MOBILE TELECOMMUNICATIONS TECHNOLOGY CHANGE AND THE CONTRIBUTIONS IN SUB-SAHARA AFRICA: A COMPARATIVE CASE STUDY OF KENYA AND GHANA

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List of Acronyms

GoK	Government of Kenya
MNO	Mobile Network Operator
FDI	Foreign Direct Investments
ISP	Internet Service Providers
WHO	African Health Observatory
GDP	Gross Domestic Product
AHO	Africa Health Observatory
CAK	Communications Authority of Kenya
IEG	Independent Evaluation Group
UNCTAD	United Nations Conference on Trade and Development
ISDN	Integrated Services Digital Network
CCK	Commission Communications of Kenya
CAK	Communications Authority of Kenya
NGO	Non-Government Organization
ICT	Information Communication Technology
MPC	Monopolies and Prices Commission
OECD	Organization for Economic Development and Co-operation
ICC	International Chamber of Commerce
CAoK	Competition Authority of Kenya
GSMA	Groupe Spéciale Mobile Association
GoG	Government of Ghana
ITU	International Telecommunications Union
USF	Universal Service Fund
FDI	Foreign Direct Investment
GIFEC	Ghana Investment Fund for Electronic Communication
GP&T	Ghana Post and Telecommunications
RTMPC	Restrictive Trade Policies, Monopolies and Price Control Act
NISL	Netcom Informations System Ltd
MICT	Ministry of Information, Technology and Communication
NCA	National Communication Authority (Ghana).
TFS	The Fletcher School
EPZ	Export Processing Zones Kenya

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Abstract

This research paper examines how institutional and technological change in mobile telecommunications has contributed to economic growth in Sub-Sahara Africa. This study draws attention to the liberalization and reregulation process and how telecommunications infrastructure has developed and contributed to the progress in the region. The study uses a comparative case study regarding Ghana and Kenya to investigate how these structural changes and reforms of policies and institutions influenced the performance of the industry in these respective countries. This paper uses two main variables to investigate telecommunications teledensity: mobile cellular subscriptions per 100 people and individuals using the internet in percent of population. The variation of these variables over time demonstrates how different policy concerns and implementation strategies contributed to the long-run success of the industry in the Ghana and Kenya. This study also investigates why Ghana performed better than Kenya in telecommunications. The study emphasizes the importance of institutions, technology change and strong competitive structures for a thriving sector. The findings of this study indicate that Ghana's performance is attributed to a fast liberalization process and implementation mechanism tied with different strategies and institutional frameworks that encompassed increasing rural cellular density compared to Kenya.

Relevance to Development Studies

Technology evolution in mobile telecommunications is important for economic growth. Telecommunications infrastructure has improved the access of telecommunication services in the rural areas. The expansion of the infrastructure improves access to information, reduces transaction costs between farmers and buyers and improves access to health information through mobile applications. Mobile telecommunications have revolutionized the access to educational materials in rural areas through mobile phone applications. Platforms such as e-learning are improving the access to information in the rural areas in Kenya. The development of mobile applications for modern mobile devices enabled financial inclusivity using mobile money services and improving access to information. "Policy makers, newspapers, and mobile phone companies have all touted the poverty-eradicating potential of mobile phones" (Aker and Mbiti 2010: 208). These developments are attributed evolution of the telecommunications industry which led to the increased access to mobile phones and internet use in Sub-Sahara Africa.

Studies in Kenya indicate that the penetration of Internet and mobile technology services improved access to health care services such as health information, telemedicine and eLearning under the umbrella 'mHealth' which "manages mobile technology projects in the health sector" (mHealth 2018). The industry contributes to the development of innovative services that provide alternative solutions. Technology change in telecommunications has contributed to improve the standards of living. Mobile penetration in the rural areas have increased inclusivity in services such as mobile financing which are now available without requiring a bank account. The ease of use and low costs of transmission through wireless technologies has increased literacy levels in the rural areas.

Key Words: Mobile Telecommunications, Telecommunications Infrastructure, Telecommunications Liberalization, Kenya, Ghana, Technology Change, De-Regulation.

Chapter 1. Introduction

1.1. Background

Since the early 1990's, the telecommunications industry has experienced significant changes. These changes evolved from fixed telephony with limited use such as voice calls to more modern mobile technologies expanding use and functionality such as text messaging, android services, and mobile apps such as mobile banking (Aker and Mbiti 2010: 220). During this period, state monopolies operated the industries which were also characterized by poor quality of products and services. Because of this, structural changes of reforms in the industry began in the developed countries (Starr 1990).

These changes triggered the reform process towards competitiveness, liberalization, infrastructure innovation and institutional reforms which lead to the establishment of independent regulators. During this time industry reforms began to take place in Europe whereby countries like The Netherlands and United Kingdom introduced structural changes in the telecommunications industry among them eliminating monopolies and competitiveness (Kloosterhuis and Bergeijk 2005: 67).

The process to these structural changes underwent years of challenges to reform and adopt the changes. The delay to de-regulate was severed for a long time because the reforms were viewed as a mechanism for control as a form of a 'capitalist order'. The structural changes were contested by 'radicals and Marxists' who argued that a "capitalist society required increased state intervention to control their internal contradictions" (Starr 1990). In Ghana, telecom reforms were developed after the state-owned monopoly GP&T was considered inefficient in terms of service delivery (Haggarty et al. 2003: 4).

The monopoly of industry establishes "Low labour productivity, deteriorating fixed facilities and equipment, poor service quality, chronic revenue shortage and inadequate investment" (Kessides 2004: 2). There are emerging concerns that network monopolies manipulate the processes and industry results to public resources waste. Therefore, the state-owned entities had to be 'reversed or undone' to encourage privatization and competition (Starr 1990).

From the elimination of monopolies to a decade of implementing structural changes of policies and institutions, the changes were continual into the 2000's (Kessides 2004: 2-7). Between 1990 and 2000 privatization and competition were realized by the entry of new firms. In Ghana, the entry of new competitors occurred during the ADP-2000 structural reforms of Ghana Post and Telecommunications (GP&T) to allow a second operator in 1993 (Ebo 2010: 1). In Kenya, full liberalization was realized after the Economic Reforms of 1998 were implemented allowing new entrants and competition in 2000. Nevertheless, internet connection in Kenya was available until 1992 by email services only through Internet Service Providers (ISP) (Netcom Informations System Ltd (NISL) 2012: 34; Otieno and Aligula 2006: ii). The paradigm shift in Sub-

Sahara Africa was particularly important in the 1990's to align the telecommunications industry to a path of development (Aker and Mbiti 2010: 208).

As new entrants emerged, so did mobile technology change occur thus increasing competitiveness and innovation of the industry. To maintain competitiveness telecommunication firms adopted innovation through a process of 'Creative Destruction' and in the process, ensuring the sustainability of operators (Laino 2011: 2). The need to meet the changing mobile technology led to the innovation of differentiated products and services, which led to exponential growth of the industry with a myriad of mobile technological capabilities. This increased mobile coverage in sub-Sahara Africa (SSA) by 60% as of 2007, and more mobile technology variations possibilities. The evolution of mobile telecommunications has transformed how service delivery occurs to "transform the lives through innovative applications" (Aker and Mbiti 2010: 208).

In Sub-Sahara Africa, de-regulation of the industry was inevitable given the number of state-owned monopolies and bureaucratic interferences hindering industry evolution. To experience industry growth, monopolies are eliminated and adaptation to the changing telecommunications environment is embraced. This leads to the liberalization of industry which allows new entrants to transform the network with new ideas, technology and strategies for growth and diversification of industry (Lal and Strachan 2004: 14).

1.2. Statement of the Problem

Since 1990, Ghana and Kenya have undergone significant telecommunications structural changes in reforms of policies and institutions. Both countries were influenced to initiate the reforms by the global shifts to make the industry more de-regulated and privatized. Due to this, Sub-Sahara Africa underwent changes at the same time as the rest of the world. (Haggarty et al. 2003: 7; Gachagua 2004: 3).

Ghana and Kenya underwent the same periods of structural changes. The need to undertake structural changes in reforms of policies and institutions to eliminate monopolies and implement better policies that allow competition began soon after the global shifts towards de-regulation and privatization (Kloosterhuis and Bergeijk 2005: 67). These structural shifts were the beginning of the continual process to liberalize the respective telecommunications industry. Nevertheless, both countries were implementing and prioritizing different policies and implementation mechanisms. This influenced the transformation of the telecommunications industry which experienced poor telecommunication density between 1990 and 2000. Despite a poor density, Ghana was performing better than Kenya. Ghana experienced rapid growth in the density of mobile cellular per (100) population and Internet use per cent population after 2000. Kenya also experienced growth but not as rapid as Ghana which has a mobile penetration rate of 68% as of 2017 (GSMA 2017)

1.3. Purpose of the Study

The purpose of the study is to analyze how technology change in mobile telecommunications transformed the industry and the factors that enabled these transformations to occur. The study will address the significance of the industry to transform the livelihood of the people and how this contributed to economic growth. The comparative analysis provides recommendations for action by the government and stakeholders such as Competition authority of Kenya. This research will provide recommendations at the end as possible insights for the growth of the telecommunications industry in Kenya.

Based on previous studies, Braathen (2004: 32-34) conducted an empirical analysis of the telecommunications industry in Mozambique and Zimbabwe. The study focuses on institutional capabilities such as 'power and trust and how they influence institutional performance. Moreover, the study contains two main variables of discussion i.e. professionalism and neo-patrimonial. The former addresses characterization and the latter discusses how personalization of institutions influence institutional performance (Braathen 2004: 32-34). Therefore, these research papers use a 'Tracing' comparative approach to examine how communications technology change contributes to development. Bennet (2004: 23) documents that tracing in comparative case studies enables the researcher to identify "similar patterns or sequences in different cases" (Bennet 2004: 23). This study allows to trace how structural changes of policies and institutions contributed to overperformance in Ghana, and why not in Kenya. The findings of this research will be crucial towards improving Kenya's performance.

1.4. Research Question

The research focusses on how the institutions and market structure of the telecommunications industry evolved and the contributions to development. Given the above background the research will address the following questions:

1.4.1. Main Research Question

1. Under Which Conditions Can the Communication Sector Contribute to Positive Development?

This question will address under what conditions did the communications industry evolve. Based on the literature, the study identifies the main variables to analyse these conditions. Telecommunications liberalization improved the performance of the industry, which resulted in new entrants and competition. Thereafter, increased investments in telecommunication infrastructure improved teledensity. The process of telecommunication change is continual due to changing technological environment.

1.4.2. Sub-Questions

2. Is the Mobile Industry Important for Economic Development?

This question is important to track how technology change in the telecommunications industry contributed to economic development at the macro-level and improving livelihoods at the micro-level.

3. How Can the Mobile Industry Be Stimulated by the Government?

This question demonstrates the role of institutions towards de-regulation and reregulation. The institutions are an integral part of the telecommunication liberalization and improved performance of the industry.

4. Why Did Ghana Perform Better Than Kenya?

This is a comparative case study. Its relevance demonstrates how different approaches to structural changes of reforms in policies and institutions contributed to the rapid performance of Ghana's telecommunications industry.

1.5. Research Objectives

This research is an extensive analysis of the technological changes and trends experienced in the telecommunication industry in Ghana and Kenya: The objectives are:

1. To understand why Ghana's telecommunications industry performed better.
2. To assess the reason behind Ghana's performance.
3. To provide recommendations to the Government of Kenya.

1.6. Methodology

The research paper examines the structural changes in policies and institutions that transformed the telecommunications industry performance and innovation. The study will place context in practicality by identifying two case studies in SSA i.e. Kenya and Ghana. The two countries are to a large extent comparable given that they have similar timelines during which deregulation and re-regulation of industry occurred. However, the data analysis from the respective telecommunications industries indicates interesting differences in the patterns of telecommunication density growth and innovation.

The research method was designed based on the research objectives of this study. The study develops a theoretical framework that will be a useful tool for understanding how mobile technology change results to industry performance and the sequences of technology change in the industry. This research is based on literature by Damsgaard and Gao 2007 and World Bank 2018. The identified variables formulated the data selected for this analysis in two ways. First,

to analyse which factors enabled mobile technology change to occur between 1990 – 2000 and after 2000. Second, the analysis illustrates the factors that influenced sector performance in Sub-Sahara, case study Kenya and Ghana.

1.7. Data Inputs

The telecommunications infrastructure density is examined using world bank development indicators as 'mobile cellular subscription per 100 people and Individuals using internet per cent population (World Bank 2018). Below presents the summary statistics of the data collected between 1995-2016 to understand how the data is distributed. Mobile cellular subscription in Ghana had a higher standard deviation compared to Kenya at 48 and 31 respectively. A descriptive statistics table is important to illustrate how the data was dispersed (Statistics Solutions n.d.) *see table 1*. While measuring the technology change in telecommunications, I analyzed data between 1994-1999 and between 2000-2016. The observed trends during the de-regulation and privatization were of great significance. Key written materials from newspapers, NGOs, blogs and academia were identified.

Credible sources such as the World Bank, articles, UNCTAD, GSMA, blogs, newspapers, OECD and ITU provided credible secondary data for analysis and validation of the theoretical framework. The collected data comes from 1990 (i.e. when the paradigm shift of the telecommunications industry was undergoing structural changes) and up to 2016 to demonstrate the current trends.

Case study data was collected from existing literature, journals, blogs and newspapers. This data was used to develop a comparative analysis to establish the trends of growth in mobile telecommunications and which policies and reforms were implicated in the process. Deloitte and GSMA (2012: 89) conducted an analysis in SSA on how a 10% increase in mobile penetration would impact GDP in selected SSA countries. The result depicted that Kenya had 1.7 while Ghana followed with a 1.4 increase respectively (Deloitte and GSMA 2012: 89). This similarity in timelines to structural changes, de-regulation and new entrants make Ghana and Kenya ideal for a comparative case study.

Table 1. Data and Summary Statistics

Variable	Observation	Std. Dev	Min	Max	Mean
Mobile cellular subscriptions (100 people) Ghana	22	48.376	0.0369	135.801	42.5727
Individuals using the internet (% population Ghana)	22	10.4371	0.0	34.666	7.190
GDP growth (annual % Ghana)	22	2.466	3.7	14.047	5.785
Mobile cellular subscriptions (100 people) Kenya	22	31.8471	0.008	80.439	39.516
Individuals using the internet (% population Kenya	22	5.7929	0.008	16.6	5.448
GDP growth (annual % Kenya)	22	2.2595	0.2322	8.405	3.921

Source: World Bank 2018 (https://data.worldbank.org/topic/infrastructure?view=chart)Accessed 20 October 2018, figured by author

1.8. Choice of Case-Study

The case study is an excellent method to examine how a similar past is an interconnection for future implications with different outcomes (Goodrick 2014: 1). Ghana and Kenya depict similar past of structural changes of policies and reforms to de-regulate, re-regulate and privatize the telecommunications sector from 1990's. However, both countries different outcomes as from 2000, where Ghana performed better than Kenya. Therefore, this research applies a comparative case-study to conduct the analysis. The importance of this approach is to examine how similar periods of structural changes and reforms had different outcomes in teledensity in the long run. In comparative case-studies, it is important to assess "why particular programmes or policies fail to work" (Goodrick 2014: 1).

