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How do innovations in the digital economy contribute to inclusive development and growth in Sub-Saharan Africa?

Briony Gould
br1824go-s@student.lu.se

Abstract: In recent years an explosion of new innovations have developed in the Sub-Saharan African digital economy. The services these innovations have provided such as banking, insurance and health care have long been widely available in the Developed World, yet massively underprovided in the region. This research has found that new innovations have developed to tackle unique problems to Sub-Saharan Africa and contributing to a path of inclusive and sustaintable development. The paper disscusses how the expansion of the digital economy in Sub-Sahran Africa has changed the way in which people live, economies exist and socieites function

Key words: Innovation, inclusive growth, digital economy, m-development

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1   Introduction

1.1   Background

Differences in standard of livings have never been so stark with 767 million people living below the international poverty line the need for action is unquestionable and imminent (United Nations Organisation, 2017). In a new digital age there is hope that this could be alleviated. The digital economy as defined by (OECD, 2014) "addresses the use of information communication technologies (ICTs) and the internet at work in the relation to the economy and society". Within the context of Sub-Sahran Africa this digital economy has also been utilised to attempt to achieve development goals. The UN has outlined 17 sustainable development goals (SDGS), which are used by many as the objective to work towards. These goals range from no poverty, zero hunger, quality education, health and well-being, gender equality and clean energy among others.

A crucial aspect for development is that is inclusive across populations and regions. This is also presented in another SDG as "reduced inequality within and among countries" that is that firstly that while poverty reduction has been significant, health and educations access still see "large disparities". Further the goal presents the issue that while income inequalities across countries decreases, income inequality within countries remains and has risen.

The use of ICT and internet technologies to achieve development goals is referred to a m-development short for mobile development (Aker & Mbiti, 2010). The region in which this research is undertaken is within countries in Sub-Saharan Africa. Due to the varied nature of countries within this region it is not relevant for all however I will discuss this further in later sections.

In the Developed World there is a focus on how new innovations such as increased levels of automation within the digital economy will affect the level of jobs and wages, with many concerned for the effect for workers (McKinsey Global Institute, 2017). However, these new innovations have vastly different possibility's in the Sub-Saharan African region, which has received little attention within research. Where technological advances have allowed not access to driverless cars or drone delivered shopping but have allowed for improved access to services such as education, health and banking services.

1.2   Aim and Objectives

The aim of this thesis is to investigate what effects recent innovations in the digital economy have for development and growth for the selected region in Sub-Sahran Africa. The innovations are across sectors from banking, health and education. I will study specifically how such innovations have contributed to inclusive development and growth within the region, looking towards how they have helped to achieve specific SDG's.

My analysis will involve looking to cases of specific innovations and the outcomes for users and economies in which they exist. These outcomes are sector dependant, but each sector banking, health and education can be directly linked to a path to sustainable development.

1.3   Research Purpose

The purpose of this research is to highlight the possibilities innovations have for the populations of the region in terms of inclusive and sustainable development. Considering the implications of the potential relief to the regions significant problems this subject has received little attention in previous research. Further research in to how these innovations affect growth and development outcomes such as reducing inequalities could have considerable implications for the policy decisions of national governments and the development community. This especially pertinent in the achievement of the UN's SDGs (The United Nations, 2018).

1.4   Delimitations and Scope

I refer to the region as Sub-Saharan Africa, however within this region there is a vast difference in economic, political and social landscapes. Due to the scope of this research it would not be possible to study all countries and innovations. Therefore in my analysis I will only include 8 out of the 46 listed as Sub-Saharan countries by the UN (About Africa | UNDP in Africa, 2018). The countries I include are Cameroon, Ghana, Kenya, Liberia, Nigeria, South Africa, Tanzania and Uganda. However, accounting for 6.1% of world population and 40.38% of Sub-Saharan Africa's population this is still a significant proportion.

1.5   Outline of the Thesis

The thesis is constructed as follows, in the following section I will review the relevant literature. This begins with the topic in a more general sense, beginning with the links between development, growth and technology. Next, I will address the different areas in which inequalities occur within development. I will then turn my focus to the more recent role of digital economy in the region. Following this will be the methodology section in which I will present the chosen research design, a case study method, the rationale for this and the benefits and limitations. Within the next chapter I will then present the chosen cases of innovations or companies. This will consist of a background, the purpose and impact of the particular case and finally the limitations and success of the innovation in attaining sustainable inclusive development. My final section will comprise of a discussion and conclusions of my findings.

2 Literature/Theoretical Review

2.1 Technology and Development

To begin we can look towards the literature on technology and development through economic growth in a wider sense. An evident place to start is Solow (Solow, 1956) who first addresses the inclusion of technology change within the production function. Within his model he includes a parameter to show how changes in exogenous factors such as technological progress and population growth affect economic growth. The outcome of his work proposes that only with policy to augment these factors can you achieve an increase in the steady state of long run growth.

This is followed by the work of (Romer, 1986) who presents a long-run growth model in which technological change is endogenous, leading to long-run growth being driven by "accumulation of knowledge by forward-looking, profit-maximizing agents". Investment in the accumulation of knowledge is presented as having diminishing returns. With this accumulation having positive externalities for the production frontier as technological transfer will happen throughout firms. Crucially he suggests that through his model there will be increasing marginal productivity from "the intangible capital good knowledge".

2.2 Technology, Economic Development & Inequality

The second idea to acknowledge within the literature is the links between development of technology and inequality. As already discussed for inclusive development to happen it must be felt throughout populations, regions and socioeconomic groups. This means for development to be inclusive all inequalities must be addressed, in particular income and wealth inequality (United Nations, 2017). (Calderon & Serven, 2010) work looks at how infrastructure may affect inequality within a country. The literature presented shows how the "intrinsic features" of Africa could make investment in infrastructure have greater potential. This is due to the landlocked nature of many countries and the remoteness of many regions from other global markets. This leads to difficulty in both inter and intra-regional trade due to high transport costs (Veneables, 2001).

The need for a good infrastructure to facilitate the use and innovations of new technologies is clear. The UNs SDG 9 to "build resilient infrastructure, promote sustainable industrialization and foster innovation" shows that the investment in infrastructure which is defined as

"transport, irrigation, energy and information and communication technology" are crucial to foster technological progress (UN Economic & Social Council, 2016).

(Calderon & Serven, 2010) works is evolved from others who use telephone density as infrastructure proxies finding that "other things being equal, infrastructure development is associated with reduced income inequality". The gap within previous research they wished to address surrounded measurement errors including the measurement of infrastructure, problems with a reverse causality between equality and growth and finally the heterogeneity in measure of infrastructure.

Within their work they use a combination of infrastructure assets in their indices including power generation per 1000 workers, length of road network in km per km² of arable land and fixed and mobile telephone lines per 1000 workers. In their econometric methodology the control for the coefficient of both unobserved country characteristics and a coefficient to capture the standard income effect. This is to attempt to mitigate the issue of a reverse causality between equality and growth.

Their findings show a clear connection between the infrastructure indices and levels of income inequality shown through the Gini index with the correlation ranging from -0.47 to -0.56. Within the regression standard controls are included such as the realisation of the Kuznets curve that income inequality first rises the declines. Also, the negative correlation of income inequality and education and finally the trade openness linked with greater inequality is found to exist but is not significant.

To explicitly look at the links between inequality and infrastructure two different time periods are considered, 1991-1995 and 2001-2005. The regression results show that the development of infrastructure had reduced inequality due to the quantity of infrastructure; however Sub-Saharan Africa is the only region in which when considering the quality of infrastructure has lead an increase in the Gini coefficient.

A more specific focus is that of (Aker & Mbiti, 2010) on the rapid saturation of mobile phones in the African market. A striking statistic from their work shows that while only 29% roads are paved as many as 60% of the population have mobile phone coverage. This could give rise to the argument that previous work does not encapsulate the true potential of infrastructure when not considering full extent and effect of mobile phone use.

They show that the use of mobile phones in the African continent have provided many possibilities of reducing transaction costs and improving access to information on many economic, political and social issues. The adaptation of mobile phones has socioeconomic implications, the fixed cost of a mobile phone can be out of reach for many however a trend found within the work is that of mobile phone sharing. While only 47% of their sample owned a mobile phone as many as 80% had access to one. This trend of mobile sharing can further increase the benefits beyond those who directly own one, a siginifcant impoication for the positive externalities.

