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Investigating the relevance of mobile technology adoption on inclusive growth in West Africa

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ABSTRACT

This paper empirically investigates the role of mobile technology adoption on inclusive growth in 15 West African countries with a view to ascertaining if the positive role of mobile technology adoption on human development as established in other regions holds in West Africa. It used data from World Development Indicators for the period 2004–2014, which was estimated with System Generalised Method of Moments (SGMM). The SGMM results show that mobile cell subscription has a statistically insignificant effect on inclusive growth in West Africa which refutes the positive and significant role of mobile technology adoption on inclusive growth. The possible reasons for the results and recommendations are documented in the study.

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1. Introduction

Scholars have documented the possible drivers of economic progress among the different sectors within an economy; some emphasised the importance of technology as a driving force for economic and human development under the new growth theory (Asongu, Boeteng, & Akamavi, 2016; van der Boor, Oliveira, & Veloso, 2014; Lucas, 1988; Romer, 1990). The economic growth rates, as well as other economic indicators in some West African countries, have been reducing recently (especially in 2015 and 2016) due to the oil price shock. However, it is still evident that during the period of rapid economic growth, the levels of inclusiveness, gross domestic products (GDP) per capita, level of educational attainment, health care availability, poverty, inequality, and unemployment did not increase significantly. Thus, for countries to experience inclusive growth, economic or financial improvement alone is not sufficient but inclusiveness of the growth is necessary.

Information and communication technology (ICT), essentially driven by the forces of globalisation, plays a crucial role in the growth and development of an economy (Ogunsola, 2005). ICT is among the indicators used in measuring the degree of sophistication of the investment 'climate' of a country. ICT can be viewed as a tool to increase efficiency and save time. ICT is a dimension (subset) of technology (alongside electricity production, transportation, and so on) that can be viewed as an essential indicator of the level of

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development attained by an economy and given the current trend of globalisation, ICT could be a tool for achieving this goal.

Globalisation has led to many innovations in technology such as the internet, mobile phones, television sets, personal computers, radios and others that have made communication everywhere around the world easier and faster. These modern tools for communication are collectively called information and communication technologies-ICTs (Olise, 2010), which play a fundamental role in the sharing of knowledge – a knowledge-driven economy (Asongu, 2015). The argument for developing countries to globalise is important and is designed to enhance access to foreign capital and improve technology in order to enhance the prospect for larger markets (Alege & Osabuohien, 2013).

There is a somewhat consensus in the existing literature that the knowledge economy is key to economic development (Asongu & Le Roux, 2017; Kuada, 2015; Tchamyou, 2017). Knowledge-based economies have a higher chance of confronting the challenges that globalisation poses to economic development. Amongst the four components of the World Bank's Knowledge Economy Index (KEI), ICT is likely to exert the highest effects on economic and human development landscapes because of its potential for wider and faster adoption and penetration (Asongu & Le Roux, 2017). Mobile technology is an example of a technology product whose falling costs over time made it accessible to all income classes.

The adoption of mobile technology has been relatively high across countries. For example, India's rate of adoption has demonstrated the potential of ICT for inclusion (Goyal, 2015). India's ICT adoption grew in double digits after 2000 and its annual contribution to GDP growth grew about 10% within that same period. Specifically, India moved from 5 million cellular subscribers in 1991 to 37 million in 2001 and 898.02 million in 2013. The mobile cell subscription per hundred people was 72 in 2011 compared to the United States' figure of 93. Many other emerging and developing economies such as those in West Africa have had more success with the adoption of mobile technology (Goyal, 2015).