The telecommunications industry competitiveness has often been evaluated using M. Porters Theory of Competitive Advantage. Nonetheless, the theory is limited to expound on how technology change in telecommunications contributes to economic growth and improving livelihoods. In addition, the institutional context formulating policies and implementing policies is inadequately addressed by M. Porter who focuses on the threat of new entrants, substitute

of products, Bargaining power of buyers, bargaining power of suppliers and competitive rivalry (Porter 1990). In addition, another limitation is that while conducting a comparative case study analysis, thus using a theory is contradictory. Therefore, the researcher must initiate a 'tracing' approach to identify "how some situations and events influence others" (Bartlett and Vavrus 2017: 10).

1.8.1. Kenya

Kenya's performance in the telecommunications industry has been exemplary since fully liberalizing in 1999. By 2000, the industry was motivated by new entrants who established a competitive niche for innovation, this increased technological barriers to entry. In Africa, Kenya is among the top 5 innovators in mobile applications and start-up technology (CapitalFM 2018). Kenya is an interesting case study due to innovations in mobile telecommunications such as M-pesa, mHealth and e-Learning (AHO 2018; BBC 2018 ICT-Authority n.d.). In East Africa, Kenya mobile telecommunications penetration is the highest at 57%, Rwanda at 52% (GSMA 2017). The research findings and recommendations can be shared with stakeholders in Kenya given that the researcher is Kenyan.

1.8.2. Ghana

The telecommunications industry in Ghana is a significant driver for economic growth. The industry underwent structural reforms between 1990 and 1995 and an implementation period from 1995 to 2000. Ghana is particularly an interesting case study because structural changes in the industry began at the same time as Kenya in the 1990's. By 1999, Ghana had 3 private network operators and the teledensity increasing rapidly faster than Kenya. Teledensity has increased from 0.36 in 1995 to 0.81% in 1999, whereas mobile cellular subscribers per 100 persons increased from 0.04 to 0.36 in 1995 and 1999 respectively (Nayo 2001). As of 2011, Ghana had one of the highest mobile phone penetration rate in Africa with 73% (Deloitte and GSMA 2011).

1.9. Ethical Considerations

Ethical considerations are an important factor in every research process. While conducting the comparative case study, trends and patterns indicated different results which deviating slightly from the research question. Therefore, to accurately analyse these research question, I addressed the issue by rethinking of an appropriate research question to address emerging trends. This contributed to developing an appropriate research question that properly investigated the research problem.

1.10. Limitations of The Study.

While conducting the research, the main limitation experienced was about identifying an appropriate theoretical framework that addresses the research question and research objectives in a holistic manner. On the other hand, it is difficult to assess exact reasons why Ghana performed better than Kenya in mobile teledensity. In order to present an accurate analysis, qualitative research entails reviewing a considerable amount of literature which can be time consuming.

1.11. Organization of The Paper

The organization of this research paper is illustrated as below:

Figure 1. Organization of the Research Paper

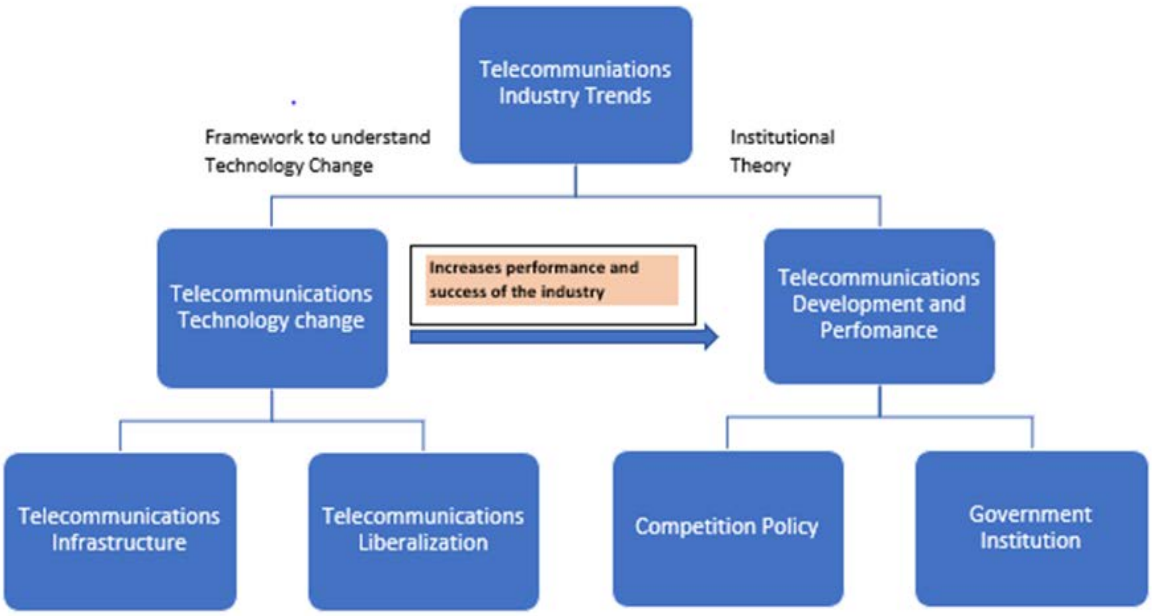
Source: Figured by author

Chapter 2. Literature Review

2.1. Introduction

This chapter examines the review of literature I have organized the discussion based on Figure 2 that reflects my theoretical framework my theoretical framework is based on my reading of Damsgaard and Gao 2007; World Bank 2018; Kloosterhuis and Bergeijk 2005 and Crabtree 2006: 6. The research paper will use this framework to structure the review of literature.

Figure 2 Theoretical Framework Demonstrating A Visual Interaction of the Variables that Influence Mobile Technology Change and Performance



Source: Figure by Author

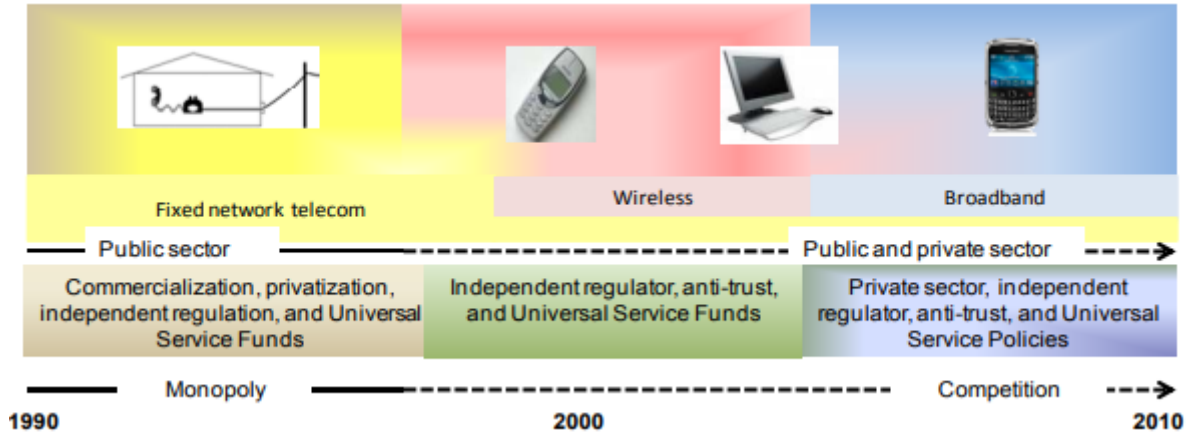
2.2. The Process of Telecommunications Change

Since 1990, Sub-Sahara Africa has undergone technological changes in mobile telecommunications. The previous existence of traditional methods of communication such as telegraphy, faxing and fixed telephone lines advanced to include services such as broadband, cloud sourcing services and internet data services. This "improved access to use information, thereby reducing search costs" (Aker and Mbiti 2010: 213).

Telecommunication firms use innovation to ensure sustainability in the market. Firms innovate to ensure that they can sustain their existence in the industry and develop competitiveness for the market (Christensen et al. 2011: 5). *Figure 3* below demonstrates how innovation in mobile technology evolved during the 1990's, dominated by industry monopoly in the public sector which was underwent policy reforms to privatize and establish independent regulators. By

2000, the introduction of wireless mobile services documents the struggles of an independent regulator in a bureaucratic system and weak anti-trust rules which protect consumers from predatory behaviour of firms and "anti-competitive practises of private-sector elites, but also the anticompetitive practices of state-owned enterprises and unnecessarily competition restricting laws and regulations" (Aydin and Büthe 2016: 31). Moreover, the elements of power and trust are critical to the functionality of independent regulators (IEG 2011). Braathen (2004: 34) documents that trust within public institutions is pre-determined within agency or the bureaucracy of the system which is a characterization of monopoly (Braathen 2004: 34).

Figure 3. Evolution of Technology Changing Mobile Telecommunications



Source: IEG 2011

2.3. Theoretical Framework for Understanding Technology Change and Factors Influencing Technology Development

2.3.1. Economic Theory of Institutions

This theory places a rational position with which an agent maximizes their economic value. The rationality is that institutions are not the primary focus, but rather the existence of choice and ideology and the significant impact of individual interaction through multiple cooperation. This argumentation anchors on the formation of "institutions and the way they evolve shape the performance of economies over time" (North 2016: 73-74). However, this theory exudes limitations while expounding on exogenous factors such as competitors that influence institutional changes. "When the changes in social conditions are considered exogenous, they are thereby deemed unexplainable within the economic model" Boland (1979: 1). Therefore, this theory is unsuitable to this research since the technology change in telecommunications is exogenous.

2.3.2. Institutional Theory

The applicability of Institutional theory as a tool for analysis in this paper illustrates how institutions play a role in formulation of policies and implementation to enable technology change in the telecommunications industry. Institutional theory examines the role of institutions and organisations to influence economic policies and how the institutions transform due to the changing environment (Berthod 2016: 2). The applicability of this theory has been adopted by Braathen (2004: 26), who documents that the theory was applicable to assess how 'institutions shape' telecommunications industry including individual choices and external influences. The focus on Mozambique's and Zimbabwe's telecommunications industry heightens the applicability of the theory to expound on how varied levels of institutionalism impact governments action towards a specific industry. The interaction between professionalism and neo-patrimonial where the former attributes power and trust especially in Africa (Braathen 2004: 26-33). In hindsight, Braathen deviates from the focus of this research paper by analysing "the hierarchic relationship between the sector leadership and the main professionals" (Braathen 2004: 32). Nevertheless, the study signifies the importance of institutions in telecommunications and how institutions play a role in formulation of policies and how these policies influence technology change in the telecommunications industry in Ghana and Kenya. Institutional theory "analyses the necessary involvement of institutions in promoting infrastructure innovation and market transformation. From this perspective, the innovation of mobile telecommunications infrastructure will be possible only if coordinated action takes place for which institutions play an important role" (Damsgaard and Gao 2007: 172).

Mobile telecommunications technology change defines how institutions are shaped by these changes and vice versa. The telecommunications market policy reform involves institutions such as the government and the regulatory bodies which shape policy to influence mobile technology change (Nelson and Nelson 2002: 2). Nevertheless, the theory is critiqued by Mohamed (2017: 151) who argues Pava's sentiments that the institutional theory exhibits weakness due to the changing nature of the interacting environment which influences how institutions react. Moreover, as institutions develop "human ideation, creative ideas and emotions are systematically avoided" (as cited Mohamed 2017: 151).

Strengthening institutions encompasses a holistic institutional transformation of the "social processes of institutional change, political and socio- economic power" (Groenewegen and Künneke 2005: 21). The structural changes deliver institutional changes that necessitate the need for strong institutions and effective legal frameworks for industry development. The theory contends that institutions gain legitimacy by interacting with the surroundings to function efficiently through formalities such as "legal structures, property rights and how they influence economic behavior" (Groenewegen and Künneke 2005: 3).

2.4. Technological Change in Mobile Telecommunications

Technology change in mobile telecommunications is influenced by infrastructure innovation which provides a platform for offering access to mobile services and internet data. “The infrastructure innovation involves both radical and evolutionary shifts in its underlying technologies” (Damsgaard and Gao 2007: 187). To assess these shifts the World Bank documents the need to evaluate telecommunications infrastructure using the following indicators: Mobile cellular subscriptions per 100 persons, Fixed telephone subscriptions per 100 people, Fixed broadband subscriptions per 100 people, and secure internet servers per 1 Million people (World Bank 2018). these indicators assessed how technology change occurred.

Technology change in mobile telecommunications has generated a lot of interest in the last two decades. The change evolves due to increased innovation by firms as a competitive strategy applied by new entrants (Crabtree 2006: 8). To evaluate the extent to which technology change occurs, it is important to consider how regulatory structures contribute to the process, what changes occur, and their value to society (Christensen et al. 2011: 2).

Mobile technological changes “are built upon networked technologies and infrastructure. Its transformation involves evolutionary innovation” (Damsgaard and Gao 2007: 172). entry of new operators also creates innovation. Nonetheless, most operators ‘innovate without ever inventing’ which implicates how technology change diffuses in developing countries without undertaking research and development (Jaffe et al. 2002: 43). In this case, we address the factors that contributed to telecommunications technology change using telecommunications infrastructure to assess the contribution of infrastructure innovation Damsgaard and Gao 2007: 172).

2.5. Government in Telecommunications

The government is an important institution in the telecommunications industry. It establishes institutions that regulate the industry to nurture competition and develop governing policies. “The government can employ in pursuing control over entry, rates, access charges, conditions for operations and technical standards” (Nam 2000: 357). De-regulation of network industries is executed through legislative bodies. They provide an oversight role as well as implementing policies and institutional reforms of network industries. Moreover, the regulatory bodies ensure that competition policy, corporate governance and sectoral reforms” prevail (de Rosa and Malyshev 2008: 4).

The government positions telecommunication infrastructure on an autonomous path to sustained growth through policy formulation, implementation and financing. Telecommunication infrastructure is an integral part for continuous growth of industry. Technology change in telecommunications has increased the costs associated with

sophisticated telecommunication infrastructure. Network industries encounter significant costs to purchase and invest in equipment's such as 'transmitters and fibre optic cables'. To bridge these costs ITU recommends telecommunication infrastructure sharing. The role of the government is to mobilize resources through the Universal Service Fund (USF) to invest in rural telecommunication infrastructure and to formulate policies in infrastructure sharing (Sozzi 1996: 434-437: ITU 2013).

The government provides a platform for development and implementation of policies that affect the industry. The policies and regulations are formulated and implemented by the government institutions. The government provides "the institutional and physical conditions and the policy environment necessary to promote the initial stages of industrialization" (Adelman 1999: 12).