It is hard to understate the extent to which mobile phones in particular can further inclusive and sustainable development. Firstly, their research puts forward the increased access to information and reduction in transition costs that is gained with access to a mobile phone. Previous methods included personal travel, newspapers or landlines. Both of which rely on infrastructure or have a significant cost to the consumer. It is noted that the economic impact of reduced search costs come in two frames, firstly in the short term some traders could exploit "spatial arbitrage opportunities". In the long run the market will approach one price benefiting the consumers. This will be especially evident if there is monopoly power, the use of increased market information has the potential to break such powers up. The reduction in search costs from the removal of the need of things such as personal travel especially for those in rural areas have great potential for reductions in inequality.

Secondly, the use of mobile phones allows firms to coordinate more efficiently within supply chains. This is of particular importance to smaller firms in rural areas to mitigate periods with production interruptions, where there are limited other supply options. Later I will show how developments in this health sector have helped this issue specfically in regards to reduce medication supply shortages. A direct and obvious impact to the economy will be through employment. Through formal employment we can see through the example of Kenya between 2003 and 2007 employment in private transport and communications sector rose by 130% (Aker & Mbiti, 2010). This is also coupled with gains in the informal sector, mobile phone companies have had to create "extensive phone credit distribution networks". This often means selling small denominated mobile phone tops ups in shops previously selling food staples and soap. Other business opportunities came from fixing, renting and charging handsets. The reduction of risk is an important area in which mobile phones could help, in natural disasters, disease prevention and conflicts. The access to mobile phones allows greater, quicker and more efficent information flows between national and international borders.

There is much speculation as to future path of development for Africa; there is a growing argument that through modern innovations there is a possibility for a "leap frog model" (The Economist, 2017a). This is that Africa can bypass old technologies and business models with the introduction of mobile based technologies. This "leap frog model" allows Africa to adapt new technologies to solve issues that are unique to the continent. The report further argues "that a cluster of new technologies will have a huge impact on Africa".

2.3 'M-Development'

2.3.1 M-Money

This next section will focus specifically on the role of these innovations within the digital economy and mobile development projects in Sub-Sahran Africa so called 'M-Development' (Aker & Mbiti, 2010). The use of mobile phones in Africa has now also surpassed the first

stage of basic calls and texts to services based on third and fourth generation networks, 3G and 4G respectively. These innovations are found across sectors ranging from agriculture, health care, education to banking and transport. This is vast contrast to the use of this services in higher income countries where 3/4G networks are primarily used for entertainment services.

Examples provided from (Aker & Mbiti, 2010) and the most prominent use of mobile services in the developing world begin with 'M-money'. That is services and applications to transfer and store money via mobile phone outside of the banking sector. The use of 'M-money' emerged around 2005, its main benefit being that many without previous access to a bank account now could store and send money safely at a reduced cost. In 2008 with only 30% of the population in East and Southern Africa being part of the banked population the need for this service is clear.

The need for financial inclusion was set forward in the G20 "Principles for innovative financial inclusion" in 2010. Stating the need for access to financial services for the worlds unbanked population to be able to borrow and save to alleviate them from future effects of hunger, crime or natural disasters. By 2017 the G20 had reaffirmed their commitment to these stating that "there is increasing evidence that financial inclusion has a positive development impact" at both the micro level of consumers and business and at a macro level for the whole financial sector. The report also presents that through the multiplier effect, financial inclusion "contributes to reducing poverty and income inequality at a national level".

Since its inception the use of m-money transmission has diffused significantly. The first use can be seen within the Philippines in 2000, however it quickly spread to Africa. This first project within Sub-Sahran Africa backed by the UK foreign aid department (DFID) began in Kenya. The initial idea came from a trend noticed in which Kenyans were transferring each other small amounts of mobile credit air time as a virtual currency. This idea has now evolved into a full money transfer system run by SafariCom, a mobile network company. Called 'M-Pesa' the service now has nearly 30 million accounts.

Variants of this service of mobile money transfer not linked with a bank account can now be found throughout the world. The largest of which is in China called 'AliPay' who have 520 million users (The Economist, 2018). Unlike M-Pesa which is designed and implemented to be used over basic text services, AliPay is available through 3/4G enabled smartphones. This shows the difference in markets that mobile money has reached.

The reach of mobile money services is exploding, one interesting use in East Africa is a company Acre Africa now automatically pays its customers when the rain index falls below an average level this is the processed via mobile money (Acre Africa, 2018). This kind of product has also been replicated in other insurance markets such as life insurance in Nicaragua where customers pay around $0.23 a month for a $100 cover, without mobile money services to facilitate this labour input and administrative costs would have been too high for the service to run.

A previous study on MPesa specifically conducted by (Jack & Suri, 2011) presents two rounds of surveys. The research shows that while initially being more prominent in the higher socioeconomic status respondents the second round found wider adaptation throughout lower status respondents. Between rounds the urban banked population saw sustainably more users. However, the unbanked population also increased significantly from 25% and 50% the same pattern is also seen in the rural population increasing from 29% to 41%. Also evident in the data is that the non-user ownership of a mobile phone falling from 52% to 39% suggesting that the lack of access to a mobile phone could be a constraint in adoption to M-Pesa.

In the second round when broken down by socio economic status new users were distributed "almost equally" between expenditure quartiles.

When looking at education level among users and non-users the research shows that those with higher education levels are more likely to use the service. However, in the second round the adoption of M-Pesa was seen within the less educated groups. Overall what is presented is that while M-Pesa use is higher among higher socioeconomic status populations the growth between rounds has meant the adaptation is now seen more equally between all classes.

The most detailed piece of ethnographic research on M-Pesa is put forward by (Morawczynski, 2009). The research focuses on impact at a household level and was conducted in two areas. A slum outside Nairobi and a small fishing village in Kenya; it followed the cash flows of users. It is proposed by her that this could become "transformational" through becoming a "foundation for economic development" and to "allow the poor to climb the banking ladder". Through becoming a part of the banked society, it is asserted in the paper this could insulate the poorer in society from shocks and help them increase their wealth.

The first point for an increasing equality level through the use of M-Pesa is the level of access; in the paper it is estimated that only 19% of the population can access money transferring services through established banks. Conversely, SafariCom claim that their network coverage is available for 81% of the population. When following the money trail what is found is primarily the flows were from the urban slum to the farming village. Usually in the form of remittances from husband's home to their families.

2.3.2   M-Health

The next area which mobile innovations have begun is the health sector. So called 'mHealth' the WHO define this as "the use of mobile and wireless technologies to support the achievement of health objectives" (World Health Organization, 2011).

The importance of a healthy population for sustainable economic growth is long and well documented (Fogel, 2004)(Baird, Friedman & Schady, 2011a). With the rapid saturation of mobile phones in the developing world there is much hope that this can be captalised on to achieve greater health outcomes. The coupling of health and mobile technology has been explained as "the use of mobile telecommunications and multimedia technologies and their integration with mobile healthcare delivery systems" (Istepanian, 2003). Unlike much of the

western world who have comphrehensive healthcare systems many countries in Sub-Sahran Africa lack basic resources such as physical medial capital, drugs and healthcare workers (Betjeman, Soghoian & Foran, 2013). Sub-Sahran Africa also has some unique health problems in their populations for example the presence of more than one serious disease is a common occurrence (The Economist, 2017). This shows that it is clear Sub-Sahran Africa must find solutions to problems unique to the region. There is hope by many that the rapid uptake of mobile phones could have significant benefits for mHealth, this has been backed by many outside of the development community as well.

2.3.3   M-Learning

Another area in which problems unique to the region have potential to be alleviated through innovations in technology is education. The inclusion of "The pursuit of inclusive and equitable quality education for all" (UN Economic & Social Council, 2016) within the UN's SDG's has led to a committed response throughout the world to extending the reach of schools and education. We can see this evidently in Sub-Sahran Africa where there has been a remarkable focus on trying to improve the reach of education.