The choice of West Africa for this study was informed by two main reasons: First, West African countries have high levels of non-inclusiveness (such as poverty rates, inequality, low education enrolment rates, and relatively low health care delivery) however, amidst of the aforementioned, there seems to be a relatively high level of utilisation of mobile technology despite development challenges according to report (World Bank, 2016a). Penard, Poussing, Yebe, and Ella (2012) reported that mobile phone and internet penetration rates in Sub-Saharan Africa (SSA) stood at 41% and 9.6%, respectively as at 2010. Secondly, Asongu (2015) suggested that while high-end markets in Asia, Europe, and North America are stable in terms of growth of mobile phones, developing African markets are still substantial target markets and business opportunities for mobile penetration. Asongu (2015) and Asongu and Le Roux (2017) also noted that the prospects of mobile phone penetration in Africa are encouraging and these considerations motivate research in the African context.

To achieve its objectives, this study employs the system generalised method of moments (SGMM) to underscore the linkage between mobile phone technology diffusion and inclusivity between 2004 and 2014 using a sample of fifteen West African countries The rest of the study is structured as follows: Section two provides some insights from extant studies, the analytical framework and method of analysis are encapsulated in the third section, section four discusses the empirical results and the findings; while Section five concludes the study.

2. Insights from related literature

From the literature, inclusive growth denotes both the pace and pattern of economic growth, which is assessed and interlinked (World Bank, 2009). The rapid pace of economic growth is necessary for reducing absolute poverty, but for sustainability, it should be broad-based across sectors and inclusive of the large part of a country's labour force. Inclusive growth is an economic growth that creates opportunities for all segments of the population and distributes the dividends of increased prosperity, both in monetary and non – monetary terms, fairly across society (Organisation for Economic Cooperation and Development [OECD], 2014).

The European Commission-EU (2001) defined ICT to denote a term concerned with the storage, processing, dissemination, and management of information and knowledge adopting various types of software and equipment in a digital and non-digital form. Hence, ICT can be broken down into three components – services, application, and technology. Services include the internet, emails and so on. The application involves management information systems, distance learning, and teleconferences while technology ranges from the traditional technology (including radio, television, accounting ledgers) to modern technology (such as cellular phones, Internet access facilities).

Literature in this regard is beginning to witness increasing theoretical and empirical debate on ICT such as mobile telephones and its effect on economic growth and inclusive growth. ICT so far is seen as a medium for dissemination of information. Most researchers on ICT adoption have focused on achieving economic growth through ICT (Ghosh, 2016; Imbert & Papp, 2015) without much emphasis on inclusive growth. Some researchers have investigated ICT penetration on specific sectors like the banking sector and other sectors (Osabuohien, 2008); how institutions matter for technological utilisation in Africa (Efobi & Osabuohien, 2015; Oluwatobi, Efobi, Olurinola, & Alege, 2015), the challenges and opportunities in technological diffusion for economic progress in Africa (Osabuohien & Efobi, 2012), ICT and productivity in Europe and the USA (Ark, Melka, Mulder, Timmer, & Ypma, 2002; Jorgenson, 2003), ICT and agriculture (Ejemeyovwi et al., 2017); ICT investments, human development and institutions in ECOWAS (Ejemeyovwi, Osabuohien, & Osabohien, 2018), among others.

Some researchers used primary data to evaluate the impact of ICT on economies and businesses due to the insufficient nature of large ICT data in the West African part of the world (which is due to the lateness in the adoption of ICT in this area) and the relative scarcity of research in ICT penetration in the area while some others used cross-sectional data for correlations (Asongu, 2013, 2014), extended the research to causality (Asongu et al., 2016) for policy implications. However, the results were similar – ICT such as mobile phone technology adoption contributes positively to inclusive growth and the adoption and utilisation of ICT in sectors like agriculture can bring changes to the poor and needy areas in an economy such as food security (Kumar & Sankarakumar, 2012).

Insights from the literature have revealed some gaps that this study fills as follows: (1) investigation of the relationship between mobile technology and human inclusive growth using the real values and not the conventional mobile technology per hundred persons, (2) utilisation of a dynamic panel data for West Africa considering the model and variables considered, (3) utilisation of human development as proxy for inclusive growth for the unique model. Thus, this study makes contribution to the literature by examining

the role of mobile technology adoption in influencing inclusive growth drawing empirical evidence from West African countries using SGMM technique of estimation on a dynamic model.