The government has a functional role in the de-regulation of industry to provide an enabling environment that attracts investors in the industry hence competition. In telecommunications, the government is instrumental in the elimination of structural barriers that hindered competition and privatization. Providing an enabling environment for competition is a government function. Government implements policies that ensure there is fair competition and sustainability for all in the market (ChristianAid 2012: 1).

Through competition, the sustainability of firms encourages innovation through a process of 'creative destruction'. In this regard, the government provides a platform for innovation through provision of funds or any supplementary assets that contribute to the innovative process. This platform propels innovators towards "shaping the opportunities that innovators target" (Christensen et al. 2011: 2).

2.6. De-regulation and Re-regulation in Mobile Telecommunications Industry

Liberalization of the telecommunications industry gained momentum in 1990's (Kloosterhuis and Bergeijk 2005: 67). The need to reform the industry was created to improve efficiency, improve quality, and productivity of markets by eliminating monopolies which resulted into uncompetitive markets. Telecommunication monopoly was characterized by basic services such as voice calls. The inefficiency of a monopoly in an industry affects the growth of the industry (ICC 2007: 9).

The telecommunications industry achieves competition by liberalizing the industry from entry of new innovative entrants. The entry of new investors creates a competitive environment for technological growth in the mobile telecom industry and increases FDI (ICC 2007: 9). Nevertheless, the success of the operator is dependent on the timing to enter a market. "The choice of market-entry time is one of the major reasons for new product success or failure" (Lilien and Yoon 1990: 1).

Telecommunication de-regulation influences mobile technology change. In Europe, the telecommunications industry experienced rapid technology change after liberalization. evidence in Ireland, Denmark and United Kingdom indicate rapid technology change after the telecommunications paradigm shift in 1990 (Procházka 2014: 117). De-regulation is important for increased competition which leads to technology change. Deregulation and competition policy have an interwoven consequence to "improve transparency of (world) product markets, reduce transportation costs and foster both domestic and international competition" (Bergeijk and Haffner 1996: 10). Therefore, the considerations for reforms have a fundamental impact on network development, especially in telecommunications industry. The inserts of competition policy in telecommunications bring forward the element of anti-trust which is a remnant of efficiency of the regulatory body. The regulator body is designed in a manner to assess and understand the market needs in order to highlight an effective anti-trust policy. The regulatory body substantiates the "capability to dismantle private and public barriers to competition" (Aydin and Büthe 2016: 3).

Liberalization of industry entails developing strong, effective and independent regulators. The role of regulatory institutions is to establish an enabling environment for competitiveness and enforce telecom reforms and policies (ICC 2007). Bureaucratic interferences hinder the independency of these regulatory bodies because those involved "sometimes include their objectives as part of the public interest. This rent-seeking behaviour sometimes leads to telecommunications regulators to impose policies that have little to do with telecommunications markets" (Economides 2004: 52). Therefore, developing independent bodies that are flexible improves the implementation of policies.

2.7. Telecommunications Infrastructure

Telecommunications infrastructure has a pivotal role in industry growth and technology evolution. Old and new infrastructures in telecommunications have an impact on economic growth and industry development. The report indicates expanding telecommunication Infrastructure impacts the growth mobile services. This growth is experienced at both the micro and macro level. "At the micro level, telecom investment in low- and middle-income countries tend to generate internal rates of return of approximately 20 percent and economic rates of return that are even higher" (World Bank 2002: 6).

While assessing the telecommunications infrastructure, the world bank recommends analyzing indicators such as; Mobile cellular subscriptions per 100 people; Fixed telephone subscription per 100 people; fixed broadband subscription per 100 people and lastly Individual internet percent population. The same report evidenced that a cross-country survey showed that the number of telephones per 100 people had an impact on the (GDP), increased income and macroeconomic growth. The higher the number of telephones, and density, the higher the

income and growth rates, the lower the number of telephone accessibility and teledensity per 100 people, the lower the growth rate and subsequent slow economic growth (World Bank 2002; World Bank 2018).

2.8. Competition Policy in Telecommunications Industry

The paradigm shift from monopoly to telecommunications liberalization between 1990-1999 lay a foundation for establishing competition policy. Competition policy is derived from an increasing entry of new entrants into the market, then eliminating bureaucratic and monopolistic entities. Increased competition in an industry interrogates the customer preferences by variation of innovative products and services. This increases consumer demand, which enables operators to innovate to meet the demands and the global paradigm shifts in mobile technology. This creates a conducive atmosphere for competition to thrive (Whiteman 1990: 47).

A more liberated industry increases competition due to new entrants to position themselves in transforming the industry through new ideas and strategies for growth and diversification of industry (Lal and Strachan 2014: 14). Competition and Innovation are crucial for the survival of network operators. Innovation in the telecommunications industry is a key driver to increase competition and expansion of industry. The competitiveness of the telecommunications industry is largely defined by the financial performance and technology innovativeness. The firms market share and consistent innovation of new products and services determine the profitability and market penetration (Lee et al. 2011).

2.9. Conclusion

The theoretical framework presents a holistic approach to address the research question and critically addresses the research problem. This framework integrates telecommunications liberalizations as instrumental to driving technology change in mobile telecommunications for development. Liberalization of industry is instituted by the government through policy formulation and regulatory role through statutory bodies. Further, telecommunications infrastructure sharing and investment are important divers for telecommunication expansion to increase mobile cellular subscriptions (per 100 people) and individual internet percent population.

Chapter 3. Mobile Telecommunications Technology and Its Significance to Development

3.1. Introduction

This Chapter examines how mobile telecommunications technology has played a significant role in economic development. The chapter takes a general approach to address the significance of mobile industry to improving the livelihoods of the people particularly in rural and remote areas creating new possibilities.

3.2. Mobile Technology and its Contribution to Economic Growth Sub-Sahara Africa

The relationship between the telecommunications industry and economic development is important. This is because the telecommunications industry creates an enabling environment for economic growth through FDI from new entrants who develop mobile telecommunications infrastructure. Telecommunications infrastructures increase mobile cellular penetration which improves the accessibility of information through mobile digital means such as text messages, mobile application apps. Increasing accessibility of mobile cellular services reduces transaction costs in rural and marginalised areas thus increasing the affordability of mobile services due to improved infrastructure. Reduced costs of operations improve the quality of information. "Lower communication costs lead to more information on the probability distribution of prices and permit the transformation of uncertainty into risk" (Norton 1992: 177).

Telecommunications infrastructure has a significant role in the economic development of developing countries. Investing in mobile telecommunication infrastructure is pivotal to improving mobile technology. Therefore, increasing investment in telecommunications infrastructure will enable penetration of services such as internet and increased mobile penetration (World Bank 2002). The impact of investing in telecommunication equipment such as fibre optic cable, ISDN lines and signal transmitters increases firm revenue due to the wide coverage and increased internet and mobile subscriptions (Greenstein and Spiller 1996: 29). Telecommunications infrastructure contributes to the development of developed countries by a margin of more than 50% compared to developing countries (Gruber et al. 2011).

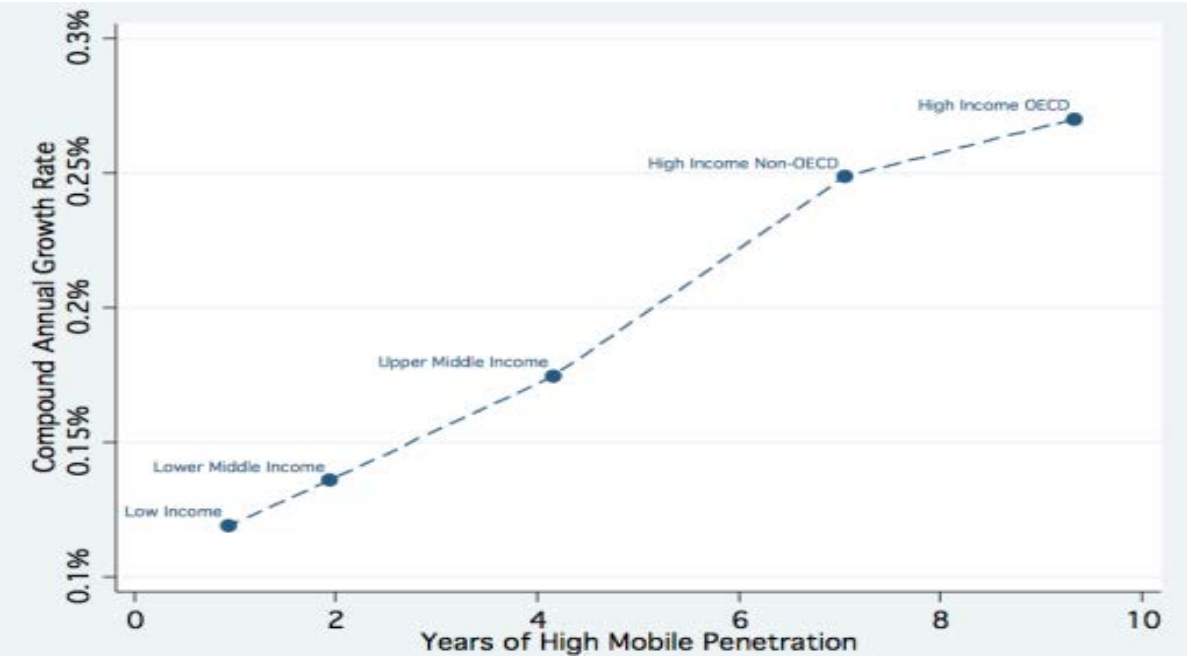
Lee et al. (2011: 4-5) conducted an empirical analysis of telecommunications and economic growth in 44 Sub-Sahara African countries. The study focused on the growth of mobile telecommunications and how different technologies such as fixed telephone lines and mobile devices have contributed to economic development. In the estimation model, the analysis applies the use of different variables such as GDP per capita assessing the degree of openness of a country's economy and population growth rate. The findings identify a positive correlation between the growth rate of GDP and fixed telephone lines per 100 persons. When the study estimated for the growth rate of GDP and mobile subscriptions per 100 persons the results indicate a positive correlation. Nonetheless, the latter demonstrated a statistically insignificant

result given that estimation period used in the study was before structural changes of reforms of policies and institution which took effect from 2000 (Lee at al. 2011: 4-5).

Gruber et al. (2011) conducted a study to assess the impact of mobile telecommunications on economic growth in 194 countries between 1990-2007. The study assesses the endogenous growth model to estimate the 'weighted average of OLS coefficients. Telecommunications infrastructure and productivity demonstrated a causal relationship in developing countries. While estimating for telecommunications and national output, the results indicated that there was an impact on economic growth. The latter having been controlled for 'capital and labour'. The results for estimating economic growth and telecommunications were significantly positive (Gruber et al. 2011).

Nonetheless, World Bank (2009) dissects this positive relationship began in 2000 after de-regulation of industry, especially in developing countries. More so, liberalization enables mobile technology change to occur. The period before deregulation indicate how telecommunications technology was scarce, evidence from 43 developed countries indicated that between 1975 and 1990, the estimation results for telecommunications and economic growth were statistically significant with a positive correlation (Lee et al. 2011: 2). This demonstrated the conclusion that the impact of mobile telecommunications on economic growth varies between developing countries and those that are developed. (Grubers et al. 2011). In *figure 4* Below, the graph demonstrates the findings of a cross-country analysis on the impact of telecommunications on growth rate and the x-axis represents the number of years of mobile penetration. Low middle-income countries are in the bottom of the graph with a margin of between 0-2 years maximum, the growth rate for this period was below between 0.1% and 0.15% for developing countries with low income. Further, the growth rate increases as the number of years increases. Upper-middle-income countries which also fall in the developing world categories such as Tunisia, Russian Federation and Georgia are upper-middle-income countries with a GNI per capita of between $ 4, 036 and $ 12, 475 (World Bank 2016). The figure below demonstrates that mobile telecommunications do contribute to economic growth. For most developed countries classified as high income, the relationship is stronger especially if the country is categorised under OECD compared to High income non-OECD (Gruber et al. 2011). The differences the rate of returns between low middle income and high middle income is due to the delay to de-regulate telecommunications and limited telecommunications infrastructure (Starr 1990).

Figure 4. Mobile Telecommunication and Growth Rate Weighted on the Number of Years of Mobile Penetration



Source: Gruber et al. 2011: 408 (https://www.jstor.org/stable/41261993?seq=1#page_scan_tab_contents), Accessed 20 October 2018.

3.3. Mobile Technology Improving Livelihoods

Mobile phones improve the livelihoods in developing countries. Different studies in developing countries have indicated that mobile telecommunications has significant impact on Health delivery services, education. Mobile technology has improved that access of information on health services such as telemedicine which reminds HIV patients to take their medicines on time (Aker and Mbiti 2010: 222-223). Mobile technology has had a positive impact on health services. mHealth a mobile technology solution has demonstrated significant improvements to access medical statements and medication. Across SSA mobile penetration has improved access to a variety of different of mobile such as MAMA SMS in South Africa and Rapid SMS in Rwanda. *See table 2* for a summary of mobile health services in selected parts of SSA (AHO 2015).

The significance of mobile services also highlights the importance to alleviate poverty. Mobile telecommunications penetration to the rural areas improves the livelihoods of people. Through mobile technology, the marginalized people can access services that were previously unavailable to them. Delivering services such as eLearning have profound impact on poverty reduction in developing countries. For instance, the contribution of a digital eLearning platform dubbed Village eScience for Life (VeSel) which is "aimed at identifying and developing suitable

information and communication technologies for groups of rural farmers to promote eScience" (Camara et al. 2010: 1) and primary education.

Table 2. A Summary of Mobile Technology Health Services in Selected African Countries.

Country	Type of service	Description
Kenya	mHealth: Jami Smart Sent via SMS	Confirm the authenticity of health providers and their qualifications and provide information to pregnant women on safe motherhood.
Ghana	Mobile Technology for Community Health (MOTECH) initiative	Information access to rural mothers on child care
Mozambique	SMS	Send reminders to HIV patients about adherence and prevention of mother to child transmission.
Nigeria	SMS Printers to Accelerate Return of Test (SMART)	Improve communication of early infant diagnosis of HIV/AIDS from the laboratories to health centres.
Rwanda	RapidSMS and mUbuzima	Track pregnant women with life threatening conditions for both mother and child
South Africa	MAMA SMS services	Send SMS support to local languages

Source: AHO 2015 (http://www.aho.afro.who.int/en/blog/2015/03/10/mobile-health-transforming-face-health-service-delivery-african-region) Accessed 15 October 2018, figured by author

The introduction of mobile telecommunications improves food security in developing countries. Mobile telecommunications technology has reduced food wastage and time, and improved information-based transaction cost. Farmers in marginalized areas access information regarding market availability for their produce using mobile phones. The farmer can eliminate time wastage to by prioritizing the market that has more returns as compared to the one that is costlier by factoring the geographical distance (Overå 2006: 1308). Therefore, the farmer "can put resources where they are most needed and most valued. Resources can be better coordinated between sectors and across geographies" (Lee et al. 2011: 1). In Niger, mobile technology reduced the transacting costs and wastage for traded goods such as grain. (Aker and Mbiti 2010: 215). In Ethiopia, telecommunications infrastructure expansion improved communication between buyers and sellers trading in cash crops such as coffee after. The empirical analysis also indicated that transaction costs were reduced (as cited Norton 1992: 178). The presence of mobile innovations enables farmers to maximize their yield by reducing the distance previously encountered while searching for markets. With mobile phones, the individual can access information instantly. Nevertheless, it is crucial to realize that

“information-based transaction costs are found to be a significant proportion of the total transaction costs incurred by farmers” (de Silva et al. 2008: 4).