The need for an educated workforce is unquestionable, improvement in human capital allows for improvements in productivity, health and poverty elimination. Much of Sub-Sahran Africans progress in education has come in numbers, increasing numbers of pupils in school. However, what is needed now is the improvements in the regions knowledge capital. Knowledge capital has previously been measured through years of schooling, with the massive inequality in a year's education around the world now however this seems redundant. A recent report found that in 14 Sub-Saharan countries, an average grade 6 teacher did not outperform the highest pupil in the grade (World Bank, 2018a). Under performing teachers only add to the other problems that the regions face, children often attend school suffering from malnutrition among other illness and schools lack proper resources. Accountability is also a crucial issue an alarming World Bank statistic shows that absentee teachers are a considerable problem. With a recent report showing that during spot checks 20% of teachers were absent from their class and a further 20% not on school premises at all.

Also, another issue for policy makers in the region is the lack of data to improve schooling systems. Sub-Saharan Africa are the lowest region in the world for monitoring learning outcomes. In primary schools 65% of countries monitor both mathematics and reading learning outcomes by lower secondary this stands at only 35% for mathematics and 45% for mathematics (World Bank, 2018a). The recording of learning outcomes can allow for the adjustment of both curriculums and teaching to improve the education of pupils. The recording of learning outcomes also allows for comparisons across regions and socioeconomic characteristics, seeing where inequalities exist and allowing these to be fixed (World Bank, 2018a).

The use of technology in schools, otherwise known as m-Learning, comes in many forms and shows potential to reduce the fore mentioned barriers schools in region face. An important challenge in the use of technology in low income countries is the use of previously existing technology. (World Bank Group, 2016) show how this could be done through delivery of SMS texts to teachers at the start of the day to suggest daily teaching plans, due to the high saturation of mobile phones this could be implemented fairly easily with the potential gains being considerable.

Further suggestions for use of technology are through more advanced internet connections. A previous case study produced by (Okine, 2013) shows how the use of an online platform in Ghana, Moodle, improved "efficiency and effectiveness of educational interventions" . It allowed for courses to be delivered remotely enabling more students to take the course that otherwise would be unable to due to poor and expensive transport infrastructure. Other example of m-Learning provided (Charley Rogers, 2017) show how in Nigeria language courses can now be taken entirely online.

2.4 Summary of the state of the current literature

After reviewing the current litertaure it is clear to see where the logical next step in research should occur. Along with (Aker & Mbiti, 2010) it is clear to identify the areas of research needed that could be of high importance. This begins with unknown considerable amount of economic and social benefits that could be probematic to empirically research. That is there is firstly possibilities of measurement issues as data on mobile phone adaption is limited and can be unreliable. Secondly the possibility of externalities makes it hard to identify individual level adaption. The authors show that mobile phone technology can have effects on social networks and this is an issue that will need to be further addressed in research as this could affect households economic and social outcomes.

Another aspect specifically they suggest being researched is the macro and micro effect of m-money systems. They show that there is much potential as the systems facilitates increased international transfers leading to greater economic power for households. This can come in the form of higher educational investment or business opportunities.

The next area in which they identify as a gap within research is mobile phone development projects. Showing the improvements that can be sought from such projects as "improving communication, coordination and service delivery" it is still however crucial to ensure that when they are used it is Pareto improving. There could be a want to overuse mobile based solutions so "rigorous impact evaluations of m-development projects" are needed. A concern for the authors is the data and identification of such issues, they suggest that due to the nature of the topic researches could use "experimental" techniques. Also, what is suggested is that researchers could partner with organizations and NGOS. This is the gap in which this research attempts to fill.

3 Methodology

Within this section I will discuss my research approach and the sources of my data. In the first section I will review my chosen approach and its justifications and limitations within literature. In the second part I will discuss the data I have chosen, its source and the validity of this data.

3.1 Research Approach

The design of my research will be the consideration of three different case studies of innovations within 'M-development'. I will consider the companies of M-Pesa, Bridge International Academies as well as mHealth developments.

The use of case studies is a well-established research method within social sciences with much valid rationale behind the use of such a method. (Yin, 2006) defines a case study as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context". Further he presents that the use of case study is particularly of use when "contextual conditions" are "highly pertinent to your phenomenon of your study". Within my research this justification for the use of case studies is highly important, that is the characteristics of Sub-Saharan Africa are highly different from the Developed world. The context of the innovations within Sub-Saharan Africa are essential for the outcome of the research. The use and impact of these innovations would be highly different if located in areas with other social and economic characteristics. (Creswell, 2014) shows that the use of qualitative research approach such a case study allows for the use of many data sources which can be of use in a new field of research of where there is a lack of data.

The alternative methodology that could be used within research of economic studies is assessing purely quantitative data. Assessing the suitability of this method for my research question it is clear that there would be many flaws. The topic of study, the impact of new innovations, inherently lack data due to the time periods in which they have been implemented, which is usually less than 10 years. Secondly the region of research lacks data in many areas due to lack of efficient institutions and infrastructure. The Centre for Global Development shows that quality and availability of data "remain significant challenges across Africa" (Center for Global Development, 2018). They present the issues of lacking technical and qualified human resources needed for the collection of data as well as "misaligned political and institutional incentives". The use of a quantitative research also would not fully assess the impact of these innovations due to the high number of externalities that are

involved with the impact of the cases on the economy. That is (Baxter, 2008) shows the use of a case study can have several propositions to guide a study however the study overall must have a distinct purpose. Therefore, this method will allow me to explore other externalities while remaining focused on my central research questions.

Also, a key aspect of my research approach will be to study innovations across sectors. This allows for a more comprehensive view of developments in 'm-Development' meaning the research question can be fully assessed. The focus on one sector would not give a robust enough study. Within the results we can see the use of many case studies allows to see if there is a pattern of replication. (Yin, 2006) argues that the use of multiple case studies that produce replication allows for "the development of a rich, theoretical framework".

Theory development is an important aspect of case studies, Yin presents how that within theories of international economic development previous literature can provide a good framework. Through a case study these can be tested across different industries and specific countries. This particular case study is an exploratory one, as opposed to a theory testing design.

3.2   Limitations

While a case study has been shown to be the most suitable research design for my topic it is important to consider the drawbacks of this method. (Yin, 2006) presents three main issues for consideration construct validity, internal validity and external validity. The first construct validity addresses those who consider case studies to collect data subjectively. To overcome this, I will use multiple sources of data within the cases. Next is the issue of internal validity, that is how can we ensure that the inference made from the research is correct where sources of evidence may be lacking? Yin suggests that to overcome this all rival explanations should be considered. The second issue from within internal validity is causal third factors not being considered.

External validity deals with the issue of generalization, can the findings in these case studies be attributed to other innovations? The problem with this concern is it is comparing a case study design to a survey design with empirical data. Rather than a statistical generalization as would be gained through a survey this research aims to provide analytical generalization. Where an analytical generalization can be considered to hope to generalize a set of results in some broader theory. The scope of this research would not be that to gain a specific number that can be attributed to the gains from the issue of 'm-development' but rather show the impacts that could be seen in a more general sense.

The final issue is that of reliability, should another researcher conduct this case study would they come to the same results? Yin suggests that to overcome this the research should be

conducted "as if someone is looking over your shoulder" in practice this means ensuring that should someone else conduct the same case study they will indeed come to the same result.

3.3   Case Selection

The cases I have selected are found across industries of banking, energy, health and education. Within 'm-development' there are many innovations that could be considered across many sectors, the scope of this research is therefore unable to review all or even a majority of cases. I have therefore selected cases that appear to be "crucial case" making them essential for theory development (L. George, Alexander Bennett, 2005). M-Pesa the case I have chosen as case a crucial case has also advanced to less developed regions. This trend of the innovation spreading to different regions is also evident in Bridge International Academies. Showing cases of innovation that have been successful in some of the most underdeveloped region will hopefully be a reflection of the potential they may have in regions that are already more prosperous and robust in terms of infrastructure and institutions.

The motivation for choosing a case of crucial case is to stress the ability of theory development among the cases not to test previous theory. While conducting the research it will be necessary to avoid over generalisation and ensure that any results are inferred as a contingent generalisation to the factors under which their success has occurred. (L. George, Alexander Bennett, 2005) present the essential trade off when selecting cases between "attaining theoretical parsimony, establishing explanatory richness, and keeping the number of cases to be studied manageable". One step I have taken to ensure that theory can be developed is by using cases from across different sector types and that have worked in different countries.