3. Analytical framework and method of analysis

3.1. ICT and inclusive growth nexus

Hameed (2006) emphasised how ICTs such as mobile technology could improve sector performance and empower countries in terms of national capacity building (employment, international trade –exportation) as strategised and implemented by Pakistan which has been productive so far. Johnson (2016) discovered that countries with high ICT adoption are usually characterised by high levels of inclusive growth. The research showed that all countries in the world could be categorised into three; ICT empowered economies (ICTEE), ICT adopting economies (ICTAE) and ICT deficient economies (ICTDE). Johnson (2016) discovered that countries that are ICT empowered are characterised by high level of inclusiveness, vibrant ICT infrastructure, low inequality, low unemployment rate, high enrolment rate, large human capital development, and largest ICT investment; ICT adopting economies are characterised by moderate level of inclusiveness, relatively less robust ICT infrastructure, high level of poverty and inequality, relatively high unemployment rate while ICT deficient countries are characterised by poor level of inclusiveness, huge digital divide, and low human capital investment, poor investment in ICT infrastructure, poor ICT infrastructure, very high levels of unemployment and inequality.

Worthy of note is the fact that the populace does not need word processing to survive, but they may want efficient ways to share information about livelihood and employment (Hameed, 2006). This buttresses the fact that ICT for human development is not about the technology but about people using technology to meet some needs, thereby creating time for other things. ICTs such as mobile technology could assist in job creation, facilitating education for all, research and development for more productivity, achieving financial inclusion and providing improved value chain interaction and social media connection for networking purpose [See Figure 1].

Some factors limit and slow down the adoption of ICTs by West African countries. These factors, among others, include cost of adoption, level of literacy and language disparity, low ICT related investment and infrastructure, low electricity and energy supply (a common problem of most developing countries), anti-globalisation mindset. ICT has its advantages as well as disadvantages. Having highlighted the models, benefits and limitations, some of the backdrops of ICT adoption are: ICT or process automation threatens the availability of jobs, ICT creates room for organised criminal activities such as hacking and cybercrime activities which could lead to loss of huge amount of money due to online fraudulent activities, and high cost of acquisition of some mobile technologies such as smart phones.

3.2. Theoretical framework and empirical model

The theory that underpins this research work is diffusion theory of innovation as initially enunciated by Rogers (2003). The diffusion theory of innovation explains the process it takes a new idea or product (technology) to be adopted over time. Diffusion of innovation theory proposes that four elements influence the spread of a new idea: the innovation

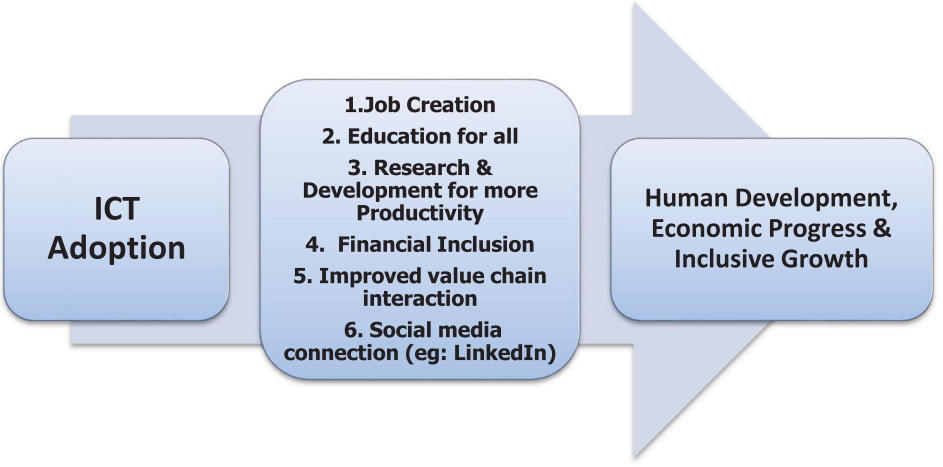

Figure 1. ICT adoption and inclusive growth linkage. Source: The Authors'.

itself, communication channels, time and a social system. Rogers (2003) proposes that diffusion of innovation requires communication channel over time among the participants in a social system. Rogers (2003) argues that diffusion is the process by which an innovation is communicated over time among the participants of a social system. It explains patterns of adoption and predicts how unsuccessful or successful a technological innovation will be (Tan & Eze, 2008).