Multinational corporations entering developing markets generate work opportunities and increased tax returns which contributes to macroeconomic development. Employment opportunities are generated through direct employment to the telecommunications company for positions such as managers or technical jobs such as telecoms equipment operators and human resources. In other forms of employment, the industry has contributed to indirect form of employment, such as retailers in the industry selling airtime and other products and services such as sim card replacement. The industry has also created opportunities for mobile applications, call centres and supply-chain deliveries of other goods and services in the firms that enable a company to operate on a day to day basis (Andelkovic and Imaizumi 2013: 98). In Kenya, telecommunications has contributed to the growth of the mobile APPs which led to the establishment of incubation centres to nurture innovative skills and provide a platform or access free internet for App developer. The number of Internet Service Providers has increased thus generating employment (ICT Authority n.d.).

3.4. Infrastructure Innovation in Sub-Sahara Africa

Mobile telecommunications technology has contributed to economic development. To achieve this, internet provision is paramount to ensure that mobile technology contributes to this evolutionally change. Nevertheless, internet access in developing countries remains elusive. Therefore, in the last one decade, infrastructure innovation in telecommunications has evolved through air balloons designed to provide satellite services for internet data in rural areas and remote areas (*See text box 1 for further details*). The baseline for these innovations is to ensure that data provision is “more efficient, to carry a much higher volume of information, at a lower cost” (ITU 1999). Therefore, in this section I will illustrate infrastructure innovations in Kenya.

Text Box 1. Current development in Mobile Telecommunication Infrastructure

Project Loon in Kenya

Project Loon is a Google initiative "to provide internet access to unserved and underserved areas around the world. Loon combines advancements in material science and atmospheric modelling, machine learning and communicating systems and more" (Loon 2011). The technology utilizes the lift of an airborne balloon. Loon is a sustainable project given the components of its functionality are 'green'. The balloon is designed to float in the stratosphere, higher than Planes and weather disruptions. The balloon is also 'filled with helium and is powered by solar panels' (BBC 2018).

Project Loon – Kenya was launched in the Kenyan market in 2018. The project was launched under the partnership with Telkom Kenya, the partnership documents that Telkom Kenya provides service signals whereas Loon will distribute the signals for to cover 5, 000 sq. kms (BBC 2018). The operations details that Loon will provide accessibility of 4G/LTE internet service in rural areas and semi-urban centres such as: Ngong, Kitengela, Limuru, Kiambu etc. The services will be a step further to reducing the ratio of 1GB data to 2% GNI which is currently at 1GB to 18% of GNI in Africa (BBC 2018).

Figure 5. Loon in the Stratosphere

Source: Loon 2011 (https://loon.co/journey/)

Express Wi-Fi by Facebook Joins the Kenyan Market

Express Wi-Fi collaborates with selected service providers to expand connectivity to low population density locations in Kenya and other parts of Africa such as Nigeria, India and Indonesia. Following the launch of 'Project Loon', Facebook launched Express Wi-Fi and partnered with Surf Kenya to provide internet services in Nairobi and its immediate environs. According to the Daily Nation (2017), "the network will provide "daily data bundles at a cost of Ksh.10 for 40 MB and Ksh. 20 MB; weekly bundles will cost Ksh. 50 for 300 MBs and 100 for 500 MBs". Compared to the other three MNOs, Express WiFI is affordable given that at a cost of Ksh. 50 Safaricom, Airtel and Telkom Kenya offer 65MB, 50MB and 400 MB respectively (Daily Nation 2017).

3.5. Conclusion

Technology change in mobile telecommunications has contributed to the developmental change in Sub-Sahara Africa. Education, agricultural farming and Health have experienced significant improvement to access information through mobile phones. The provision of mobile services has revolutionized access to information in the rural areas.

Chapter 4. Government Stimulating Telecommunications Industry Performance

4.1. Introduction

This chapter examines the role of the government as an institution and its role in the telecommunications sector. In this chapter, the study identifies key policy issues implemented by the government to stimulate the telecommunications industry and the institutions associated with telecommunications regulations. Some of the issues identifies include; policy formulation in telecommunication infrastructure, competition policy and regulation and regulatory and institutional frameworks that formulate and implement these policies.

4.2. Policy Formulation in Telecommunication Infrastructure Sharing

Telecommunications infrastructure sharing is an important facet for a thriving industry. Government policies in infrastructure sharing indicate that industries that adopt tower sharing efforts have a progressive growth of the telecommunications industry and improved fair competition due to reduction of costs for operations. New Zealand and Germany incorporated infrastructure sharing policies to navigate the high costs associated with individual firms investing in telecommunications infrastructure. In Europe, countries such as Sweden and Norway are mandated to a 30% infrastructure share. The results of this infrastructure sharing mechanism improved competition between MNOs (ITU n.d.).

In Sub-Sahara Africa, Ghana, Uganda and South Africa are among the countries that have implemented a network sharing framework. In 2008, Ghana initiated the tower sharing framework under the Electronic Communications Act of 2008 was enacted to curb infrastructure expansion costs and improve competition among MNOs in Ghana (*see table 3.*). The ensuing market share structure is 'reasonably' within threshold where the leading operator has a 47% market share compared to Kenya whose leading operator has 69% market share (Haggarty et al. 2003: NCA n.d.; CAK 2016/2017: 10).

Implementation of a network sharing framework by NCA improved access to mobile services in the rural areas in Ghana. The framework was designed to ensure that three tower companies were allowed into agreement with MNO's in Ghana under the regulations of NCA. The contentious issues addressed in the framework includes sharing mechanisms such as site sharing, Mast sharing, RAN Sharing, Network roaming and core network roaming. Nevertheless, the framework also identifies the potential to "erosion of competitive differentiation" for which it is address as a setback (Sayki-Addo n.d.). The successful implementation of the tower sharing framework reduces infrastructure costs of investment for operators; therefore, improving competition. The Ghanaian framework was developed to ensure that network towers were licensed and operated by third parties such as 'America Towers Company, Helios and Eaton' providing services to 4 leading operators who receive services from them. This policy has

contributed to recover costs of operations and increased mobile cellular subscription in rural areas (Osei-Owusu and Henten 2017: 4-7).

Contrary, Kenya's infrastructure sharing policy has been contested by mobile network operators. In 2016, CAK released competitiveness of industry report which recommended that infrastructure sharing was important for Kenya to reduce cost of equipment investment and improve competitiveness of smaller players (*See table 3 for a summary of the progress*). Therefore, "it was not economically viable for smaller operators to extend coverage in areas of low population density given current market share and costs of tower sharing" (as cited in Kamau 2018).

Table 3. Policy Formulation in Telecommunication Infrastructure Sharing in Ghana and Kenya

Country	Infrastructure sharing Policy	Period	Status and type of sharing	Did Government get involved	Tower Companies
Kenya	Recommendation by CAK	None	Not implemented & passive, active	Through Communications Authority of Kenya a statutory regulator in telecommunications industry. Initiated a study to assess the competitiveness (Kamau 2018)	None
Ghana	Tower sharing framework *(Site sharing, Mast sharing, RAN Sharing, Network roaming and core network roaming)*	2008	Implemented & passive infrastructure sharing	Through NCA oversight and policy formulation	America Helios Tower Company, Eaton Tower Company and Helios Tower Company

Source: Sakyi-Addo (n.d.) (https://www.nca.org.gh/assets/Uploads/Infrastructure-Sharing-IS-MNO-Perspective.pdf) and Osie-Owusu and Henten 2017 (http://hdl.handle.net/10419/178421) Accessed 15 November 2018, figured by the author

4.3. Regulatory and Institutional Frameworks

In the 1990's the telecommunication paradigm shift towards liberalization was initiated by international development partners. In 1982 and 1985, Kenya and Tanzania held the first ITU conference and the World Telecommunications Development Conference respectively in SSA. The former's outcome led to the establishment of a commission to lead to an expansive plan to liberalize the telecommunications, while the latter was evaluated the recommendations of the commission. In 1993, the World Trade Organization concluded the Uruguay Round whereby the texts recommendations in the telecommunications industry were assessed (Mureithi n.d.; Ebo 2010: 1).

Since these two conferences, the formation of institutions and effective legal frameworks were consistent with the key prerequisites for sustainable advancement in telecommunication. Since 1990, both Ghana and Kenya have experienced gradual and consistent legal formulation and creation of regulatory institutions. The ministry of Transport and Communication initiated the ADP programme in 1994. The formation of these institutions is anchored within the constitutional Acts of parliament whereby through ADP-2000, Ghana Frequency Regulation and Control Board (GFRCB) was established to issue operator licenses in Ghana. As of 1996, the agency had issued 3 operator licenses to Mobitel, celtel and Spacefon (Ebo 2010: 7-9). On the other hand, Kenya enacted the RTMPC Act in 1988 to eliminate monopolies from the industry and to establish competition. This led to the formation of the MCP (Gachagua 2004).

The elimination of monopolies in Ghana and Kenya was eliminated at different times. In 1998, Kenya enacted the 'Kenya Communications Act of 1998' which led to the separation of the state-owned Kenya Post and Telecommunications Corporation into three institutions i.e. Telekom Kenya, Postal Corporation of Kenya and Communication Commission of Kenya. The separation of powers was a step towards improving telecommunication services (Gachagua 2004: 2). Meanwhile, GP&T underwent reform through the ADP-2000 which recommended the elimination of state-owned institutions which were inefficient and recorded poor teledensity of '3 phones per 1000 inhabitants. In addition, GP&T provision of services were poor due to limited infrastructure (Haggarty et al. 2003: 7). The Statutory and Reforms Act of 1993 led to the establishment of the Ghana Telecom and an independent MNO in 1993. The reforms also institutionalised an independent operator NCA under the National Communication Act of 1996, Cap 524 (Ebo 2010: 8).

By 2000, both countries had liberalized the telecommunications industry. The millennial years led to the realization that institutional changes were inevitable as the surrounding environment changed (Berthod 2016: 2). The entry of new competitors and the changing mobile technological environment ignited more reforms in Ghana and Kenya. In 2009, Kenya Information Communication Amendment Act 2009 was enacted in 2010 which led to the disbarment of CCK and established CAK. The latter had more powers to regulate the industry

and restitute the independency of the institution (Gachagua 2004: 16). Around the same time, Ghana enacted the Electronic Communications Act of 2008 which focused on affordability and expansion of the telecommunications industry. GoG ensued to invite tower companies to bid for provision of network towers. The implementation of the infrastructure sharing framework took 7 years for MNO's and tower companies to come into agreement in 2014 (Osie-Owusu and Henten 2017: 3).

Table 4. Summary of Regulatory and Institutional Bodies in Telecommunications in Ghana and Kenya

Country	State Actors	International Bodies	Academic Institutions
Ghana	Ministry of Communications 2018, Ghana Chamber of Telecommunications – 2018, National Information Technology Agency 2018 Ghana Frequency Regulation and Control Board - 1992	World Trade Organisation International Telecommunications Union	Ghana Technology University College
Kenya	Ministry of Information and Technology, National Communications Secretariat	Groupe Spéciale Mobile Association	Kenya Institute of Mass Telecommunications

Source: Nanevie 2012: 33; MICT n.d. (http://www.ict.go.ke/wpcontent/uploads/2016/04/MinistryStrategic.pdf) Accessed in 8 November 2018; MoC 2016 (https://www.moc.gov.gh/agencies) Accessed 18 November 2018, figured by the author.

4.4. Competition Regulation

Telecommunications competition policy has undergone rapid changes. The industry has experienced structural changes that began in the early 1990's. The shift from state-owned monopolies meant de-regulating and privatizing the industry. Ghana and Kenya had experienced monopolies which were eliminated in the early 1990's. In Ghana, the telecommunications industry trajectory required de-regulation of industry followed by monopoly elimination and privatization of GP&T to allow for the second operator (Haggarty et al. 2003: 4). In Kenya, the process toward liberalization and privatization of the

telecommunications industry began in 1990's. In 1998, the government enacted the Economic Reforms of 1998 which fully liberalized the industry leading to entry of Safaricom and Airtel in 2000 (Otieno and Aligula 2006: ii). These two countries depict the major milestones in the process to move towards competition.

The existence of competition polices in telecommunications sector in Ghana and Kenya was developed in the early 1990's. Ghana, developed ADP 2000 between 1994 – 2000 to mandate to eliminate state-owned monopoly and allow a second national operator to provide telecommunications services. The emergence of this policy allowed for increased competitiveness which lead to an entry of four member by 2000 (Ebo 2010: 7). In Kenya, RTMPC was the first competition law in the 1990's that was mandated to redefine the competitive structures through the establishment of MPC (Gachagua 2004).

Competition policy laws oppose the existence of 'abuse of dominant position'. A firm that dominates a market with 'predatory, discriminatory exploitations' are 'unfair' (Kloosterhuis and Bergeijk 2005: 74). The Competition Act of 2010 Section 24(1) "Prohibits any abuse of a dominant position by an undertaking in a market for goods or services in Kenya" (CAoK n.d.). The existence of a dominant network operator with a market share more than one half of the market is substantiated as a 'dominant position' (CAoK n.d.). In Kenya, Safaricom has a dominant position in the market exhibiting 69% of the total market share. In Ghana, the largest MNO has a 47% market share below the 50% which determines above as presumably dominance of market. To evaluate dominant position, a market between 50-70% market shares exude 'a weaker presumption of dominance, any shares below 50 are contrary to dominance of market power (Malkovsky 2017: 26-27). Nevertheless, firm's dominance might be "perfectly legitimate through innovation, adoption of superior production or distribution methods or greater entrepreneurial efforts" (World Bank 1999: 82).

The government role is positioned by the competition authority which is mandated to ensure that such dominance does not exist. 'Unfair' markets require regulatory measures that address the breaching threshold evoked by dominant operators (Fernández et al. 2014: 227).

4.5. Estimating Herfindahl index in Ghana and Kenya

Evaluating the level of competitiveness in telecommunications indicates assessing the concentration ratio of market share in Ghana and Kenya as indicated in *table 5*. The similarity of these ratio does not indicate the relative size of each of the largest MNO's in either of the countries. Clearly in Kenya, close to 70% of the market share is controlled by Safaricom PLC limited while in Ghana, almost 50% of the market share in voice and data is controlled by MTN. The situation above demonstrates different market dynamics such as when each MNO has a significantly narrower margin ratio. Safaricom limited having a share of 69% of the total mobile market in Kenya which significantly increases the Herfindahl index (HHi). The Herfindahl index

is defined as the sum of the squared market shares Ωi The Herfindahl index equals ∑Ωi2. This indicates that the mobile market in Kenya is more concentrated so less competitive. Similar analogy applies to the mobile market in Ghana where MTN significantly has a lead in market share. However, the mobile market share in Ghana is moderately more competitive (because of a lower HHi) than mobile market in Kenya, which is dominated by Safaricom Limited. The significance of HHi is important to analyse market concentration. In this case, Kenya's HHi is more concentrated than Ghana's HHi index. The difference occurs due to "technical properties of their production technologies or unique characteristics of the markets" (Shughart II n.d.). HHi estimates the "market concentration index for each country, and it is calculated as the sum of the squares of market share of all firms in the market" (Gruber et al. 2011: 400).