3.4   Data Sources

Due to the nature of the research design they need for many data sources is evident. The data sources will be different within each case. I will present both micro data on the individual case and macro data to show its impact on the wider economy.

My first case study will present SafariCom's extension of MPesa. For this example, I will use different data set from the World Banks website. One based from the financial inclusion survey, FinAccess, from 2014 and 2017 taken in Kenya. The survey was conducted by the central bank of Kenya and Financial Sector Deepening Kenya a not for profit organization. The purpose of the survey as outlined by FSD is to firstly inform policy makers about barriers to financial inclusion including socioeconomic status as well as to provide information to the private sector. Further to provide empirical evidence of evaluation of government and donor

led initiatives and finally use in academic research (FSD, 2018). Other data used from the World Bank includes indicators of Kenya's economic indicators such as GDP and poverty levels. Further, I will use company annual reports from SafariCom's website. A partner company or MKOPA will also be reviewed in this section using their company report and information from there website.

The second case will present Bridge International Academies. This is a company within the sector of m-Learning developments. My main source of information for this will come from the company's annual report and website. There is a consideration to be made that the use of reports published by a profit-making company have the potential to be biased and present the company in a positive light. Within my case I will also review previously published reports by the Brookings Institute and the World Bank; due to the nature of these organisations having non-profit goals it can be assumed that they are free from ulterior motives to present the company positively.

The case of mHealth will not be a specific company view as there is no crucial case or dominant firm. M- health is a much more fractured market due to the varied uses and needs of this service. To gauge the full range of services, I will look into a service from each of the four categories m-health is used for as defined by (World Health Organization, 2011). Once again, the information will come from the websites of the respective companies in addition to this I will look at reports by the World Health Organisation (WHO) and the World Bank.

4   Case Studies

I will next present some cases of technological innovation that have shown to have the potential for disruptive effects within their given sectors. These innovations were specifically setup for Sub-Saharan Africa and not exported use of technology from the Developed World. During these case studies I will consider firstly the purpose of the company or innovation. Secondly, I will consider the actual impact of the company and its reach. Finally, I will assess in reference to the literature what success and limitations the innovations or companies has had on the development in the region.

4.1   Banking: MPESA

 "M-Pesa" comes from the Swahili for "money" and M for mobile. It is arguably now the most famous of all mobile money services. The initial idea came when it was noticed that Kenyans were transferring each other small amounts of mobile credit air time as a virtual currency. This idea has now evolved into a full money transfer system run by SafariCom, a mobile network company.

4.1.1   Purpose and Impact:

Established in 2007 M-Pesa is technology formalized by SafariCom in which you can deposit, transfer and withdraw money using a "e-float" through a basic feature mobile phone. Registration only requires an ID card or passport; deposits and withdrawals of cash are facilitated by a set of agents throughout the countries. SafariCom stress, due to concerns of regulation, that M-Pesa is not a bank however the advantages that this technology could hold for the unbanked are clear.

On start-up MPesa was a joint venture between SafariCom, owned by Vodafone and the UK foreign aid department (DFID). The private actor, Vodafone primary aim being to identify areas of financial innovation that could take place for their customer base. DFID on the other had was looking for ventures which would assist the unbanked population of Kenya. The initial the purpose was to distribute microfinance loans throughout the population. While trailing the technology what was noticed was that that many customers would use the service to send money across the country. This lead the creators to adjust the system to a service where you can send money via SMS and it be held on a customer's SIM card.

To put into perspective the need for this service in the 2006 FinAccess survey results showed that only 18.9% of the population had access to a formal bank account (FinAccess, 2007).

The impact of MPesa is unprecedented, it currently owns around 80% of mobile money market share with 27 million users and 130,000 agents (Safaricom, 2017) (Chironga, Grandis & Zouaoui, 2017).

Figure 1 shows the percentage of those in Kenya who in the last 12 months had accessed a financial institution or mobile money account after the introduction of M-Pesa. The level of those who have access to a financial institution almost doubles in six years, showing clear progress in helping the unbanked.
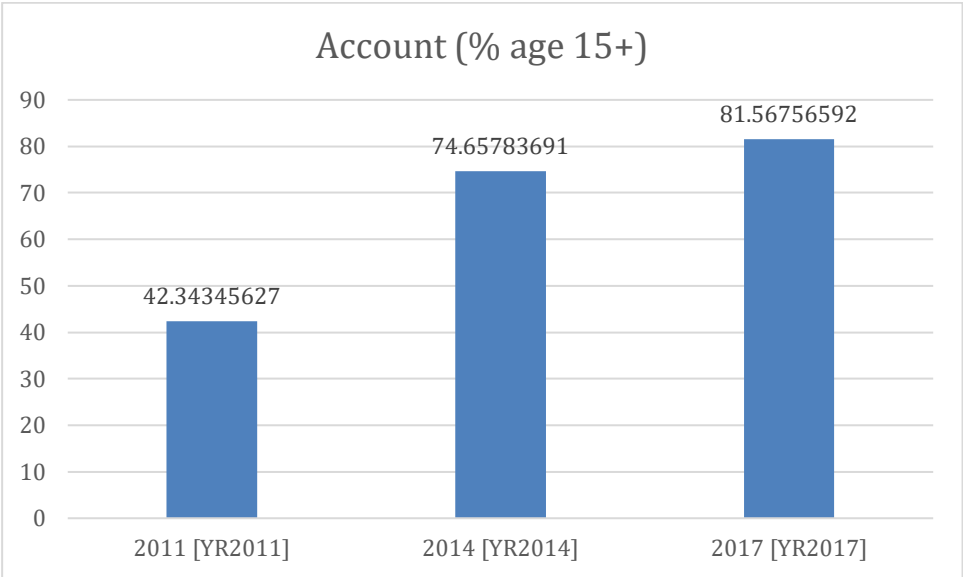

Account (% age 15+)

Year	Value
2011 [YR2011]	42.34345627
2014 [YR2014]	74.65783691
2017 [YR2017]	81.56756592

Figure 1 Account ownership at financial institution or with a mobile-money-service provider (World Bank, 2018)

Figure 2 shows the break down in demographics in access to mobile money accounts specifically, from 2014 to 2017. Data specifically on MPesa accounts is not available however with 80% of mobile money market share, the correlation can be seen through the total growth in mobile money account usage.
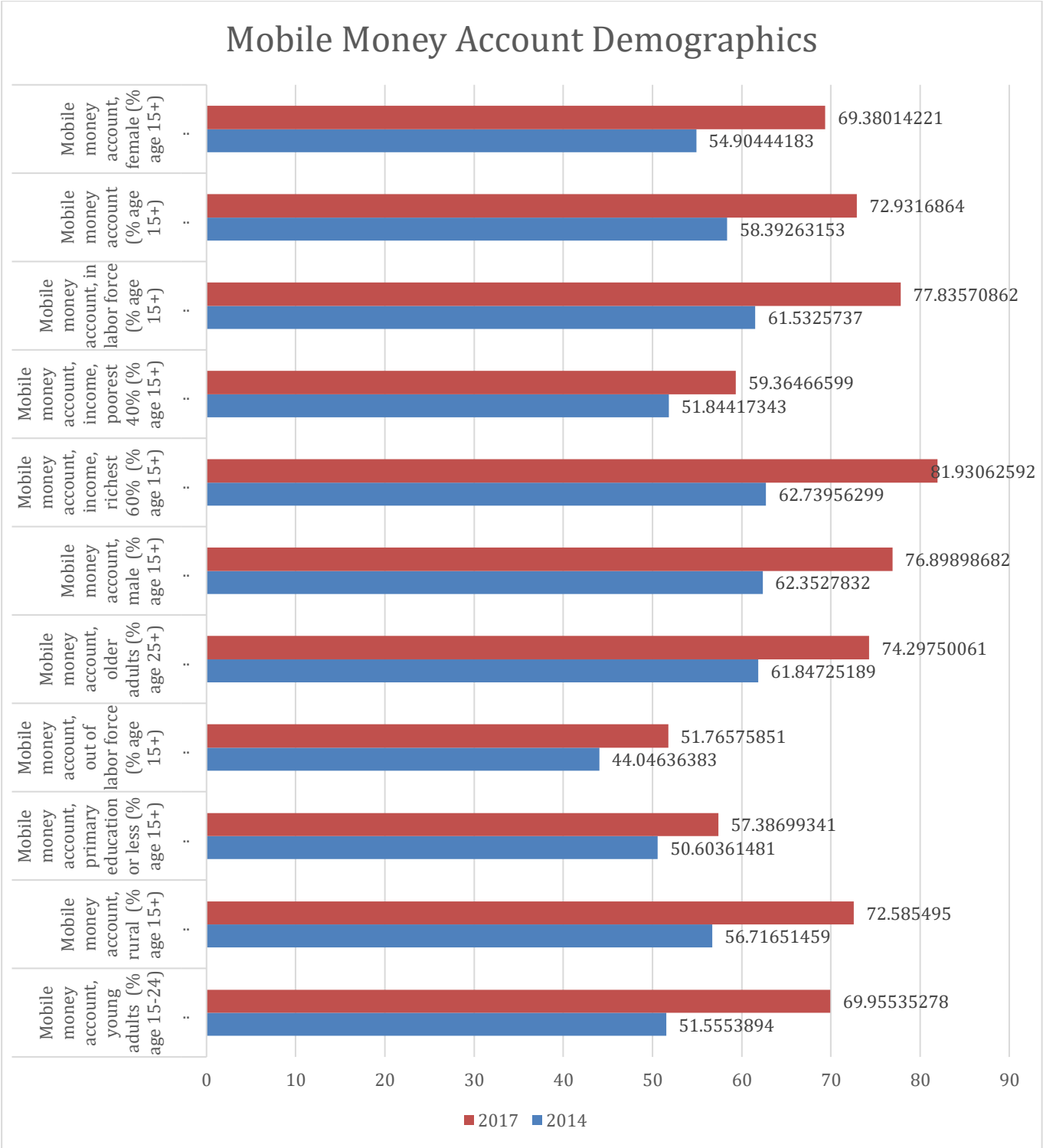
Figure 2 Demographic breakdown of mobile money account use (Global Findex Database, 2017)

