the series are non-stationary in their levels, but stationary in their first differences except human capital which becomes stationary after differencing twice. Due to these tests, we use first differences (indicated by D) for the causality test. It is well known that lag length can affect the results of causality tests. Standard practice calls for selecting a lag length that minimizes information criterion such as the Akaike information criteria. This task was accomplished by choosing a maximum lag length M and estimating regressions for all possible combinations of lag lengths ($M2$ regressions), then selecting the lag combination; a lag of two was found to be optimal. Granger causality test results are presented in Table 5.

Table 5: Granger Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Probability
TELEXP does not Granger Cause GDP	30	0.55516	0.46265
GDP does not Granger Cause TELEXP		0.00655	0.93610
HC does not Granger Cause GDP	30	0.18757	0.66839
GDP does not Granger Cause HC		4.50372	0.04314
K does not Granger Cause GDP	30	3.68956	0.06537
GDP does not Granger Cause K		0.06597	0.79924
HC does not Granger Cause TELEXP	30	0.26143	0.61330
TELEXP does not Granger Cause HC		5.01327	0.03359

K does not Granger Cause TELEXP	30	0.55810	0.46148
TELEXP does not Granger Cause K		1.08481	0.30686
K does not Granger Cause HC	30	0.98164	0.33059
HC does not Granger Cause K		0.95540	0.33703

Source: Author's Computation

From Table 5, there is no causality between telecommunication expenditure and real GDP growth. This could be probably because; telecommunication expenditures are not high enough to have significant influence on economic growth. Though there has been an impressive growth in the ICT sector, it is more of a result of the private sector investments and initiatives but not the government. However, there was causality between GDP growth and human capital as was expected because human capital is an important factor of production. This was confirmed by Mankiw et al 1992 seminal paper. As human capital grows and improves, there is therefore a causal link between telecommunication expenditure and human capital. In addition, Training in ICT in Kenya is very popular especially among the youths and there has been quite a lot of innovation especially software applications such as mobile banking among others.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS, POLICY IMPLICATIONS

5.1 Introduction

In this chapter, summary, conclusions and policy implications of the study are presented,

5.2 Summary and Conclusions

The main objective of the study was to investigate the relationship between the penetration of telecommunication services and economic growth rate in Kenya The estimation was carried out in the following four steps. Firstly, the study established the order of integration of the variables included in the model using ADF test. GDP, telecommunication expenditure and physical capital were found to be stationary after differencing ones implying that they are integrated of order one. On the other hand, human capital became stationary after differencing twice meaning that it is integrated of order two. Secondly, the study established the optimum lag structure using the Akaike information criteria. Thirdly, a cointegration test was conducted using Johansen maximum likelihood procedure just to find out whether the variables are bound together in the long run. Finally, Granger causality test was conducted.

Cointegration test confirmed one cointegration test. Granger causality test results failed to confirm the presence of causality between GDP growth and telecommunication expenditure. This is not entirely unexpected since most of the investments have been carried out by the private sector and not the government. It is likely that the investments made by the government in the

telecommunication sector are not high enough to cause major changes in terms of economic growth.

5.3 Policy Implications

Telecommunication expenditure is expected to exert a significant influence on economic growth by ensuring setting up of necessary investments to ensure that the ICT sector flourishes. However, in this study, telecommunication expenditure failed to support strong changes in GDP growth rate though there was a positive relationship between the variables. Unlike the other forms of infrastructure such as roads, railways, ports among others which are very expensive to put up, ICT related infrastructure is fairly cheap. There is a likelihood of Kenya becoming a hub of ICT related innovations as was exemplified by innovations such as Mpesa and setting up of Google African region headquarter in Nairobi. Since we are living in a very competitive environment, that advantage needs to be safeguarded through supporting infrastructure investments.

References

Ayanwale A.B, (2007). FDI and Economic Growth: Evidence from Nigeria, AERC Research Paper 165, African Economic Research Consortium, Nairobi.