Table 5. Calculating Ghana and Kenya's Herfindahl index

MNO in Ghana	Ghana Mobile Market Share (%)	Squares	MNO in Kenya	Kenya Mobile Market Share	Squares
MTN	47.53	2259.101	Safaricom Limited	69	4761
Vodafone	24.1	580.81	Airtel Networks Kenya	17.5	306.25
Tigo	14.72	216.6784	TelKom Kenya Limited	7.6	34.81
Airtel	11.64	135.4896	Finserve Africa Limited (Equitel)	5.9	57.76
HHI: Total Sum of Squares		**3192.119**	**HHI: Total Sum of Squares**		**5159.82**

Source: NCA n.d. (https://www.nca.org.gh/industry-data-2/market-share-statistics-2/voice-2/) Accessed 7 November 2018 ; (CAK 2016/2017 (https://ca.go.ke/wp-content/uploads/2018/02/Sector-Statistics-Report-Q1-2016-2017.pdf) accessed November 2018, figured by author

4.6. Mobile Innovation Incubation Centres: Mobile Technology for Better Socio-Economic Services

The mobile technology innovation has stimulated the development of mobile applications. These innovations have contributed to the development of mobile applications services which are improve livelihoods in developing countries. mHealth and eLearning mobile applications are a good example of how mobile applications have revolutionized technology (AHO 2015; Aker and Mbiti 2010: 220). Because of this, GoK recognized the potential of ICT to address socio-economic issues such as improving access to information and developed incubation centres to support start-ups. Moreover, incubation centres are critical for nurturing emerging start-ups to develop and advance their ideas especially in the mobile applications. The government has an important role to play through provision of an enabling environment for incubation which enhances mobilization of resources to innovate and commit fiscal resources for the operations. In Africa, Kenya is one the leading start-up Hubs including Egypt and South Africa (*see table 5*.). In 2013, GoK Under the Ministry of ICT established 'Nailab' under the ICT Authority. Nailab is a 'Business Incubation Project' aimed at nurturing ICT skills that include developing e-Learning Mobile apps; a mobile based betting app; mobile app that is based on community crowd source funding; and mobile money services (ICT - Authority 2018). In Ghana, GoG established 'Ghana Multimedia Incubator Centre under the Accelerated Development (ICT4AD) initiative. The incubation centre was established to nurture ICT skills for development of mobile applications (GoG n.d.).

Table 6. A Summary of Africa's Leading Start-up Countries

STARTUP	COUNTRY	INDUSTRY	FUNDING TYPE	AMOUNT (USD)	INVESTORS
cellulant	Kenya	Fintech	Series C	47.5 Million	TPG's Rise, Satya Capital, Endeavour Catalyst, Velocity Capital, Progression Capital Africa, TBL Mirror Fund
branch	Kenya + Nigeria + US	Fintech	Venture Capital	20 Million	Trinity Ventures, IFC, Andreessen Horowitz, CreditEase Fintech Investment Fund, Victory Park Capital
M-KOPA SOLAR	Kenya	Cleantech	Private Equity	10 Million	CDC Group
Africa's Talking	Kenya	SaaS	Venture Capital	8.5 Million	IFC Venture Capital, Orange Digital Ventures
SWVL	Egypt	TransportTech	Series A	8 Million	BECO Capital, Silicon Badia, DiGAME, Raed Ventures, Arzan VC, Oman Technology Fund, Esther Dyson
SureRemit	Nigeria	Fintech	ICO	7 Million	–
Lidya	Nigeria	Fintech	Series A	6.9 Million	Omidyar Network, Accion Venture Lab, Newid Capital, Alitheia Capital, Bamboo Capital Partners, Tekton Ventures
	Egypt	Recruitment	Series B	6 Million	European Bank for Reconstruction and Development, Endure Capital, Kingsway Capital
we farm	Kenya	Agritech	Seed Investment	5 Million	True Ventures, LocalGlobe, Accelerated Digitial Ventures
terragon group	Nigeria	Analytics	Venture Capital	5 Million	TLcom Capital

Source: CapitalFM2018 (https://www.capitalfm.co.ke/business/2018/07/kenyan-tech-startups-scoop-half-of-africas-funding-in-six-months/)

4.7. Conclusion

The government implements different policies in telecommunications industry more than indicated above. In this study we focused policies revolving around on telecommunications infrastructure, competition policy, institutional reforms based on the framework of this research. Ghana has implemented telecommunications infrastructure sharing policy which has contributed to a higher teledensity. Nonetheless, this is not the only reason why the industry density has improved over time. The identification of these reasons requires a further analysis of the industry given that the current existing literature such as Osie-Owusu and Henten 2017 and Haggarty et al. 2003 focusses on analysing the performance of the industry but not a comparative study to examine why Ghana performed better. The study establishes that Kenya experiences 'abuse of dominant position' while Ghana is below the 50% threshold. Therefore, the government should formulate guidelines to deal with abuse of dominant position.

In Table 7. Is a summary of this chapter is presented to map the scenarios why Ghana performed better than Kenya? Market concentration ratio between Kenya and Ghana indicate that Kenya's MNO market share is higher. Therefore, strengthening anti-trust policies could potentially curb this concentration (Aydin and Büthe 2016).

Table 7. Summary of Structural Policies in Ghana and Kenya (1990 – 2017)

	Ghana	**Kenya**
Competition Policy	National Telecommunication Policy of Ghana (2005) – bridge competition policy gaps in ADP.	Restrictive Trade and Monopolies and Price Control Act and its Limitations (RTMPC) 1988 – establishment of Monopolies and Prices Commission. Competition Act No.12 of 2010 – Establishes the CAK and Competition Tribunal receives appeals from CAK.
Infrastructure	Accelerated Development Plan (ADP-2000) (1994-2000) ✓ *Teledensity expansion (1.5 & 2.5 lines per 100 people).* ✓ *Rural and urban coverage of mobile services.*	Kenya Information Communication Amendment Act 2009 and Kenya Information and Communication Regulation 2010 - Telecommunication infrastructure expansion and establishment of Universal Service Fund.

	Electronic Communications Act 775 – establishment of GIFEC to manage the Universal Service Funds.	Kenya Information and Communication Act (2013) – Universal Service Advisory Council to advice CAK on USF policies.
Liberalization of the telecommunication	Statutory Corporations Act 1993, Act 461 – "Privatization of post and communications into two" (Frempong 2002: 11). National Communication Authority Act 1996, Act 524 – regulation of telecommunications industry and implicating technology. The Ministry of Communications was created in 1997.	The Kenya Communications Act 1998 *(A framework for regulation)*. ✓ Dismantled Kenya Post and Telecommunication into different entities i.e. CCK and Posta. Economic Reforms 1996 – 1998 – to implement the liberalization policy of 1998.
Number of Firms	Six no. of MNO's Namely: Scancom (MTN), Millicom (Tigo), Glo Mobile, Airtel Mobile and Vodafone Mobile	Four number of Firms. Namely: Safaricom, Airtel Kenya, Finserve Africa Limited, Telekom Kenya limited and Sema mobile services limited (The last two entered the market in 2015 and 2016 respective;
HHi Index	3192.11	5159.82

Source: Otieno and Aligula 2006; Frempong 2002; Nayo 2001; Ebo 2010; ITU 2013. figured by the author

Chapter 5. Telecommunications Industry Performance in Ghana: A Comparative Case Study Between Kenya And Ghana?

5.1. Introduction

This chapter will examine the technology changes that have occurred since 1990 and the factors that lead to Kenya's outperformance in telecommunications. The chapter will demonstrate how the sector has performed in Ghana addressing their competitive structures, structural changes and mobile infrastructure. This section will analyse why Ghana was more successful in mobile telecommunications compared with Kenya.

5.2. The Making of Mobile Telecommunications in Sub-Sahara Africa

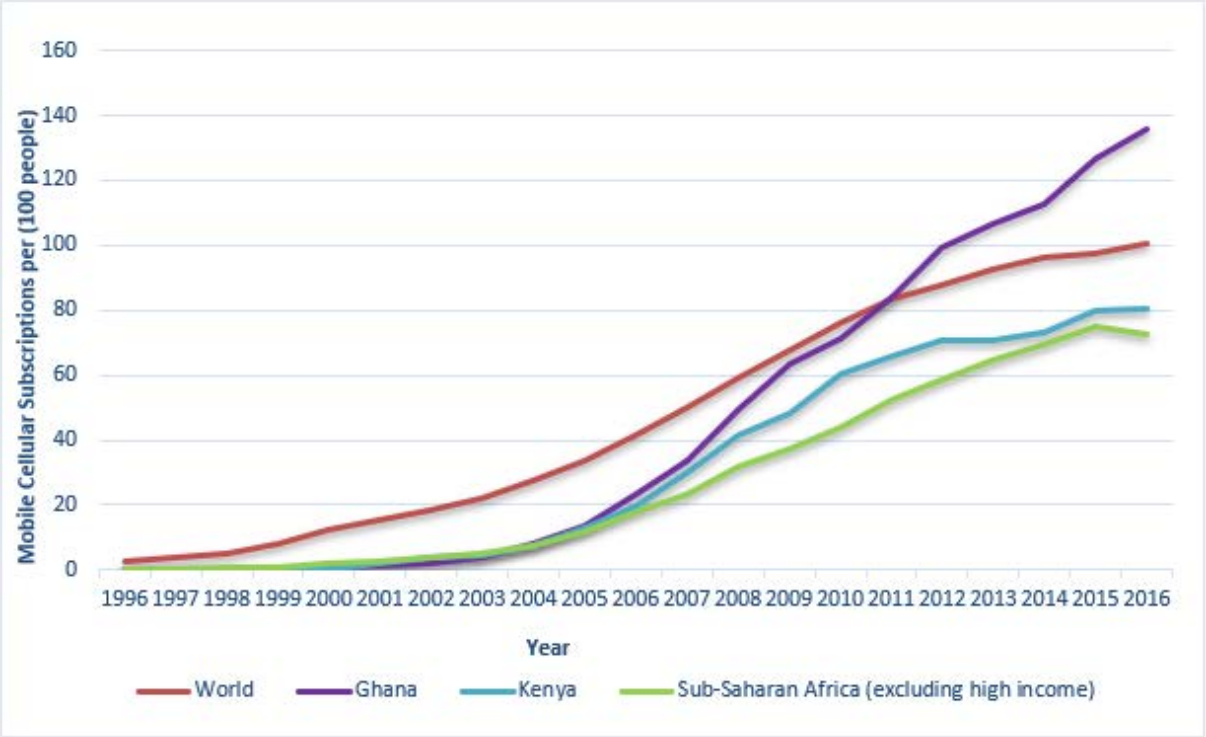
The telecommunications industry in Africa has been undergoing significant transformations since 1990. The remarkable process began when the rest of the world especially was restructuring their regulatory frameworks in the telecommunications sector. The focus on these reforms sought to eliminate public owned monopolies which were dominant in the 1990's. The process of deregulation in developed countries was primarily enhanced by the global shift for an open economy, which was deemed to be beneficial for developed countries to establish a competitive frame for industry growth (Kloosterhuis and Bergeijk 2005: 67). In Europe, the liberalization process was particularly successful due to considerations to eliminate monopolies and eliminate barriers in all sectors in the telecommunications sector including "terminal equipment, value-added services, satellite equipment and services, cable TV networks and mobile communications" (Liikanen 2011: 2).

The scarcity of mobile services in Sub-Sahara Africa (SSA) and the affordability of mobile devices in 1990 resulted to slow the industry's growth. Accessibility and the costs to purchase and maintain a mobile device was expensive such that only the affluent could afford. Therefore, between 1990 and 1995, the use of mobile density was low whereas fixed telephone density was higher (*figure 6*) Between 2000 and 2008, mobile density indicates a rapid growth and "a strong positive correlation with population density" (Aker and Mbiti 2010: 209).

Liberalization in the telecommunications industry was implemented at different times in Ghana and Kenya. The difference resulted in timelines and strategies generating different densities in the long-run. Ghana liberalized its industry earlier than Kenya in 1993. The liberalization of the industry established a competitive market which increased attractiveness leading to more operators to enter the market during the ADP-2000 implementation period (Haggarty et al. 2003). On the other hand, Safaricom and Kencell were the first privately owned operators to enter the Kenyan Market in 2000 after the Economic Reforms of 1996-1998. The entry of new competitors steered the industry to innovativeness. Mobile devices were more accessible, and the telecommunication density increased rapidly (Gachagua 2004: 17).

Between 2003 and 2006 Kenya had a higher penetration rate compared to Ghana. By 2005, Ghana experiences a significant increase in mobile cellular subscription per 100 people. The rapid increase was because of implementing the universal access fund which was key to expanding mobile infrastructure to rural areas and previously unserved areas (Ellis et al. 2010: 7). Kenya began to implement universal access fund in 2014 after a long tussle with MNOs (R. Wanjiku 2014). Between 2012 and 2016, Kenya's mobile subscription rate has been coherent with the rest of Sub-Sahara Africa. However, Ghana's mobile subscription rapidly increased and surpassed Kenya. Ghana has a higher number of mobile operators (5 as of 2017) compared to Kenya which has 3 MNOs leading operators and 2 new entrants (CAK 2016/2017). The effect of this is evident on the role of MNO to increase competitiveness for markets; therefore, subscriptions increased. In 2009, Ghana surpassed Kenya's mobile subscription. In a span of 5 years the penetration rate increased from 54% to 67% in 2012 and 2016 respectively. Ghana connected the first submarine fibre optic cable in 2012 and the second one in 2013 (GSMA 2017: 9). As of 2012 onwards Kenya's mobile subscription rate became constant. This is due to high corporate tax including universal access fund. Compare to Ghana, Kenya has a higher mobile income tax of 10% the latter 6%. The increase in mobile VAT has impacted mobile subscription by 58% per year per user (Ndwiga and Irungu 2009).