The breakdown in demographics shows that gains were seen for everyone in mobile money account use with an overall increase from 58.3% to 72.9%. With a 19.2% increase in use the highest gains were seen in the richest 60% of the population. This increasing trend was seen throughout wealth groups with the poorest 40% still seeing an 7.5% increase in access.

Both males and females saw almost equal gains at 14.5% and 14.5% respectively female access still lacks behind overall with total use of accounts being 76.9% and 69.3%. Another group that saw impressive gains in access was those living in a rural area who saw a 15.9% increase with 72.5% of respondents using a mobile money account. A suggestion in the literature which could account for this increase is the pressure from those sending remittances to family member to register, leading to lower fees.

When looking at those in the labour force and not we can see that those who are not trail behind in access with only 51.7% having used a mobile money account. In comparison those in the labour force saw a 77.8% use. The group which saw one of the smallest amount of use was those with primary education or less with only 57.5% using an account. A suggestion put forward for this would be that the use of new technologies is often perceived as not easy putting of the less educated from uptake.

Looking at the bigger picture of these results we can see that the increase is significant since the introduction of MPesa. The general trend is that of huge increases in uses of mobile money accounts across demographics. These results from FinAccess with a wider survey population reaffirms the trends (Jack & Suri, 2011) those with higher incomes and in the labour force benefited the most. In terms of equality of access, we can see that some groups do fall behind, mainly those out of the labour force or the poorest 40% of the population. This could be attributed to the lack of need for the service due to no income or lack of access to a mobile phone which is higher in lower income brackets. MPesa has great potential for the development of Kenya, not only in terms of pure gains in financial inclusions, the wider impact must be considered.
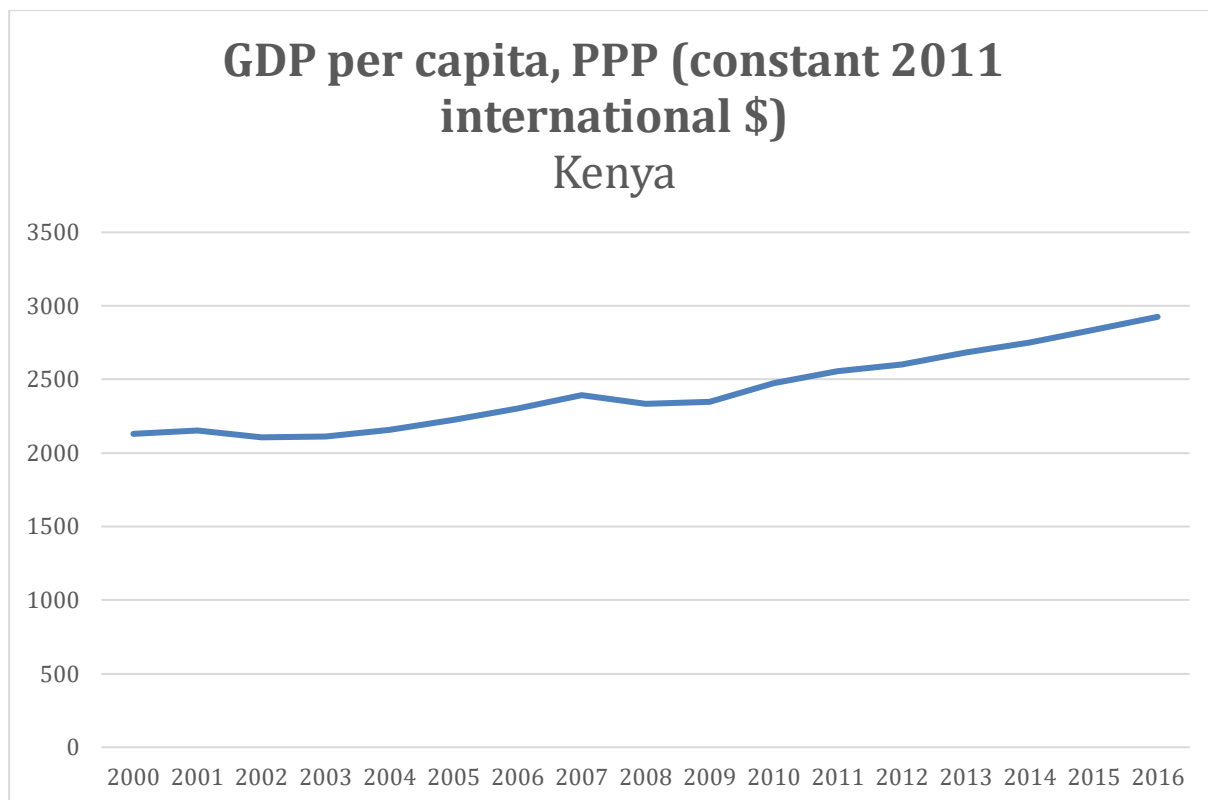
Figure 3 GDP per capita, PPP, Kenya (World Bank, 2015)

Figure 3 shows Kenya's impressive increases in its GDP growth since 2000, there are many factors which have facilitated this. However, (Safaricom, 2017) annual reports SafariCom's average contribution to GDP in the last 10 years is 6.5%. A crucial aspect with this increased growth is how equally it is distributed. To look at this level of income inequality the standard proxy would be to look at the Gini Index. However due to the already discussed problems with data in the region this statistic is not available for the period in question. This an area where with the increased level of development and economic growth research will hopefully prosper. Even though no official Gini Index a report from (Oxfam, 2018) shows that less than 0.1% of the population or 8,300 people hold more wealth than the bottom 99.9%. This is an obvious problem if benefits from growth in recent technologies is to be felt throughout populations. This is also incompatible with the SDG to prevent inequalities within societies.

Within their report MPesa also claim to have employed 845,000 workers in 2016. In the report they also focus on the social impact they have had through their foundations. With more than 4 million beneficiaries, their social programme gave 1,000,000 participants access to health initiatives and 300,000 access to clean water.

Another mechanism in which MPesa promotes inclusive development is their partnership with M-KOPA. That is an extension of MPesa which provides solar panels on credit, where a daily payment toward the system is made. Its main customer base like MPesa is in Kenya however they also operate in Uganda and Tanzania. MKOPA shows the capability of mobile money in reaching development goals. The UN's 7th SGD is "ensuring access to affordable,

reliable, sustainable and modern energy for all". The potential impact of MKOPA to realise this is clear with a total percentage of the African population on the grid standing at 35% yet the mobile saturation rate stands at 80% (M-KOPA, 2015). It is estimated that specifically in Kenya there is 6 million households not connected to an electricity grid, this translates into over $1 billion of expenditure on kerosene (M-KOPA, 2015).