Diffusion of Innovation theory could be used for research and analysis purposes to identify where technology adoption is most appropriate like in the case of education (Sahin, 2006). Triplett (1999) in a study tested and proved that technical innovations contribute positively to an economy. The author discovered that there must be improvements in diffusion through information technology (IT) investment. ICT adoption is proposed as the communication channel for firms and institutions and mobile technology adoption is a good measure of ICT adoption which also captures 'innovation' within a Schumpeterian growth framework as modelled in this study.

This study adopts the Schumpeterian growth model which explains the role of innovation as a major contribution to growth and development as well as other growth determinants as found in the literature. The Schumpeterian model of growth is an extension of the endogenous growth theory which posits the existence of three basic determinants of growth within an economy – technology (A_i) such as ICT, socio-economic setting (S_i), including institutions and the conventional growth components (X_i) (Becker, Eblinger, Hedtke, & Knudsen, 2005; Schumpeter, 2005). The implicit function is seen as follows:

$$Y = f(A_i, S_i, X_i) \tag{1}$$

where $A_i = \text{MCS}_i$; $S_i = \text{RULE}_i$, PSE_i; $X_i = \text{GDPPCGR}_i$, CREDIT_i.

Where Y represents inclusive growth, A represents technology adoption; S represents socio-economic settings such as institutions – while X represents the endogenous growth components.

Noting that the empirical model of Andres, Amavilah, and Asongu (2016) and Ejemeyovwi et al. (2018) closely related to this study, the model includes some of their

covariates and the main variables of interest. This study is interested in the relationship between mobile technology and inclusive growth. The main reason for the choice of the covariates is the fact that for human development to be achieved, institutions and other control variables in this model are to be present. The explicit form of the model is given as:

$$Y_{it} = \alpha_0 + \alpha_1 Y_{it-1} + \alpha_2 \text{MCS}_{it} + \alpha_3 \text{PSE}_{it} + \alpha_4 \text{RULE}_{it} + \alpha_5 \text{CREDIT}_{it} + \alpha_6 \text{GDPPCGR}_{it} + \mu_{it}. \quad (2)$$

where 'Y_{it}' represents human development index which proxies inclusive growth of country 'i' at time 't', 'MCS_{it}' stands for number of mobile cell subscribers which is used as the ICT adoption variable to represent the technology (A) as against investment in technology utuilsed as a proxy in Ejemeyovwi et al. (2018); 'PSE_{it}' represents primary school enrolment; 'RULE_{it}' represents institution; 'CREDIT_{it}' represents domestic credit provided by financial sector; 'GDPPCGR_{it}' represents gross domestic product growth rate in the Schumpeterian growth model and 'Y_{t-1}' represents the lagged dependent variable (to eliminate omitted variable bias).

The dependent variable, human development index is used as a proxy for inclusive growth. Consistent with recent African knowledge economy (Tchamyou, 2017), mobile technology is proxied by mobile cell subscription variable as in literature (Asongu, 2015). Primary school enrolment, institutions – rule (Binder & Geogiadis, 2011; George, Olayiwola, Adewole, & Osabuohien, 2013) and credit are necessary control variables essential to the Schumpeterian growth model to capture human development.

Given that the variable of interest is the 'number of mobile cell subscribers', the *apriori* expectation states that its coefficient should have a positive sign. This means that an increase in the number of phone subscribers should account for a significant increase in inclusive growth, hence, $\alpha_2 > 0$.