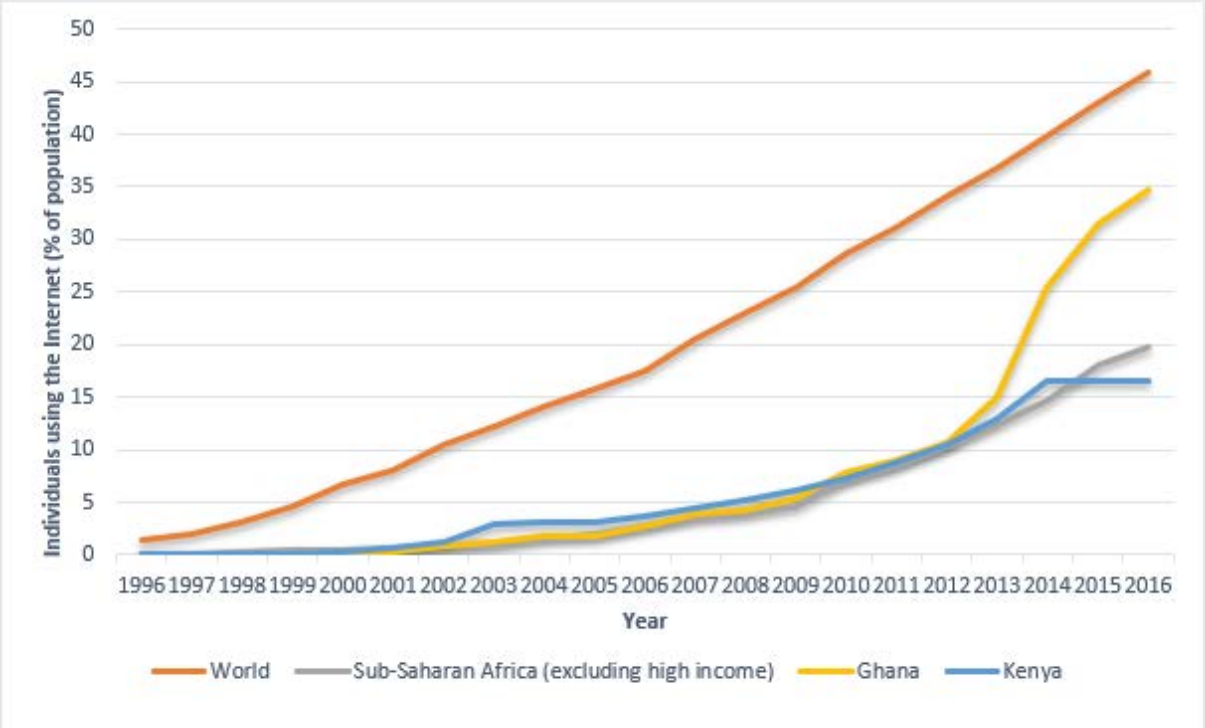
Figure 6. Trends in Mobile Cellular Subscriptions (Per 100 People) 1995-2016



Source: World Bank 2018 (http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#) Accessed 20 October 2018, figured by the author

Access to the internet came into the domain in the 1990's. Between 1990 and 1995, internet infrastructure such as secure number of internet server per 1 million was obsolete. The lack of internet services was also embedded on the availability of affordable data, internet connections and PCs. Accessibility of internet services was commercialized through internet service providers. ISPs increased after the liberalization of the telecommunications industry in Africa. Between 2002 and 2003, internet connectivity in different countries of Sub-Sahara had increased due to the increasing number of public ISPs. South Africa was leading in internet connectivity due to the high number of ISPs, (80 in 2002) whereas in Kenya there were 34 ISP in 2001 (Oyelaran-Oyeyinka and Adeya 2004: 68). Internet density between Ghana and Kenya increased in parallel with a minimal internet density percent population margin between 1996 and 2002. This is due to the implementation of ADP 2000 and privatization of Ghana Telecom to allow a third competitor to increase telecom services (Haggarty et al. 2003: 3) and the entry of Safaricom and Kencell in 2000 in Kenya. The latter had deregulated the industry and ISP providers increased internet services available to estimated 400, 000 subscribers whereas, Ghana had 200, 000 internet subscriptions in 2002 (Foster et al. 2004: 5). The number of ISPs in Kenya between 2002 to 2003 was 72 higher than Ghana which had 14 ISPS. (NISL 2012: 14; Foster et al. 2004: 38) (*See figure 6*).

Figure 7. Individuals Using the Internet (Percent Population) 1996-2016



Source: World Bank 2018 (http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#) Accessed 20 October 2018, figured by the author

5.3. Why did Ghana perform better in Telecommunications Subscriptions Compared to Kenya?

In this section, the study will assess the reasons why Ghana's performance in mobile cellular subscriptions per 100 people and internet usage percent population compared to Kenya is higher. Therefore, in this part I will provide a detailed analysis of the rends and factors identified during the analysis will be provided to explain this exemplary growth.

5.4. Telecommunications Liberalization and Infrastructure Growth.

The urge to develop and de-regulate the telecommunications industry began in 1990's. Global trends and reforms motivated by developed countries such as the Netherlands and United Kingdom and development partners such as the World Bank and International Monetary Fund ignited the reactions in developing countries to reform the telecommunications sector to eliminate monopolies and increase the entry of new competitor and privatization (Kloosterhuis and Bergeijk 2005: 67; Starr 1990).

In sub-Sahara Africa the case is no different between our case studies Ghana and Kenya. In the 1990's both countries were undergoing structural changes to reform the telecommunications industry. Nonetheless, the process of reforms encompassed different strategies and focused to develop the telecommunications sector. Bottom-line is, both countries agreed that de-regulation of the industry is important to spur growth of mobile industry and increased competitiveness. "The impact of telecommunications on competitiveness and liberalization depends on their position in competitive strategies" (Rallet 1994: 119).

In 1994, Ghana's telecommunications industry introduced a restructuring plan known as 'Accelerated Development Programme (ADP - 2000). The orientation of the plan marks the beginning of revolutionizing the telecommunications sector. ADP 2000, focused on increasing the teledensity from 1.5 to 2.5 lines per 100 people; increased fixed telephone infrastructure; affordable pricing tariffs; long-term implementation of the Universal Public Access fund; telecom infrastructure in urban and rural area with a 250 inhabitants benchmark; competitive structure detailing mergers, ownership, acquisition and control of the telecommunications operators; establishment of the National Communications Authority (Frempong 2002: 4).

The realization of ADP-2000 and RTMPC underpin different strategic focus and consequentially the resulting impact. Firstly, ADP focused on improving teledensity, establishment of an independent telecom operator from Ghana Post and Telecommunication Corporation and Ghana Telcom was established in 1995, which contributed to the development of the industry to an earlier start (Ebo 2010; Gachagua 2004). GoG established an expansion plan whereby, the second national operator would specifically operate in the rural areas providing telephone services in the southern region (Frempong 2002: 3-5). The access to mobile services in rural

and urban areas was a priority for ADP plan. During a five-year period, ADP success in mobile teledensity is evidenced in *table 8.* the increase in mobile and fixed telephone subscriptions between 1994 and 2000. Fixed telephone subscription per 100 people increased from 0.306 to 1.122 between 1994 and 2000 respectively. In addition, mobile cellular subscription (per 100 people) also increased from 0.0204 to 0.686 in 1999 and 2000 respectively. While this increase did not achieve the target density of 1.5 and 2.5 lines per 100 people. A decade after the implementation period of ADP, mobile technology was introduced in Ghana which increased the subscription of mobile cellular while fixed telephone subscriptions (per 100 people) decreased. Between 2013 and 2014 the telecommunications industry experienced decrease in the number of mobile subscriptions per 100 people due to the imposed 10% levy in Kenya and 6% in Ghana on mobile handsets and smartphones (Deloitte and GSMA 2011: 3). This tax negatively affected the purchasing of mobile phones which affected mobile cellular subscriptions. As a result, the GoG through the ministry of Finance announced a tax-exempt strategy to eliminate custom duties in 2015 and increase subscription of mobile services. (Deloitte and GSMA 2011: 62).

In Kenya, the RTMPC Act focused on eliminating entry barriers through industry liberalization to increase competitiveness. The structural plan was formulated with an impulse to address the existing monopoly in the telecommunications sector which had rendered the industry uncompetitive (Gachagua 2004: 2). During the implementation of RTMPC, The Monopolies and Prices Commission (MPC) was established to implement and regulate competitive policy reforms in the industry. The MPC was mandated to develope a regulatory and market structure, market conduct, enforcement and compliance of industry (RTMPC Act 1989). This commission faced a lot of challenges addressing how they would engage with other regulatory authorities such as CCK. Following this realization, GoK embarked on a restructuring process to ensure that the commission had more regulatory powers. The implementation to eliminate monopolies was enacted between 1996 – 1998 upon the adoption of a policy framework known as 'Economic Reforms 1996-1998'. The reforms focused on eliminating monopolies and enhancing privatization of the state-owned monopolies (NISL 2012: 14). During this reform period of reforms, mobile cellular subscriptions (per 100 people) between 1995 and 2000 increased from 0.0074 to 0.405 respectively. Despite the structural reforms, mobile density in Kenya remained lower than in Ghana. Fixed telephone subscription per 100 people slightly increased from 0.8608 to 0.9275 in 1994 and 2000 respectively (*See Table 9*.) (World Bank 2018).

Table 8. A Summary of The Comparative Measures on Ghana and Kenya Telecommunication Performance

	Ghana	Kenya
Improving Teledensity	ADP 1991-2000	RMTPC 1988 elimination of monopoly
Elimination of monopoly and independent telecom operator	Established in 1993	Telkom stablished in 1998
First privatized operator	GP&T separation to Ghana telecom and a second national operator in the rural area established in 1993	2000 Safaricom and Kencell
Operationalization of a rural firm	Implemented under ADP-2000 in 1993	Non-existent
Mobile services taxation	*6% Levy on Mobile handsets*	*10% levy on mobile handset*

Source: Frempong 2002 (https://www.researchgate.net/publication/37928088), Accessed 25 October 2018; Deloitte and GSMA 2011 (https://www.gsma.com/publicpolicy/wpcontent/uploads/2012/03/mobiletelephoneandtaxationinkenya.pdf) Accessed 19 October 2018, Figured by author.

Table 9. Telecommunications Density During the Implementation of ADP and RTMPC (1994 - 2000)

Infrastructure variables	Fixed Telephone Subscription per 100 people in Ghana	Fixed Telephone Subscription per 100 people in Kenya	Mobile Cellular Subscriptions per 100 people Ghana	Mobile Cellular Subscriptions per 100 people Kenya
1994	0.3062	0.8608	0.0204	0.0074
1995	0.3763	0.9377	0.0370	0.0083
1996	0.4532	0.9478	0.0743	0.0100
1997	0.5993	0.9389	0.1242	0.0233
1998	0.7396	0.9682	0.2315	0.0361
1999	0.8697	0.9477	0.3790	0.0776
2000	1.1222	0.9275	0.6867	0.4050

Source: World Bank 2018 (http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators#) Accessed 20 October 2018, figured by the author

5.3. New Entrants and Mobile Technology Change and Development

Liberalization of the telecommunications industry increases the number of entrants in the market. This determines the profitability and successful entry of a company to provide goods and services. In a scenario whereby; a firm makes a late entry, the comparative results between the earlier entrant and late entrant will yield different results such as, the number of mobile cellular subscription per firm, telecommunications infrastructure investment and penetration rate in both rural and urban areas. Therefore, the timing of entry in each market is important to propel a faster growth of the industry (Lillien and Yoon 1990: 569-571).

5.4. New Entrants in Ghana's and Kenya's Telecommunications industry

The process of privatization and de-regulation eliminates monopolies and creates a conducive environment for new entrants. Deregulation of industry in Ghana attracted investors due to elimination of barriers such as tax reductions, elimination of bureaucratic processes, reduced risks of operations and potential returns. "Regulatory risk not only impacts on the level and timing of investments but also the total costs of running a mobile operator" (Nanevie 2012: 47).

In Ghana's case, the GoG in the process of reforming the industry, sent invitation for bids in the early 1990's for a new cellular network operator. In 1993, Milicom Ghana had successfully bid as the first private firm to begin operations for cellular services in Ghana. Currently known as Tigo, the firm grew to 22, 000 subscriptions in 1998 and a market share of 70% in that year. In 1991, Millicom Ghana implemented the ETAC System to provide cellular service across Ghana. In addition, operations in other parts of rural Ghana were established through installation of satellites in areas such as Kumasi and Tamale. In 1993, CellTell a new entrant in Ghana's telecommunications industry brought a total of two privatised cellular providers. This operator systems utilized the AMPS services and focussed on a different location where Millicom had not started its operations such as Accra and Tema (*see table 9.)* (Nayo 2001: 9).

In 1996, NCA was established and mandated to grant licenses to telecommunication operators. In the same year, Scancom began its operations in Ghana providing the GSM 900 technology after paying a licensing fee to NCA. At that time, GP&T was providing cellular services such as voice calls and international calls. By 1996, ISPs increased to three providing their own satellite connection which enabled them to introduce competitive prices compared to Ghana Telecom (Foster et al. 2004: 3). In Kenya, the provision of internet services was illegal and became accessible in 1999 in the government officers, universities and NGO's (Mureithi n.d.: 27). Prior to 1999, Kenya's telecommunications industry was monopolistic and uncompetitive given that the only telecommunications operator at the time was one and owned and controlled by the Government of Kenya (GoK) under the brolly of Telkom Kenya. In 1997, GoK introduced structural reforms in the telecommunications industry to allow for competitive reforms from a

monopolistic sector to a liberalised industry. These reforms were based on reducing the government functions and control while addressing regulatory, a working environment, sector liberalization. Prior to these reforms, Telkom Kenya was mandated to source capitalize on fiscal resources from potential investors for expansion to the rural areas where network was still a challenge the sector continued to record low growth rate at 3.5% annually, poor cellular and internet connectivity was extensive. Between 2000 and 2016, Kencell rebranded to Celtel Kenya which was later sold to Zain a Kuwait based telecom. In 2011, Zain sold to Bharti Airtel (EPZ 2015; Beauchesne et al. 2014: 7-9).

Subsequently, Ghana Telkom also established a subsidiary cellular operator known as Westel which undergoing structural transformations to provide GSM services. Upon full de-regulation of the sector in early 1990's Ghana had 4 MNOs operating. Over the years this number increased to 5 (*See figure 8*). The number of fixed pay phones increased from 25 in 1993 to 4000 in 2001 (i.e. 287%). Compared to SSA, Ghana's teledensity was growing faster since it grew by 66% in the same time frame. This performance is attributed to the process of privatization and structural reforms that began implementation in 1990's (Haggarty et al. 2003).

Table 10. Summary of New Entrants in Kenya And Ghana Between 1990-1999 And 2000 - 2016

Country	New entrant between 1990 - 1999	New entrant between 2000 and 2016	Main type of service
Ghana	Milicom (Tigo), subsidiary of Milicom International. CellTell Ghana Westel second national operator Scancom	Glo Expresso Airtel Vodafone	Voice call both local and international, SMS and mobile money services.
Kenya	none	Safaricom PLC ltd (Majority shareholder Vodafone) Kencell rebranded to Celtel The later was sold to Celtel Kenya, then rebranded to Zain Kenya. Currently Bharti Airtel in 2011 to date Essar Group	Voice calls local and international, data services, SMS, mobile money services

Source: Nayo 2011: 7 (http://www.itu.int/osg/spu/ni/3G/casestudies/ghana/ghanafinal.doc) Accessed 25 October 2018; EPZ 2015 (http://www.epzakenya.com/UserFiles/files/ictKenya.pdf) Accessed 25 September 2018 figures by author

5.5. Conclusion

Kenya's Mobile subscription is higher than a most of the SSA countries. However, comparing to Ghana, mobile subscription per 100 persons has rapidly increased in a span of one decade. This means that the rate of ownership is higher to that in Kenya. Currently, Ghana has a higher mobile penetration rate at 67% compared to Kenya's 57% mobile penetration rate (GSMA 2017). In Africa, Ghana still lags in innovative mobile technologies and start-ups in mobile industries compared to Kenya (CapitalFM 2018).