According to MKOPA the solar panels are usually owned within a year or 365 credit payments. This allows customers of the scheme access to environmentally friendly power source with the flexibility of forgoing a day's electricity should other unexpected costs occur. Another example of innovation that takes in the realities of user's financial situation and needs in the region. The need for this to be more secure is evident, this is however real progress towards a solution to a considerable problem.

The credit payments are through MPesa in Kenya, and any form of mobile payment in other regions. Once again, this flexibility helps with the ability for participants to smooth consumption patterns and mitigate shocks. M-KOPAs has so far provided 3 million of these systems, with 27 thousand mobile money transactions being processed each day. The average alternative of MKOPAs solar system would cost around $200USD, which in comparison to MKOPAs initial refundable deposit fee which is $30USD is too high for many in the region.

MKOPA allows for something which is not a common sight in the developing world, that is fairly accessible access to investment. In the long run MKOPA report that due to reductions in fuel and mobile phone charge payments the average customer can save $700 USD over the lifetime of the product. Not only are reduction in outgoing costs a benefit, once they have paid the system off it give customers a positive credit rating, something not easy to gain in Sub-Sahran Africa. Probably the most promising aspect of MKOPAs model is the ability to refinance units after it has been paid off. Customer are reported to have used the solar system as collateral for purchases such as school fees or smart phones.

4.1.2   Success and Limitations

The contribution from M-Pesa is undoubted for the populations of Kenya more people have access to a safe reliable way to send, receive and store money. This is a clear case of where innovations designed for Sub-Sahran Africa not the developed world has been successful.

The benefits of this higher level of financial inclusion for growth and inclusive development are without doubt. The consultative group to assist the poor show that a level of inclusion can protect from cash flow spikes and allow for the payment of recurring expenses such as school fees. Access to a safe way to save money can also allow for shocks such as medical emergencies or natural disasters. It can also mean many more have opportunities for microenterprises which can be essential for growth.

Financial inclusion is essential in the path to sustainable development, even though not explicitly a UN development goals it is a clear enabler in attaining the other objectives. The

most basic goal and the first in the SDGs is "No poverty". Within this the UN target to ensure all men, women and children have equal rights to among others, "appropriate new technology and finical services including micro finance". Therefore, MPESA for the region in which it serves have contributed significantly to this goal.

The data shows that MPESA has spread rapidly throughout the whole population. However more significant gains have been seen in a higher wealth groups. It is important to consider that while great improvements have been made in finical inclusion those in lower incomes still lag behind. This inequality must be addressed by policy makers if the benefits seen by MPESA are to continue and increase.

Some restraints and areas for further improvement must be considered to ensure the benefits are realised throughout socioeconomic groups. A significant constraint to access for everyone is network coverage and mobile phone ownership. Mobile phone ownership in Sub-Sahran Africa is ever growing, however for some the fixed cost is unattainable. Unsurprisingly Sub-Saharan Africa has the lowest penetration of mobile phones at 73% in comparison to 98% in the developed world (World Bank Group, 2016). (Karlsson et al., 2017) Show that basic feature phones are approximated to cost around $6-11 and smartphones can cost upward of $45. With the most disadvantaged in society living on the international poverty line of $1.90 or below the possibility of disposable income to afford this is limited.

The problem of mobile phones ownership shows potential to be reduced through firstly the continued reduction in handset cost. However, to facilitate this the economy of Kenya must continue to grow sustainably and in turn continue to improve standards of living for all. To address the problem of network coverage policy makers and network providers must continue to invest in infrastructure, as this has already been shown to reduce inequality in other areas such as land telephone lines.

4.2 Education: Bridge International Academies

Founded in 2008 Bridge International Academies is a company providing low-fee private schools. Their focus is on the use of technology in schools. They are based in Kenya, Liberia, Nigeria, Uganda and India. They currently serve 100,000 children in these locations (Bridge International Academies, 2017a). Funded by the likes of Bill Gates and Mark Zuckerberg as well as international aid agencies such as the World Bank and DFID, they are a profit seeking company.

4.2.1 Purpose and Impact:

The mission of Bridge, as reported on their website and the work they undertake is driven by the commitment to provide "knowledge for all". The model under which Bridge operates is

technology driven, lesson plans are delivered via internet enabled tablet (World Bank Group, 2016). This helps to mitigate essential problems already mentioned within Sub-Sahran African educational systems. Further there are two business models under which Bridge operates, firstly that is "low fees" paid for by parents. Secondly some schools are operated in "public-private partnerships".

The public partnership schools are found in Liberia, where after years of civil war less than 40% of the children attended school (The Economist, 2017b). Bridge are part of a wider program "Partnership Schools for Liberia" which private companies and NGO's have taken over public schools. This model has allowed for the use of technology in schools which otherwise would be extremely unlikely to be developed by a public education monopoly. Results suggest that this within this specific region Bridge has been a success with children in the PSL programme gaining an estimated 7 month increase in learning. This success is now drawing the attention of other struggling education systems in states such as Ghana and Nigeria.

A significant problem is the quality of education in Sub-Sahran Africa, a recent World Bank reports a "severe learning crisis" (Bashir et al., 2018). Not only is it good enough to get numbers of children in to school what is essential is for those attending to actually learn. The report presents the basic needs for this to enter a new phase of development for the region. The accumulation of human capital must occur in order for the new phase of development to be facilitated. The entry to global markets will allow for improvements in standard of living so as long as there is an educated workforce to improve productivity. Bridges attempt to tackle this learning crisis is the use of data to refine educational outcomes. They attribute this crisis to the fact that "educational systems are plagued with inadequate materials and poor management systems" and that the outcome of this is "teacher absenteeism and a lack of learning". This shows how the technology has been adapted to target this problem which is distinctive in Sub-Saharan Africa.

Their lessons are planned by teachers in America in accordance with national curriculums and delivered by hand held tablets. Pupils are then tested, and results are reviewed, and lesson plans updated to fix where teachers may be failing. This allows for the expertise of highly trained teachers to assist their less equipped counter parts in Sub-Sahran Africa. Data from test scores is also compared against other schools, students and countries. The use of "teacher guides" also tracks the timings that it takes teacher to arrive at the end of the lesson plan to ensure they are stuck to, this plays an essential role to prevent teacher absenteeism.

This use of technology eases one of the greatest problems Sub-Sahran African education systems face, lack of trained teachers. The advantages of any relief of the time it take to train a teacher are crucial with 70% of countries facing "acute shortages" rising to 90% in secondary schools (UNESCO Institute for Statistics, 2016). This amounts to 17 million teachers by 2030.

Considering the aims of Bridge to improve learning outcomes and reduce educational inequalities it is important to consider their results. Firstly, educational outcomes have shown

that pupils attending show significant improvements over their peers in other educational systems. In Uganda, primary leaving exam results published by the government show that all pupils attending Bridge passed the exam. Within this exam 93.5% of the pupils in Bridge passed in the top two divisions this in comparison to the 56% national average (Bridge International Academies, 2018).

Pupils in Kenya also outperformed those in public institutions in 2017, 10% more children were admitted to secondary school. The cumulative effect of attending Bridge schools was also clear to see in Figure 3. A limitation in the identification of impacts of Bridge in particular are the lack of long term independent research. This case relies on many publications by the company itself, which could have problematic issues for validity of the case as discussed in the methodology section. As a measure to ensure validity of these sources it is important to note that exam results in the respective countries have been published by the regions governments. The second aspect in which Bridge appear to have made vast progress is teacher absenteeism. (The Economist, 2018) report that Bridge teacher absenteeism is less that 1% where the World Bank presents a figure of 47.3% in Kenyan public schools. It is clear to see that the model of Bridge is a successful. The ability to replicate this could have a significant impact to realising the development goal of quality education for all.