Given the dynamic nature of the model (the addition of the lagged dependent variable in the model), to achieve estimates that are best, linear, unbiased and efficient (BLUE), address the issue of endogeneity and reverse causality, the system generalised method of moments (SGMM) technique was used.

3.3. Data sources and description

This study, with a view to achieving its objectives, utilises two major methods of analysis. They include descriptive and econometric techniques. The former employs charts and tables to assess the trend of mobile technology adoption and inclusive growth in West Africa while the econometric analysis employs the system generalised method of moments (SGMM) technique to examine the relationship between mobile technology adoption and inclusive growth. The variables' identifiers, definitions, and the sources of data are presented in Table 1.

4. Empirical results and discussions

4.1. Patterns of mobile technology adoption and inclusive growth in West Africa

The 15 selected West African countries are Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Sierra Leone,

Table 1. Variables definition, mean and source of data.

Variable	Identifier	Source
Inclusive Growth (proxied by Human development index)	HDI	UNDP (2015)
Number of mobile cell subscribers	MCS	World Bank (2016a)
Primary school enrolment (pupils) – female	PSE	World Bank (2016a)
Institution	RULE	World Bank (2016b)
Domestic credit by financial institutions	CREDIT	World Bank (2016a)
Gross Domestic Product per capita growth rate	GDPPCGR	World Bank (2016a)

Source: Compiled by the Authors.

Senegal, and Togo. The variable used to represent inclusive growth is human development index while the data used to represent mobile phone technology adoption is the number of mobile phone subscribers. The data were sourced from the United Nations Development Programme-UNDP, 2015 and the World Development Indicators-WDI (World Bank, 2016a).

Mobile cellular subscribers are the total subscriptions to a public mobile telephone service (World Bank, 2016a). Nigeria has proven to be the giant of Africa in this regard by having the largest number of mobile cellular subscribers with about 9.15 million subscribers as at 2004 and 139 million in 2014. This is followed by Ghana with 1.69 million subscribers as at 2004 and 30.3 million subscribers in 2014. Cote d'Ivoire ranks third with 1.67 million subscribers in 2004 and 22.1 million subscribers in 2014. The smallest countries in terms of mobile cellular subscribers are Cape Verde with 65,780 subscribers in 2004 and 616,378 subscribers in 2014. The values of mobile cellular subscriptions have increased massively over time, beyond the total population of the countries due to people's preference to subscribe to two or three different networks and service providers at the same time.

Table A1in the Appendix shows the detailed data values while Figures 2 and 3 show the average trend of mobile phone subscribers and human development in West Africa.

Human development index (HDI) is a measure of human development which represents inclusive growth. It is a composite index which measures the average achievement in the three basic dimensions of human development – health, education and a decent standard of living (UNDP, 2015). The values of the HDI range from 0.1 to 1.0. The higher the value of the HDI, the better the human development in that country, and *vice versa*.

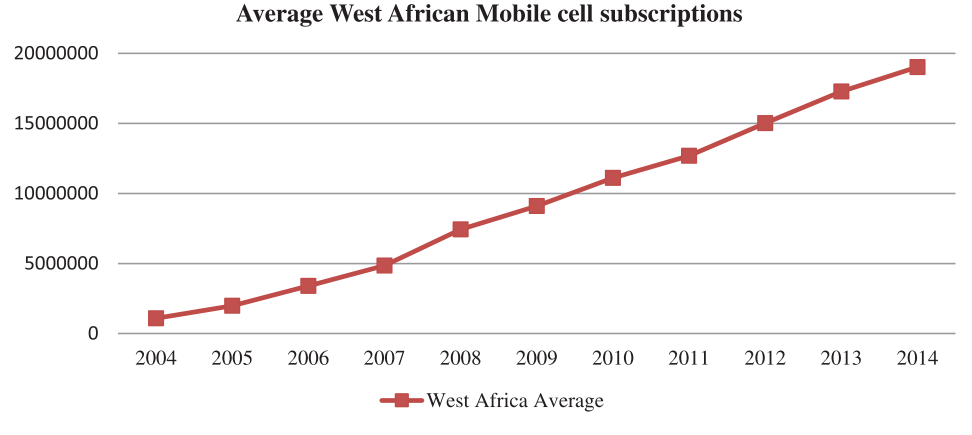

Figure 2. Mobile cell subscribers in West Africa. Source: Authors' computation using data from World Bank (2016a).