While analysing the market share between Ghana and Kenya, there are two dominant players in the market respectively. Nonetheless, the gap between the leading mobile operator and the second largest on Ghana is lower (between 47.8% and 23.78% voice subscription) compared to that of Kenya with 71.2% and 17.6% (NCA n.d.; CAK 2016/2017). In Ghana, Scancom has 47.8% share of the entire market while Kenya's dominant operator has a 67.4% market share. The wide market share gap between Safaricom and Airtel is attributed to the sophisticated telecommunication infrastructure that is accessible in 80% of the country compared to the other operators. Moreover, the quality of products and services are attributed to Safaricom's success (TFS n.d.). Network operators who enter a market earlier than the rest have a significant competitive advantage. They can increase their market share through provision of innovative services which increase barriers for new entrants. In hindsight we can say that "the attainability of market share is closely concentrated by market concentration" (Boniecki et al. 2016: 19). Therefore, infrastructure sharing is a crucial element for leveraging competitiveness in order to reduce costs for new entrants. This role is mandatory for the statutory bodies that regulate the industry (Boniecki et al. 2016:19-18).

Chapter 6. Conclusion

6.1. Conclusion

The main research question examines under which conditions can the communications sector contribute to development. The study found out that telecommunications industry thrives under a liberalized industry which creates opportunities for new entrants, increased competition. Investing in telecommunications infrastructure improves mobile accessibility and improved quality of products and services. Further, the dynamism of mobile technological progress is confined within the tenets of 'creative destruction' through progressive innovation (Laino 2011: 2). Evidently, the innovation process and policy frameworks and strategies entail cooperation between institutions such as the government, antitrust, regulatory bodies to formulate relevant policies to improve the industry.

While examining the sub-research question, the study sought to answer whether the mobile industry is important for Development. From the existing literature, there significant best practices examples in Sub-Sahara Africa, that demonstrate the importance of mobile technology to promoting growth and economic development. In Ghana and Kenya, mobile technology has been used to develop Mobile apps to provide information and to improve access to information on health issues on child health care and maternal health. In other parts of SSA, such Niger, mobile phones were useful to farmers seeking to seeking markets for their produce. This reduced transaction costs and eliminated time wastage and food wastage, thus increasing their returns.

How can the government stimulate the telecommunications industry? To answer this question, the research assessed existing literature to identify various ways with which the government has stimulated the mobile industry. In line with this study, the government stimulates the telecommunications industry b formulating relevant policies such the telecommunications infrastructure sharing framework, establishment of competition policy laws and institutional and legal frameworks that govern the industry. The institutional theory implicates institutionalism to formulating policies.

The research also examines why Ghana performed better than Kenya in mobile telecommunication density. The analysis established an interesting pattern and trend in mobile industry growth and innovation. In addition, while Ghana is performing better in teledensity (i.e. rapid mobile cellular subscription growth per 100 people and individuals using the internet percent population), Kenya is leading in mobile innovation. Using a comparative tracing approach, the study was able to identify the 'intervening variables' that implicate this performance. Therefore, through a process of tracing, the study was able to observe the probable explanations to this rapid performance (Bennet 2004: 22).

Ghana performed better than Kenya due to the institutional changes. This is attributed to the speed of implementing the reforms such as ADP-2000 between 1994 and 2000. Between this period Ghana experienced entry of new competitors who were the drivers of mobile technology change. The tower sharing framework in Ghana contributed to the rapid expansion of mobile phones in the rural areas. In addition, GIFEC also management of the universal service fund independently contributed to the expansion of internet in rural areas. Nonetheless, these alone cannot explain the overperformance of Ghana in mobile cellular services (per 100 people) and individuals using internet (percent population). Kenya by contrast experienced a lengthy timeline to implement policies and reforms. Therefore, in this study there is a good reason to believe that Ghana's performance was influenced by institutional reforms, and the speed of implementation of these reforms.

6.2. Policy Implications Recommendations for the Government of Kenya

Telecommunications infrastructure sharing is important for the industry's performance. It increases mobile penetration and improves the quality of internet connectivity. Infrastructure sharing reduces the costs of operations for new telecommunication firms. Telecommunication companies such as Vodafone and Orange (Spain and UK) demonstrated that sharing telecommunications infrastructure reduced their cost of operations (ITU n.d.). In Ghana, the infrastructure sharing model has successfully eliminated infrastructure investment risks for MNO through third parties such as 'Helios Tower Ghana, Eaton Towers and America Tower Company' (Osei-Owusu and Henten 2017: 5-10).

The existence of telecommunications infrastructure sharing in Kenya remains elusive. Given the state of industry competition in Kenya, new entrants and 'smaller players' often face difficulties investing in telecommunications infrastructure which reduces competition (Kamau 2018). Therefore, the GoK should involve state and non-state actors to develop a mobile sharing framework to increase mobile technology access.

The Universal Service Fund has contributed to the expansion of the industry. To ensure that the funds are used accountably and effectively, an independent body with flexibility to adjust policies should exclusively run the fund (ITU 2013: 15). In Ghana, GIFEC is an independent body that runs the operations of the fund independently of the national regulator NCA. GIFEC improved the efficiency, accountability and transparency of the fund in expanding telecommunication services in rural areas (GSMA 2014: 14). In Kenya, the fund is under the CAK the national regulator in telecommunications. Therefore, separating the two institutions will be crucial to expand the capabilities of an independent institution. "A central oversight body has proved very helpful to many countries" (OECD n.d.: 4).

The following recommendations are important having identified gaps and opportunities for improvement. The following action points can be taken into consideration for increased subscription and affordable services.

The following recommendations to GoK are:

- ✓ *Develop and implement a telecommunication infrastructure policy plan for MNOs.*
- ✓ *Establish a subsidiary of Telkom Kenya to operate in the rural and marginalized areas.*
- ✓ *Establish an independent body to manage USF.*
- ✓ *Involve the local communities in the development plans.*
- ✓ *Provide tax incentives to the companies seeking to operate in the underserved areas.*

7. Reference

Aker, J.C. and I. Mbiti (2010) '*Mobile Phones and Development in Africa*', *Journal of Economic Perspectives* 24(3): 207–232. Centre for Global Development Working Paper no. 211, Accessed 12 September 2018 <http://sites.tufts.edu/jennyaker/files/2010/09/aker_mobileafrica.pdf>.

Aydin, U. and T. Büthe (2016) 'Competition Law & Policy in Developing Countries: Explaining Variations in Outcomes; Exploring Possibilities and Limits', 79 Law and Contemporary Problems, 79(4): 1-36. Accessed 16 November 2018 <https://scholarship.law.duke.edu/lcp/vol79/iss4/1>.

Andjelkovic, M. and S. Imaizumi (2012) 'Mobile Entrepreneurship and Employment', *Innovations: Technology, Governance, Globalization* 7(4): 87-100. 11 October 2018 <https://www.mitpressjournals.org/doi/10.1162/INOV_a_00154>.

Adelman, I. (1999) 'The Role of Government in Economic Development', Department of Agricultural and Resource Economics Working Paper No. 890. Berkeley: University of California.

African Observatory Health (AHO) (2015) 'Mobile Health: Transforming the Face of Health Service Delivery in the African Region', *World Health Organization*. Accessed 15 October 2018 <http://www.aho.afro.who.int/en/blog/2015/03/10/mobile-health-transforming-face-health-service-delivery-african-region>.

Braathen, E. (2004) 'Institutions Matter: Engineers and Telecommunication Development in Mozambique and Zimbabwe', Telematics and Informatics 21(2): 25-47. Accessed 15 October 2018 <https://doi.org/10.1016/S0736-5853(03)00021-2>.

Bergeijk, P.A.G. and R.C.G. Haffner. (1996) 'Privatization, De-Regulation and the Macroeconomy: Measurement, Modelling and Policy'. United Kingdom: Edgar Edward Publishing Limited.

British Broadcasting corporation (BBC) (2018) 'Google's Loon Brings Internet-by-Balloon to Kenya', 19 July, p. 1. Accessed 20 October 2018 <https://www.bbc.com/news/technology-44886803>.

Boland, L. A. (1979) 'Knowledge and the Role of Institutions in Economic Theory', *Journal of Economic Issues*, 13(4): 2-4. Accessed 16 November 2018 <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.29.15&rep=rep1&type=pdf>.

Berthod, O. (2016) ‘Institutional Theory of Organisations’. Accessed 16 November 2018. <https://www.researchgate.net/publication/312572322_Institutional_theory_of_organizations>.

Beauchesne, L., N. Dorion, N. Griggs and J. S. Harrison (2014) ‘Safaricom: Innovative Telecom Solutions to Empower Kenyans: Case Study’. Accessed 2 November 2018 <https://scholarship.richmond.edu/cgi/viewcontent.cgi?article=1015&context=robins-case-network>.

Bennet, A. (2004) 'Case Study Methods: Design, use and Comparative Advantages', in D.F. Sprinz and Y. Nahmias-Wolinsky (eds)Models, Numbers, and Case: Methods for Studying International Relations, pp. 19-23. Michigan: The University of Michigan Press.

Boniecki, D., Marcati, C., Abou-Zahr, W., Alatovic, T. and El Hamamsy, O. (2016) 'Middle East and Africa Telecommunications Industry at cliff’s Edge Time for Bold Decisions' (a webpage of McKinsey and Company). Accessed 10 November 2018
<https://www.mckinsey.com/~/media/McKinsey/Industries/Telecommunications/Our%20Insights/Winning%20the%20rush%20for%20data%20services%20in%20the%20Middle%20East%20and%20Africa/Telecommunications%20industry%20at%20cliffs%20edge%20Time%20for%20bold%20decisions_June2016.ashx>.

Bartlett, L. and F. Vavrus (2017) ‘Comparative Case Studies: An Innovative Approach’, Nordic Journal Comparative and International Education, 1(1): 5-17. Accessed 14 November 2018 <https://doi.org/10.7577/njcie.1929>.

Crabtree, P. (2006) ‘A Framework for Understanding Technology and Technological Change’, 11(1): 5-9. 4 October 2018 <https://www.innovation.cc/discussionpapers/crabte_tech07-25-05rev3l.pdf>.

Competition Authority of Kenya (CAoK) (n.d.) ‘Consolidated Guidelines on the Substantive Assessment of Restrictive Trade Practices under the Competition Act’. Accessed 18 November 2018. <https://www.cak.go.ke/images/docs/Restrictive-Trade-Practices-Guidelines.pdf>.

Camara, S., S. Shrestha, J. Abdelnour-Nocera and J. Moore (2010) ‘Village eLearning: An Offline Mobile Solution to Rural Communities’ Knowledge Recruitment’. Accessed 14 October 2018 <https://pdfs.semanticscholar.org/10dc/f3c9c748f502f1b1f140c57dbd723179ca15.pdf>.

Communications Authority of Kenya (CAK) (2016/2017) 'Second Quarter Sector Statistics Report for the Financial Year 2016/2017 (October-December 2016)', Sector Statistics Report, pp. 10-15. Nairobi: Communications Authority of Kenya.

Capital FM (2018) ‘Kenya Tech Start-ups Scoop Half of Africa’s Funding in Six Months’ Accessed 7 November 2018 <https://www.capitalfm.co.ke/business/2018/07/kenyan-tech-startups-scoop-half-of-africas-funding-in-six-months/>.

ChristianAid (2014) ‘Levelling the Playing Field: The role of Government in Enabling Pro-poor Businesses to Thrive’. Accessed 9 November 2018
<https://www.christianaid.org.uk/sites/default/files/201705/Levelling%20the%20playing%20field%20%20the%20role%20of%20government%20in%20enabling%20propoor%20business%20to%20thrive.pdf>.

Christensen, M.C., D.S. Anthony and A.E. Roth (2011) ‘Innovation in the Telecommunications Industry Separating Hype from Reality’. Telecommunications Working Paper. Accessed 16 August 2018
<http://ant.comm.ccu.edu.tw/course/92_3G/1_Papers/Innovation%20in%20the%20Telecommunications%20Industry.pdf>.

Damsgaard, J. and P. Gao (2007) ‘A Framework for Analyzing Mobile Telecommunications Market Development’, Journal of Electronic Commerce Research, 8(3): 186-193. Accessed 18 September 2018
<https://www.researchgate.net/publication/228343034_A_Framework_for_Understanding_Mobile_Telecommunications_Market_Innovation_A_Case_of_China >.

Deloitte and Groupe Spéciale Mobile Association (GSMA) (2012) 'Sub-Sahara Africa Mobile Observatory', *The Mobile Economy Sub-Sahara Africa*, pp. 2-16 GSMA. Accessed 19 October 2018
<https://www.gsma.com/publicpolicy/wpcontent/uploads/2012/03/SSA_FullReport_v6.1_clean.pdf>.

Deloitte and Groupe Spéciale Mobile Association (GSMA) (2011) ‘Mobile Telephony and Taxation in Kenya', pp. 3-4 GSMA. Accessed 19 October 2018
<https://www.gsma.com/publicpolicy/wpcontent/uploads/2012/03/mobiletelephoneandtaxationinkenya.pdf >.

De Rosa, D. and N. Malyshev (2008), ‘Regulatory Institutions: A Blueprint for the Russian Federation’, OECD Working Papers on Public Governance, No.10, OECD Publishing. Accessed 4 November 2018 <https://www.oecd.org/regreform/regulatory-policy/42142925.pdf>.

De Silva, H., D. Ratnadiwakra, S. Soysa (2008) ‘Transaction Costs in Agriculture: From the Planting Decision to Selling at the Wholesale Market A Case-Study on the feeder area of

the Dambulla Dedicated Economic Centre in Sri Lanka'. Accessed 4 November 2018 <http://ssrn.com/abstract=1555458>.

Economides, N. (2004) 'Telecommunications Regulation: An Introduction', NYU Working Paper no. 04-10. New York: Stern School of Business. Accessed 2 October 2018. <http://dx.doi.org/10.2139/ssrn.465020>.

Export Processing Zones Kenya (EPZ) (2015) 'Kenya Information and Communication Technology Sector'. Accessed 29 September 2018 <http://www.epzakenya.com/UserFiles/files/ictKenya.pdf>.

Ellis, K., R. Singh and D. Ong'olo (2010) 'Assessing the Economic Impact of Competition: Findings from Kenya'. Accessed 24 October 2018 <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/6064.pdf>.