4.2.2   Success and Limitations

For those who attend the educational benefits are proven. A key strength to the presence of low fee schools is the choice it affords parents. Conversely, one issue for people who object to the company is that they argue that it should not be a sector in which profit should be sought. They fear that the existence of fees could perpetuate inequalities. Bridge argue however that their schools are affordable even for those in the "most disadvantaged communities in the world". Stating that in regions where they are not in a private public partnership fees average $7 a month in comparison to income that are on average $1.90 per person per day. They also present the argument that most local government run schools requires top up fees, that are not negligible (Bridge International Academies, 2017a).

Another way in which Bridge suggests they try to mitigate the inequality that the presence of fees may present is the scholarship scheme. Within their mission report the report that they will admit any child regardless of ability and 10% of the poorest pupils have fully sponsored places. Due to the fact that Bridge have only been open for 10 years the long-term benefits cannot be fully realised. However, the short-term effects are clear the children learn more, teachers are in attendance in a much greater proportion, and educational outcomes are tracked. The success of Bridges methods could be of particular help to other systems that are in great need of reforms and improvements if the region is to have a real chance to foster growth in human capital to a level seen in the Developed World.

Particularly the quality of education has benefited, this quality is stressed in the educational SDG. The UN show that within this goal that "effective learning outcomes" are essential, that

is great efforts have been made to ensure children are in school. More work is required to ensure that this school time is effective in increasing levels of much needed human capital. Further an essential part of the development goal is that education is inclusive and must "eliminate gender disparities" with 50% female students this has effectively been met within Bridge. With the effectiveness show in Bridge, it will be important for policy makers to extend this access to all. This could be through more public-private partnerships or replicating the features in public schools.

4.3   Health: M-health

The primary goal of m-Health applications and technology is the improvement of quality and access to health care (Qiang et al., 2011). This is also in line with the UNs third SDG of "good health and wellbeing". Within this objective the importance of sustainable development in healthcare in Sub-Saharan African is stressed. There are four categories under which applications fall; firstly, patient tracking this is the support and coordination of care patients often in rural areas. Secondly, the use of m-Health addresses supply chain management issues, for example the reporting of low stocks of vaccines via SMS. Another key factor in which m-Health has helped is the efficient use of human resources. An example, outside the region in question, is India's Health Management and Research Institute. This service has served 10 million callers, giving basic medical advice. Finally, the use of m-Health also has partnered with the previously discussed mobile money to provide health financing applications. The potential impact of such services is considerable. Not only are the primary goals of the applications beneficial to improve essential health outcomes the also provide accountability. The data from m-health applications allows governments and other global health organisations allows them feedback on their funding. Enabling to see both outcome of health and the effectiveness of the service delivery.

4.3.1   Purpose and Impact

Patient Tracking: SimPill

One company in the patient tracking business is SimPill, this is based in South Africa. It is a joint partnership between SimPill and Western Cape Provincial Department of Health. Its purpose it to ensure patient medication adherence. The technology is an internet-based programme that allows the system to see if a patient has opened their bottle of medication. If the medication is not taken, then an SMS is sent to the patient to remind them. If the medication still is not taken, then the healthcare professional is informed. If medication is taken outside of a certain time frame an SMS is also sent to warn the patient should not be taken. (Unge et al., 2010) evaluation show that in a study of 155 patients drug adherence stabilized 86-92% and the success rate was 94%. As with the majority of mHealth innovations this also utilises the strained human resources in the region. The limitations of this are

concurrent with the problem of limited infrastructure due to its internet-based system, meaning scale throughout the region could be problematic.

Supply Management: Cell-Life

Also in South Africa, Cell-Life is non-profit organization using technology based solutions to effectively manage "provision and distribution of anti-retroviral treatments"(Devex, 2018). It works through a "Drug Stock Management System". Pharmacists scan drugs orders using a smartphone, this then updates the system to show current drug stock levels and daily consumption.

Human Resources: MyHealthline

An essential aspect of m-Health is the scale that it allows, automating medical advice means that health care professionals can reach a much wider audience. An impressive example of this is "MyHealthline" this a service in which Orange a network provider and Cameroon ministry of Health launched a medical information service. It provides "quick, easy, anonymous and confidential healthcare information via text message" (Orange, 2015). The reach of this service is impressive with those with access amounting to 6,500,000 that is a third of the country's population.

Financing Applications: M-Tiba

M-Tiba is another offshoot of MPESA, it acts as a health insurance provider. Its website currently claims 1,088,285 users with medical pay-outs totalling 373,020.495 Kshs. The concept of M-Tiba is users are able to save "conditional funds" (PharmAccess, 2017) and then m-Tiba will pay selected providers when needed. Its primarily aimed at those living in rural areas and urban slums. The automated design of this system is crucial for inclusion of many who would not be insured in the normal system due to high administrate costs. Another advantage of the system is the data generated that provides users with comparison of clinical and financial performance. This provides a transparent system; greater information allows users a better choice while improving standards through competition.

PharmAccess a non-governmental organization with aims to improve quality and access to health care in the African markets. They have assisted many governments and companies in launching schemes, such a M-TIBA. They promote the gains that digital technology can have to improve the scope and impact of healthcare in the region. Their goal is to stimulate both demand and in turn supply in the healthcare market, reducing risks and attracting investment.

A promising rise in these types of services have occurred, Kenya is an obvious target but seeing a wider reach would show scale can be achieved. In Nigeria a scheme called "Kwara Community Health Insurance Scheme" again assisted by PharmAccess in setup, as well as the world bank aims to insure expectant mothers and promote antenatal care. Set up in 2017 the benefits are yet to be seen although the government have supported this with 250 million Nigerian naira.

Another financial application supported in start-up by PharmAccess is AHME, this is a programme in Ghana to "identify poor households who are eligible for a premium waiver in the National Health Insurance Scheme" they do this through a digital proxy tool. This technology uses an online "enumeration process" (PharmAccess, 2017). From 110,000 tested households 25,000 were successful in qualifying. The government then uses two mobile money services e-zwich and MTN mobile money to reimburse the insurance claims (Rolans Amoah, Rajesh Bansal, Aneth Kasebele, 2017).

4.3.2   Success and Limitations

The m-Health sector is much more varied than other discussed. However, a theme in which they are linked is the use of ICT to further health outcomes. Many applications exist across many aspects of the sector. To fully assess the implications on inclusive growth and development therefore not as clear. What can be see though is through small scale innovations health outcomes have improved. Another aspect in which m-Health also show vast potential is the regions in which the cover, m-health programmes can be seen in almost all regions of Sub-Saharan Africa.