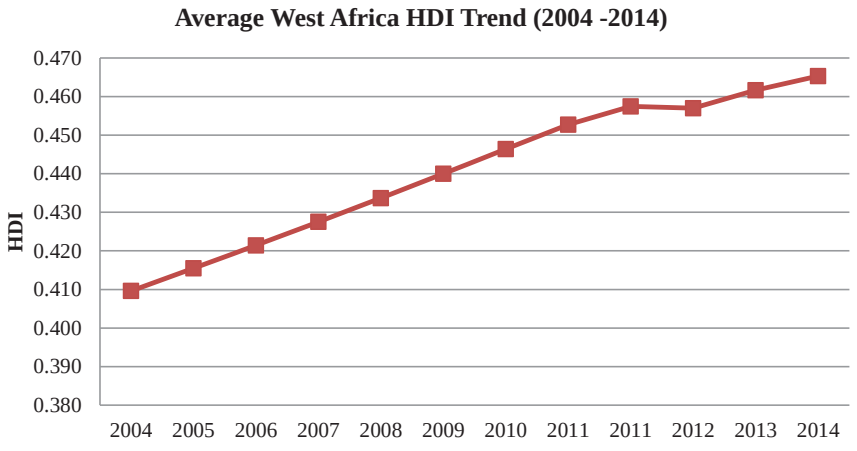

Figure 3. Human development index in West Africa. Source: Authors' computation using data from UNDP (2015).

The maximum and minimum values show that the human development index grew as high as 0.65 which was found in Cape Verde in 2014 and as low as 0.28 in Niger in 2004. The trend of the average HDI for West Africa has been increasing almost consistently until it was interrupted (2011) and remained at the same level till 2012 before it experienced a further increase.

4.2. Results from econometric analysis

The generalised method of moments (GMM) is an estimator designed for situations with 'small T, large N' panels (few time periods and many individual units), a linear functional relationship, one left-hand variable that is dynamic – depending on its own past realizations, right-hand variables that are not strictly exogenous, correlated with past and possibly current realizations of the error, fixed individual effects (implying unobserved heterogeneity – heteroscedasticity) and autocorrelation within individual units' errors, but not across (Baum, 2013). There exist two major types of the GMM estimator: the Arrelano – Bond (difference GMM) approach and its extension to the 'System GMM' (SGMM) context. Given the dynamic nature of the dataset employed in this study, the SGMM estimator caters for the possible problems usually associated with such type of data (dynamic panel data).

The necessary condition for the interpretation of the GMM results is to examine the AR (1), AR (2), the Sargan test statistics and to compare the number of instruments against the number of groups. The Sargan test checks for the validity of the internal instruments used in the SGMM. From the results in Table 2, the p-value of the Sargan test satisfies the rule of thumb that at 5% level of significance (*P*-value > 0.05), the instruments are valid and were not over-identified. AR (1) and AR (2) tests for the presence of autocorrelation of the first order and second order.

The values of the AR (1) and AR (2) of the model in this study are not statistically significant (> 0.05), there is the absence of autocorrelation of the first order and second order. In terms of the comparison of the number of instruments against the number of

Table 2. SGMM results (Dependent variable: Inclusive Growth).