Ebo, P. T. (2010) 'Understanding the Ghanaian Telecom Reform', 21st European Regional ITS Conference Copenhagen, Aalborg University, Denmark (13-15 September 2010).

Frempong, G. (2002) 'Telecommunications Reforms Ghana's Experience'. Accessed 25 October 2018 <https://www.researchgate.net/publication/37928088>.

Foster, W., S, Goodman, E. Osiakwan and A. Bernstein (2004) 'Global Diffusion of the Internet IV: The Internet in Ghana', *Communications Associations of The Information Systems*, 13(38): 22-35. Accessed 28 October 2018 <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.195.150&rep=rep1&type=pdf>.

Fernández, A.S., F, Roy and D.R. Gnyawali (2014) 'Sources and Management of Tension in Competition: Case Evidence from Telecommunications Stellites Manufacturing in Europe', *Industrial Marketing management*, 43(2): 222-235. Accessed 2 November 2018. <https://doi.org/10.1016/j.indmarman.2013.11.004>.

Groenewegen, J. P. M. and R.W. Kunneke (2005) 'Process and Outcomes of the Infrastructure Reform: An Evolution Perspective', in Rolf W. K., Aad F. C. and John P.M (ed.) *Institutional Reforms, Regulation and Privatization: Process and Outcomes in Infrastructure Industries*, pp. 1-36. United Kingdom: Edward Elgar Publishing Limited.

Gruber, H., P. Koutroumpis, T. Mayer and V. Nocke (2011) 'Mobile Telecommunications and the Impact Economic Development', Economic Policy, 26(67): 20 October 2018-387-426. Accessed 20 October 2018 <https://www.jstor.org/stable/41261993?seq=1#page_scan_tab_contents>.

Gachagua, M.P. (2004) 'The Determinants of Telecommunications Growth in Kenya', Master's Thesis. Nairobi: University of Nairobi.

Groupe Spéciale Mobile Association (GSMA) (2014) ' Sub-Sahara Africa – Universal Service Fund Study', pp. 11-15. United Kingdom: GSMA.

Groupe Spéciale Mobile Association (GSMA) (2017) 'The Mobile Economy Sub-Sahara Africa 2017' pp. 3-35. United Kingdom. GSMA.

Goodrick, D. (2014) 'Comparative Case Study'. Accessed 31 October 2018 <https://www.unicefirc.org/publications/pdf/brief_9_comparativecasestudies_eng.pdf/>.

Greenstein, S. M. and P.T. Spiller (1996) 'Estimating the Welfare Effects of Digital Infrastructure' NBER Working Papers Series No. 5770. Cambridge: National Bureau of Economic Research.

Government of Ghana (n.d.) 'GMIC/MTN Business Incubation Partnership Project Launched in Accra'. Accessed 9 November 2018 <http://www.ghana.gov.gh/index.php/media-center/news/2828-gmic-mtn-business-incubation-partnership-project-launched-in-accra>.

Haggarty, L., M. Shirley and S. Wallsten (2003). 'Telecommunication Reform in Ghana' Policy Research Working Paper. Washington DC.: The World Bank Development Research Group Investment Climate.

International Telecommunication Union (ITU) (2013) 'Universal Service Fund and Digital Inclusion For All' Accessed 26 October 2018 <https://www.itu.int/en/ITU-D/Regulatory Market/Documents/USF_final-en.pdf>.

International Telecommunications Union (ITU) (n.d.) 'Mobile Infrastructure Sharing'. Accessed 9 November 2018 <https://www.itu.int/itunews/manager/display.asp?lang=en&year=2008&issue=02&ipage=sharingInfrastructure-mobile>.

Independent Evaluation Group (IEG) (2011) 'Capturing Technology for Development: An Evaluation of World Bank Group Activities in Information and Communication Technologies'. Washington, DC: Independent Evaluation Group, The World Bank Group.

International Chamber of Commerce (ICC) (2007) 'Telecoms Liberalization: An International Business Guide for Policymakers'. Accessed 16 October 2018

<https://cdn.iccwbo.org/content/uploads/sites/3/2007/10/ICC-EBITT-Commission-Telecoms-Liberalization-An-international-business-guide-for-policymakers.pdf>.

International Telecommunications Union (ITU) (1999) 'Challenges to the Network: Internet for Development 1999' Accessed 9 November 2018 <https://www.itu.int/ITU-D/ict/publications/inet/1999/exesum.html>.

Information Technology and Communication Authority (ICT - Authority) (n.d.) 'Nailab Business Incubation Project'. Accessed 31 October 2018 <http://icta.go.ke/nailab/>.

Jaffe, A.B., R.G. Newell and R.N. Stavins (2002) 'Environmental Policy and Technological Change', *Environmental and Resource Economics*', 22(1): 41-70. Accessed 7 November 2018 <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.18.3077&rep=rep1&type=pdf>.

Kloosterhuis, E.J. and P.A.G. Bergeijk (2005) 'Competition Policy, Networks and the New Economy', in Rolf W. K., F. C. Aad and P.M, John (eds) Institutional Reforms, Regulation and Privatization: Process and Outcomes in Infrastructure Industries, pp. 67-86. Glensanda House, Montpellier Parade Cheltenham, Glos GL50 1UA, UK: Edward Elgar Publishing Limited.

Kessides, I.N. (2004) 'Reforming Infrastructure Privatization, Regulation and Competition', A World Bank Policy Research Report, pp. 3-7. Washington DC.: World Bank.

Kamau, M. (2018) 'Kenyan Telcos in Dilemma over Infrastructure Sharing', Standard Digital 25 February, p.1. Accessed 9 November 2018 <https://www.standardmedia.co.ke/business/article/2001271035/kenyan-telcos-in-dilemma-over-infrastructure-sharing>.

Lal, D. and P. Strachan (2004) 'Key Determinants of Environmental Change in UK Telecommunications: Empirical Evidence', Paper presented at the 15th Biennial International Telecommunication Society Conference, Berlin Germany (4th - 8th September).

Lee, S. H., J. Levendis, J.C. Reesman, (2011) 'Telecommunications and Economic Growth: Am Empirical Analysis of Sub-Sahara Africa', *Applied Economics*, 44(4): 461 – 469 Accessed 23 October 2018 <https://www.researchgate.net/publication/260136752>.

Lilien, G. L. and E. Yoon (1990) 'The Timing of Competitive Market Entry: An Exploratory Study of New Industrial Products', *Management Science*, 36(5): 569-571. Accessed 22 October 2018 <http://dx.doi.org/10.1287/mnsc.36.5.568>.

Loon (n.d.) 'Journey' Accessed 22 October 2018 <(https://loon.co/journey/)>.

Liikanen, E. (2011) 'The European Union Telecommunications Policy', Telecommunications Seminar, 16 July. European Commission: Enterprise and the Information Society pp2-6.

Laino, A. (2011) 'Innovation and Monopoly: The position of Schumpeter', MPRA Paper No. 35321. Accessed 16 October 2018 <https://mpra.ub.uni-muenchen.de/35321/>.

mHealth Kenya (n.d.) Accessed 14 October 2018. <https://mhealthkenya.org/>.

Mohamed, I.A.H. (2016) 'The Institutional Theory: A critical Analysis', *International Journal of Scientific and Technology Research*, 6(9): 2-4. Accessed 16 November 2018 <http://www.ijstr.org/final-print/sep2017/Some-Issues-In-The-Institutional-Theory-A-Critical-Analysis.pdf>.

Mureithi, M. (n.d.) 'Evolution of Telecommunication Policy Reforms in East Africa: Setting New Policy Strategies to Anchor Benefits of Policy Reforms'. Accessed 19 November 2018 <https://idlbncidrc.dspacedirect.org/bitstream/handle/10625/42262/129625_2002_no4.pdf?sequence=1&isAllowed=y>.

Ministry of Information, Communication and Technology (MICT) (n.d.) 'Ministerial Strategic Plan 2013 – 2017'. Accessed 8 November 2018 <http://www.ict.go.ke/wp-content/uploads/2016/04/MinistryStrategic.pdf>.

Malkovsky, M. (2017) 'Abuse of Dominant Position in the ICT Sector: A European Perspective', Master's Thesis. Charles University.

Ministry of Communication (MoC) (2016) 'Agencies'. Accessed 18 November 2018. <https://www.moc.gov.gh/agencies>.

Ndwiga, R. and C. Riungu (2009) 'Telecoms Firms Oppose 1pc Universal Fund', The East African, October 26, p.1. Accesses 3 November 2018 <https://www.theeastafrican.co.ke/news/2558-676810-view-printVersion-lus6fi/index.html>.

Nelson, R. R. and K. Nelson (2002) 'Technology, Institutions, and Innovation Systems', *Research Policy*, 31: 265-272. 20 October 2018 <https://pdfs.semanticscholar.org/90d3/1273b11fb18a6c4c657e81af2c8943d41ad9.pdf> .

Nam, C. (2000) 'Competition Policies for the Telecommunications Industry in Korea', in Ito, T. and Krueger, A. O (ed.) Deregulation and Interdependce in the Asia- Pacific Region, Vol. 8. pp. 351-370. University of Chicago Press.

Norton, S. (1992) 'Transaction Costs, Telecommunications and the Microeconomics of Macroeconomic Growth', *Economic Development and Cultural Change,* 41(1): 175-196. Accessed 17 October 2018 < http://dx.doi.org/10.1086/452002>.

North, D.C. (2016) 'Institutions and Economic theory', The American Economist, 61(1): 72-76. Accessed 16 November 2018 < https://doi.org/10.1177/0569434516630194>.

Nayo, C. A. (2001) '3G Mobile Policy: The Case of Ghana'. Accessed 25 October 2018 <http://www.itu.int/osg/spu/ni/3G/casestudies/ghana/ghanafinal.doc>.

Netcom Informations System Ltd (NISL) (2012) 'Internet Market Analysis Study Final Report', pp. 2-34. Nairobi: Communications Authority of Kenya.

Nanevie, F.A. (2012) 'The Effects of Government Regulations on the Mobile Communication Telephony in Ghana', Master of Business. Kumasi: Kwame Nkrumah University of Science and Technology.

National Communications Authority (NCA) (n.d.) 'Telephone Voice Subscriptions'. Accessed 2 November 2018 <https://www.nca.org.gh/industry-data-2/market-share-statistics-2/voice-2/>.

Osei-Owusu, A. and A. Henten (2017) 'Network tower sharing and telecom infrastructure diffusion in Ghana - a Structure-Conduct-Performance approach', 4th International Telecommunications Society (ITS) Asia-Pacific Regional Conference: "Mapping ICT into Transformation for the Next Information Society", Kyoto, Japan, 24-27 June, 2017. International Telecommunications Society. Accessed 21 October 2018. <http://hdl.handle.net/10419/178421>.

Oyeleran-Oyeyinka, B. and N.C. Adeya (2004) 'Internet Access in Africa: Empirical Evidence from Kenya and Nigeria', Telematics and Informatics, 21(1): 67-81.

Otieno, G. and E. M. Aligula (2006) 'Trade Liberalization and Poverty in Kenya: A Case Study of the Telecommunications Sub-sector'. Kenya Institute for Public Policy Research and Analysis, Nairobi.

Overå, R. (2006) 'Network, Distance, and Trust: Telecommunications Development and Changing Trading Practices in Ghana', World Development, 34(7): 1301-1315 <https://doi.org/10.1016/j.worlddev.2005.11.015>.

Organization for Economic Development and Co-operation (OECD) (n.d.) 'Better Regulation in Europe: An OECD Assessment of Regulatory Capacity in the 15 Original Member States of the EU'. Accessed 9 November 2018. <https://www.oecd.org/gov/regulatory-policy/44952994.pdf>.

Procházka, P. (2014) 'Impact of liberalization Policy on Mobile Market and Average Price per minute in the EU', *International Journal of Business Management* 2(4): 3-5. Accessed 7 November 2018 <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.859.7697&rep=rep1&type=pdf>.

Porter, M. E. (1990) 'The Competitive Advantage of Nations', *Harvard Business Review* 68(2): 73-93.

R. Wanjiku (2014) 'Kenya Starts the Universal Service Fund Implementation' IT World. Accessed 3 November 2018 <https://www.itworld.com/article/2693785/networking-hardware/kenya-starts-universal-service-fund-implementation.html>.

Rallet, A. (1994) 'Telecommunications and Competitiveness', The French Journal of Communication 2: 113-133. Accessed 1 November 2018 <https://www.persee.fr/doc/reso_0969-9864_1994_num_2_1_3263>.

Starr, P. (1990) 'The New Life of the Liberal State: Privatization and the Restructuring of State - Society Relations'. Accessed 20 October 2018 <https://www.princeton.edu/~starr/newstate.html>.

Shughart II, W. F. (n.d.) 'Industrial Concentration'. Accessed 16 November 2018 <https://www.econlib.org/library/Enc/IndustrialConcentration.html>.

Sozzi, C.J. (1996) 'Project Financing and Facilitating Telecommunications Infrastructure Development in Newly-Industrializing Countries', Santa Clara High Technology Law Journal, 12(2): 436-437. Accessed 9 November 2018 <http://digitalcommons.law.scu.edu/chtlj/vol12/iss2/6>.

Statistics Solutions (n.d.) 'Descriptive Statistics and Interpreting Statistics'. Accessed 6 November 2018 <https://www.statisticssolutions.com/descriptive-statistics-and-interpreting-statistics/>.

Sakyi-Addo, K. (n.d.) 'Infrastructure Sharing: Challenges and Opportunities'. Accessed 15 November 2018 <https://www.nca.org.gh/assets/Uploads/Infrastructure-Sharing-IS-MNO-Perspective.pdf>.

The Restrictive Trade Practises, Monopolies and Price Control Act 1990, CAP 505. Accessed 25 October 2018 <https://unctad.org/Sections/ditc_ccpb/docs/ditc_ccpb_ncl_kenya_en.pdf>.

The Fletcher School (TFS) (n.d) 'Safaricom: Managing Risk in a Frontier Capital Market'. Accessed 13 November 2018 <http://fletcher.tufts.edu/IBGC/Lab/StudentResearch/~/media/Fletcher/Microsites/CEME/newpdfs/SafaricomFinal112010.ashx>.

World Bank (WB) (2002) 'Information and Communication Technologies', *A World Bank Group Strategy*. Washington, DC. Accessed 13 October 2018 <https://openknowledge.worldbank.org/handle/10986/15243 License: CC BY 3.0 IGO>.

World Bank (2018) 'World Development Indicators'. Accessed 20 October 2018 <https://data.worldbank.org/topic/infrastructure?view=chart>.

World Bank (1999) 'Abuse of Dominance', A Framework for the Design and Implementation of Competition Law and Policy, Vol. 1. pp. 81-82. Washington DC.

Whiteman, J.L. (1990) 'Telecommunications: Competition or Monopoly?', *Economic Papers: A Journal of Applied Economics*, 9(3): 46-57. Accessed 11 September 2018 <https://doi.org/10.1111/j.1759-3441.1990.tb00609.x>.