To access the impact of these innovations it is key to look at some health outcomes. Within the target of "good health and wellbeing" some key targets are to reduce the maternal mortality rate to less than 70 women per 100,000 births. Through this goal they also aim to reduce under 5 infant mortality rates to under 25 per 1000. Although many factors contribute was can see that the region has made significant way to this target, with it falling continually throughout the period. Another aspect of this come from the well documented connection between infant mortality reductions and mothers education (Baird, Friedman & Schady, 2011b; McGuire, 2001). My previous case will showed how access to education especially for girls has also improved through new innovations. Looking a Figure 4 we can see the success in reducing infant mortality since 2000 across the region.
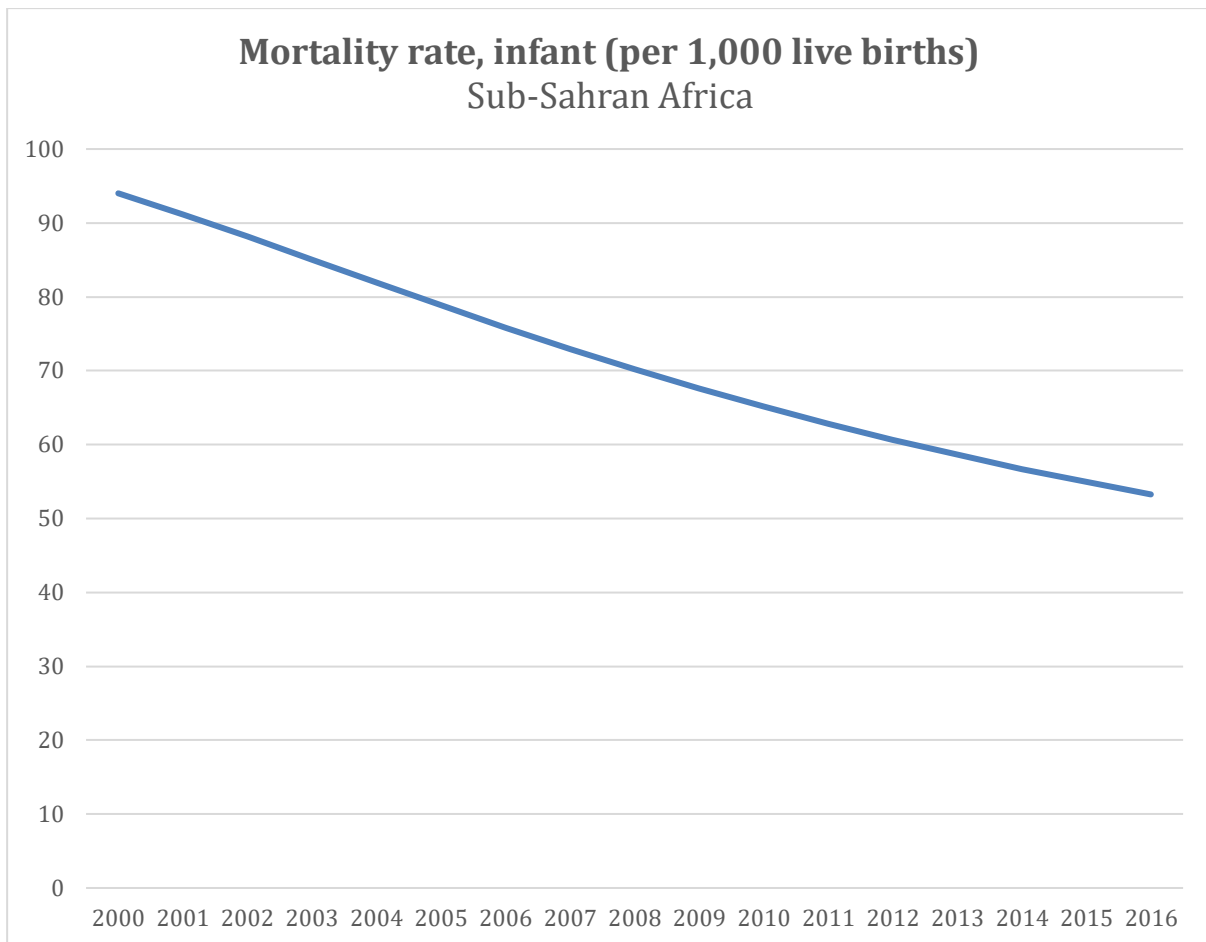
Figure 4 Infant Mortality Rate (per 1000 live births) Sub-Saharan Africa (World Bank, 2018b)

Also, an area in which mHealth is crucial is the target to "achieve universal health coverage, including finical protection risk" (The United Nations, 2018). We can see the development in mHealth have been crucial in this, they have extended not only the services of health care to many but access. This access comes from the scale the mHealth allows, for example access to health lines or the more effective time use of the already lacking numbers of health workers that is facilitated through new technologies. Secondly, we can also look to the potential of new developments such as M-Tiba and other mobile money insurers, that allows coverage of health care. Before these developments we have seen the ability for people to access healthcare was much more limited.

Further to "strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risk." we can see that the increased access of information through mobile phone has significant benefits for this, allowing people to mitigate risks especially in health risks.

Challenges still remain however with the main issues being that of infrastructure. Some innovations require a more complex connection than basic feature phones. For example, the need for a stable internet connection is essential for some of these innovations. Also, to be

considered is the role for governments, NGO's and private companies. Many of the above discussed cases are work from all three entities. This could mean a new approach to development should be more widely considered.

5 Analysis and Discussion

Innovations in the digital economy have now reached services and institutions such as banks, hospitals, energy sources and insurance companies to name a few. Such innovations come to fill a demand that is not being reached by traditional means. It appears this is due to two key factors. One being traditional infrastructure does not exist to facilitate these services through the considered normal way in the Developed World. Secondly, a crucial role regionally is the way in which functions in the digital economy minimise the potential for corruption and increase accountability.

A crucial aspect of my finding and in line with the previous literature is the essential role that ICT and internet technologies play in modern day development. Further to work by (Aker & Mbiti, 2010; Asongu, 2015; Jack & Tavneet, 2011) a clear aspect is the importance of the mobile phone as a tool for economic inequality reduction. It has given unprecedented access to essential services to some of those most in need. The saturation of mobile phones has occurred in the region at a rate like no other technology. However, for the full extent of the benefits to be reached, policymakers must ensure this access is available to all. This includes ensuring affordability of handsets while also working with network providers to extend coverage. We have already seen successful partnerships between governments and network providers such as M-Pesa and MyHealthline. These partnerships show the potential to be replicated across sectors and countries with the correct infrastructure and institutional support. Governments however must continue to ensure while working with such companies that the coverage and benefits of such projects are equitability distributed.

The success of such innovations to promote inclusive growth and development has been clearly shown on a case by case basis. What is now essential for policy makers and the development community, is to address how these innovations can be replicated and improved. I will now highlight some key issues that need to be addressed for the success of the digital economy in promoting inclusive growth and development. If this is to continue and extend governments and policy makers must promote investment and ensure regulation can facilitate this. For example, there are some companies that may concerned that increased regulation may harm their ability to operate. This is one reason attributed to the lack of success of mobile money in India, where regulation is much tighter. If governments can foster a regulatory framework inviting to private investment this could vastly expand the scope and scale of such projects.

A major factor to be addressed if these innovations are to be replicated across the regions are infrastructure requirements. Previously shown within the literature (Calderon & Serven, 2010) is the effect of improved infrastructure to reduce levels of inequality. In terms of the digital economy this is primarily network coverage and for more advanced innovations internet

connection. If infrastructure is effectively invested throughout the whole region, there is potential for the benefits seen through studied innovations to make dramatic improvements in standards of living and poverty reduction.

A consistent theme of the innovations studied was the interaction between public and private actors. Within the literature (Romer, 1986) suggests that essential for growth is "profit maximizing agents" this could have specific implications for the this research. The use of a profit seeking companies have shown to been essential in the recent success in the region. An important feature seen within the case studies is how technologies have evolved differently in Sub-Sahran Africa from that of the Developed World.

The innovations discussed tackle uniquely African problems such as lack of resources in the health sector or teacher absenteeism in schools. Innovations must come from within the region to exploit operational knowledge rather than relying on exported technology from the Developed World. It is crucial that this unique path of innovation is to continue to extend the reach of the 'm-development'.

6 Conclusion

6.1 Research Aims

Referring back to the research aim we can see that on a case study basis, there is much evidence that 'm-development' in the digital economy has contributed to a higher level of sustainable development. This has been seen across sectors, helping to reach many of the UNs SDGs.

The innovations have helped specifically in their sectors, greater financial inclusion, access to clean energy, greater educational learning outcomes and improved healthcare quality and access. More than this all these sectors facilitate a wider environment for inclusive growth. The need for a healthy, educated workforce who can effectively participate in the finical system is essential to foster inclusive growth and sustainable development.

On this exploratory case study basis, the level on internal inequality levels was harder to quantify. Some innovations such as MPESA had high levels of users from lower wealth groups, but these still lagged behind higher wealth groups. Lack of data of users of particular services meant comprehensive assessments of this problematic. However, the use of these innovations to close inequalities across the region and the Developed World are clear.

6.2 Practical Implications

The practical implications of this research aim to present how important the role of technology can be in improving lives and to give the region a real chance at development. It stresses the need for cooperation from governments, NGOs, aid agencies and private companies to implement and facilitate development of such innovations. The innovations studied would not have taken hold in the developed world due to lack of demand or need. Therefore, the ability for Sub-Saharan Africa itself to innovate and invest is crucial should other unique problems to the region be solved.

6.3 Future Research

What is clear from my findings is the need to further research. This case study method was an insightful first expletory step. The limitations to this method although are evident. A lack of

data is the most significant problem. The cases show how some crucial innovations have been highly successful in achieving certain development goals. Some areas in which clear areas for future research are whether these goals are being met equally across socioeconomic groups. For this research, more detailed insight into the users are needed as well as macro data such as Gini Index's. Research with a wider scope across all innovations could give much information in the best models of innovations in the digital economy as well as how to replicate these across regions.

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