	I	II	III
Inclusive Growth(−1)	0.96*	1.04*	1.00*
	(0.00)	(0.00)	(0.00)
Mobile cell subscription	1.30	9.70	6.52
	(0.99)	(0.29)	(0.36)
Primary school enrolment	−.0003	−.0004	−.0004
	(0.26)	(0.29)	(0.57)
Rule of law (Institution)	−.0021	−.0034	−.0014
	(0.74)	(0.40)	(0.72)
Domestic credit provided by financial sector	−.00006	−.0000	.000017
	(0.48)	(0.78)	(0.77)
GDP per capita growth rate	0.00021	0.0004**	.00034
	(0.74)	(0.02)	(0.10)
Constant	−.0081	0.023	0.01
	(0.75)	(0.11)	(0.12)
AR (1)Pr	0.379	−0.39	0.08
AR (2)	0.361	1.49	0.12
Sargan Test	0.154	0.74	0.42
Prob > *F*	(0.000)	(0.000)	(0.000)
Number of instruments	8	8	10
Number of groups	15	15	15

Note: The values in the parenthesis '()' are the probability values.
*, **denotes that the coefficients are significant at 1% and 5%, respectively.
Source: The Authors'.

groups, the rule of thumb says that the number of groups should be higher than the number of instruments. The number of groups is higher than the number of instruments for the three models. Therefore, the above confirmations support the results from this study and denote that they are reliable for inference.

Focusing on mobile technology adoption in West African countries, the variable is not significant using the SGMM estimator (i.e. Columns 1, 2 & 3). This does not conform to the *apriori* expectation which states that an improvement in mobile technology adoption is expected to contribute significantly to human development; inclusive growth of countries in West Africa. However, the *apriori* expectation is so because the usage of mobile technology and internet enables increased efficiency over time, helps to solve problems through various methods across physical barriers at a very short time. Although the results are not statistically significant at 5%, a unit increase in mobile technology adoption explains a −1.30 or −9.70 or −6.52 (negative) increase in inclusive growth. The results from the SGMM are found in Table 2.[1]

The factors that could account for the insignificant and negative impact of mobile technology adoption on inclusive growth as found by the study are the high cost of acquisition of the technology in West Africa, the usage of these technologies for non-economically productive reasons by the populace (which could be due to ignorance), low investment in research and ICT development funds as well as low investment generally in the telecommunications industry and the low penetration of these technologies enough to positively affect inclusive growth.

From the *apriori* expectation, the mechanism through which mobile technology could lead to inclusive growth is first, through spontaneous information dissemination. The transmission is initiated from the various theories (reasons) on how and why a new technology is adopted by an individual, firm, or country- in this case; mobile phone technology is then utilised by the population to reduce the information asymmetry (information)

variance between the different users at the various sides (supply and demand) of each value chain that exists in all the sectors and markets in an economy. Secondly, access to mobile technology reduces transaction costs associated with the markets (i.e. savings in time and travel) and assist in the expansion of market boundaries (Aker & Fafchamps, 2010; Asongu et al., 2016).

The above, in turn, will increase productivity and economic growth, and therefore, inclusive growth. Inclusive growth is achieved through the increased participation of the labour force in the various economic activities; which is in line with the definition of inclusive growth; that is, creating equal opportunities for all in an economy. This transmission pass – through could be applied to the labour market, capital market, all sectors of the economy including education sector, health sector, agriculture sector, and so on.

ICTs are at the forefront of many innovative activities occurring in West Africa (Asongu et al., 2016) such activities include: *M-pesa* in Kenya and other African countries as well as *e-zwich, Afric Xpress, eTransact* in Ghana (Kirui, Okello, Nyikal, & Njiraini, 2013; Osabuohien & Karakara, 2018; Singh, 2012), empowerment of women (Ojo, Janowski, & Awotwi, 2012), consolidation of health services (Kliner, Knight, Mamvura, Wright, & Walley, 2013), household management efficiency (Al Surikhi, 2012), bridging of the rural-urban (Chan & Jia, 2011); enhancement of household opportunities for business and elimination of wastes in agriculture as well as supply- and demand-side obstacles (Aker & Fafchamps, 2010; Muto & Yamano, 2009). Mobile technology adoption needs to be complemented with internet penetration and innovation (Asongu et al., 2016).