Alleman, J.et.al.(2002). Telecommunications and economic development: Empirical Evidence from South Africa. Technical report. International TelecommunicationSociety,Sydney.
http://www.colorado.edu/engineering/alleman/print files/soafrica paper

Aker, Jenny C., Michael Klein, Stephen O'Connell and Muzhe Yang. (2010). "Border or Barriers? The Impact of Borders on Agricultural Markets in West Africa." *NBER Working Paper*.

Agénor, P.R and Montiel, P. J., 1999. *"Development Macroeconomics"*. 2nd ed. Princeton University Press. Princeton, USA.

Aker, J.C. (2009) Mobile phones and Economic development in Africa. Center for Global Development. Washington, D.C

Bernard, A.B. and Jones, C.I., 1996. Comparing Apples to Oranges: Productivity Convergence and Measurement across Industries and Countries. *The American Economic Review*, 86 (5):112-142

Borensztein, E., De Gregoria J. and Lee J., (1998). How does foreign investment affect economic growth? *Journal of International Economics*, 45 (1): 115–35.

Bayes, Abdul, J. V. Braun and R. Akhter. (1999). Village pay phone and poverty reduction: Insights from a *Grameen* Bank initiative in Bangladesh. Center for Development Research (AEF), *Universitat* Bonn, Germany, Discussion papers on development policy no. 8. *http://www.zef.de/publications.htm*.

Barro, R. (1991) "Economic Growth in a Cross Section of Countries," *Quarterly Journal of Economics*, 106, (2): 407-443.

Blundell, R. and S. Bond (1998) "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics*, 87, (1):115-143.

Beil, R., G. Ford, and J. Jackson (2005) "On the Relationship between Telecommunications Investment and Economic Growth in the United States," *International Economic Journal*, 19(1): 3-9.

Cronin, F.J, et al (1993). Telecommunications and Growth: The contribution of Telecommunications infrastructure investment to Aggregate and Sectoral Productivity; *Telecommunications Policy* 677-690

Canning D. (1999), "A Database of World Infrastructure Stocks, 1950-1995," *World Bank Economic Review*, 12(1): 529-548.

Cronin, F., E. Parker, E. Colleran, and M. Gold (1993b) "Telecommunications Infrastructure Investment and Economic Development," *Telecommunications Policy,* 17(6):415–430.

CCK (2008) Status of the Telecom Market: December 2008 Report, www.cck.go.ke

Cronin, F., E. Parker, E. Colleran, and M. Gold (1991) "Telecommunications Infrastructure and Economic Growth: An Analysis of Causality," *Telecommunications Policy,* 15(6): 529-535.

Cronin, F.J. et al (1993b). Telecommunication and growth, *Telecommunications Policy (December): 677-690.*

De Long, Bradford and Lawrence Summers, (1993). How strongly do Developing Economies Benefit from equipment Investment? *Journal of Monetary Economics,* 32(2): 395-415.

Easterly, William, (2001), "Fiscal Policy and Economic Growth: An Empirical Investigation," Centre for Economic Policy Research Working Paper No. 885, London, January.

Eggleston, K. R. Jensen, and R.Zeckhauser, (2002). Information and communication technologies, markets, and economic development. Department of Economics, Working Paper, Tufts University.

Garbade, K. D. and W. L. Silber, (1978). Technology, communication and the performance of financial markets: 1840-1975. *Journal of Financ.*33 (3): 819-831.

Hardy, A.(1980). The role of the telephone in economic development. *Telecommunications Policy.* 4(4): 278-286

Kim, D.H., Jae-Ho Juhn, Won-Gyu Ha, (1997). Dynamic Modeling of Competitive On-line Services in Korea. System Dynamics: *An International Journal of Policy Modeling.* 9 (2): 1-23

Souter, D. (1999). The Role of Information and Communication Technologies in Democratic Development. *Info: Journal of Policy, Regulation, and Strategy for Telecommunications* Information and Media, 1 (5): 405-417.