5. Conclusion

This study was motivated by the debate on the role of mobile technology as a significant contributor to inclusive growth and it provides an empirical investigation on the effects of mobile technology on inclusive growth in West Africa from 2004 to 2014. This is deemed crucial based on the fact that slow level of adoption of ICT is witnessed in some West African countries while some others experience fast levels of adoption of ICTs such as mobile technologies (mobile cell subscription, smartphones, and so on). The study discovers that mobile cell adoption does not significantly impact inclusive growth in West Africa and further argued that an improvement in mobile technologies in the member countries will provide one of the required structures that will increase inclusive growth according to the *apriori* expectation. To achieve the stated objective, the study engaged econometric analysis which utilised the generalised methods of moments (GMM) technique. A number of recommendations are made and the major ones are summarised herein.

Most of the West African countries do not produce such technologies (despite the fact that West Africans are talented in terms of brain and manpower), the cost of acquisition of some mobile technologies seems to be very high which could be due to factors common to most West African countries such as increasing inflationary rates, low exchange rates, and other factors. Thus, efforts and policies such as increased investments in telecommunications industry and other related industries, rendering of tax holidays to encourage the local production of such technologies within West Africa will be laudable in enhancing inclusive growth as it will help to diversify the export content of West African countries, provide employment, reduce brain drain syndrome and intensify the penetration as well as competitiveness of their products.

Mobile technology adoption though not a significant determinant of inclusive growth in West African countries (from the result of this study) is useful and therefore, the use of cutting-edge information and communication technology (ICT) facilities should be encouraged by private and public companies, institutions offering health care services, education services, agriculture, and financial services to improve efficiency by reaching out to far distances to increase coverage for everyone.

As a suggestion for further research, it will be expedient to complement this study using other components of mobile technology (such as smartphones), internet adoption, social media usage, the average subscription fees of mobile cellular and their relationship with inclusive growth, use of other variables to represent inclusive growth, use of other forms of data (time series and cross-sectional) to add to knowledge. It is also recommended that further studies examine the role of mobile technology adoption in influencing inclusive growth in sub continents, continents, countries, regional economic communities in Africa and beyond with a view to comparing their experiences with that of West Africa.

Note

1. We carried out a number of robustness checks notably: the Tobit regressions (to control for the limited range in the dependent variable) and the Roodman GMM extension (to control for persistence in the dependent variable).The results (not included but available upon request) exhibited the same pattern. Thus, connoting that within the context of selected West African countries and for the period of the study, mobile phone technology has not significantly promoted inclusive growth. The authors appreciate Dr. Simplice Asongu for assistance in the robustness check.

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Appendix

Table A1. Mobile cell subscribers (MCS) in West Africa ('000).

MCS	2004–2006	2007–2009	2010–2012	2013–2014
Benin	703.77	3,570.16	7,749.32	9,143.94
Burkina Faso	682.03	2,901.94	7,788.69	11,867.64
Cape-Verde	85.45	240.17	397.87	556.42
Cote d'Ivoire	2,696.40	10,367.02	17,014.27	20,747.74
Ghana	3,258.93	11,427.80	21,407.07	29,193.63
Guinea	171.95	2,746.33	4,815.10	8,059.99
Guinea Bissau	98.54	452.24	819.73	1,024.10
Liberia	178.12	834.23	1,990.62	2,888.02
Mali	893.93	3,476.67	10,958.38	21,627.47
Mauritania	776.05	1,896.07	3,372.10	3,870.76
Niger	326.43	1,798.88	4,602.35	7,621.35
Nigeria	20,018.80	59,300.79	98,414.29	133,103.21
Sierra Leone	0.00	981.60	2,115.67	4,378.40
Senegal	1,944.68	5,307.14	9,722.41	13,756.75
Togo	491.40	1,642.40	2,869.95	4,389.55
West Africa(Average)	2,309.03	7,129.56	12,935.85	18,148.60

Source: Compiled by the Authors.