Norton, S.W. (1992). Transaction Costs, Telecommunications, and the Microeconomics of Macroeconomic Growth. *Economic Development and Cultural Change.* 41(1): 175-196.

Datta, A. and S. Agarwal (2004) "Telecommunications and Economic Growth: A Panel Data Approach," *Applied Economics.*36 (15): 1649-1654.

Dutta, A. (2001) "Telecommunications and Economic Activity: An Analysis of Granger Causality," *Journal of Management Information System.17 (4): 71-95.*

Islam, N. (1995) "Growth Empirics: A Panel Data Approach," *Quarterly Journal of Economics.11 (4): 1127-1170.*

Levine, R. and D. Renelt (1992) "A Sensitivity Analysis of Cross-Country Growth Regressions, "*American Economic Review*.82 (4): 942-963.

Madden, G. and S. Savage (2000) "Telecommunications and Economic Growth," *International Journal of Social Economics*.27 (7): 893-906.

Muto, Megumi and Takashi Yamano. (2009). "The Impact of Mobile Phone Coverage Expansion on Market Participation: Panel Data Evidence from Uganda" *World Development*.23 (1):402-432

Mankiw, N., D. Romer, and D. Weil (1992) "A Contribution to the Empirics of Economic Growth," *Quarterly Journal of Economics*.107 (2): 407-437.

Perkins, P., J. Fedderke, and J. Luiz (2005) "An Analysis of Economic Infrastructure Investment in South Africa," *South African Journal of Economics*. 73 (2):211-228.

Pack, H., 1994. Endogenous Growth Theory: Intellectual Appeal and Empirical Shortcomings. *Journal of Economic Perspectives*". 8 (1):113-125

Pesaran, M., Y. Shin, and R. Smith (2001) "Bounds testing Approaches to the Analysis of Level Relationships," *Journal of Applied Econometrics*, 16(3):289-326.

Röller, L. and L. Waverman (2000) "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach," *American Economic Review*, 98(6): 909-923.

) "Transaction Costs, Telecommunications, and the
Macroeconomic Growth," *Economic Development and Cultural*
6.

xternalities, information costs, and social benefit-cost analysis
lopment: an example from telecommunications, *Economic*
ltural Change, 32(2): 255–76.

9) Telecommunications and Economic Growth: An empirical
aran Africa, working paper No.64

8). Telecommunications infrastructure and economic growth:
eloping countries, working paper No.21

8) "The role of telecommunications infrastructure in the
ic growth of Africa", MPRA Paper No. 19133,
-muenchen.de/19133/

) "The economic impact of telecommunications Diffusion on
Growth", working paper No.492, University of London

ecommunication Union (ITU) (2007), Telecommunications
ort 2007

1969. Investigating Causal Relations by Econometric Models
al Methods, *Econometrica.* 37(2): 424-438.

Gray, V. (2006) *The Un-wired Continent: Africa's Mobile Success Story*, International Telecommunication Union, Geneva, Switzerland.

Wolde-Rufael, Y. (2007) "Another Look at the Relationship between Telecommunications Investment and Economic Activity in the United States," *International Economic Journal*, 21(2): 199-205.

World Bank. (1994), World Development Report 1994: Infrastructure for Development. New York: Oxford University Press, 1994

Wallsten, S (2001) the effects of state monopolies, private ownership and operating licenses on telecommunications in Europe". Stanford Institute for Economic Policy Research. Discussion paper no.0037

Hardy, A. (1980). The role of telephone in economic development, *Telecommunications Policy*, 4(4): 278–86.

Johansen, S., (1991). Estimation and Hypothesis Testing of Cointegrating Vectors in Gaussian Vector Autoregressive Models. *Econometrica*. 59(2): 1551-80.

Pesaran, M.H. and Shin. Y., (1996). Co-integration and Speed of Convergence to Equilibrium. *Journal of Econometrics*, 71(2): 117-43.

Solow, R. (1956). A Contribution to the theory of economic growth. *Quarterly Journal of Economics*, 70(1): 65-94.