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Workforce Productivity Growth and Inequality Reduction in Developing Countries: The role of Mobile Banking & Financial Services Development in Africa

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Abstract

Using a specific database on mobile banking and financial services across countries, we document the questionable pro poor and inclusive growth in developing countries and show the importance of mobile financial and banking development for workforce productivity growth and inequality reduction. This paper uses several econometric techniques to investigate mobile finance and banking stylized facts with a focus on its real impact in Africa. The mobile banking index is constructed using the principal component analysis method. The statistical analysis reveals that there is a positive link between mobile banking development and inclusive growth. The estimation of three econometric models using different dependent variables and estimation techniques mainly show a positive impact of mobile finance & banking development on both workforce productivity growth and inequality reduction. These main findings suggests that policies to boost mobile finance and banking development in Africa should be viewed as measures that would bear fruits in the medium to long run.

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1. Introduction

It is globally theoretically and empirically established that an important part of growth is supported by investment and business performance. To this major factor of economic growth, we should mention the importance of a healthy and developed financial system (Nguena and Tsafack Nanfosso, 2014ab). In Africa, the main concern is the inclusion and depth aspect of the financial system which tends to considerably explain the lower level of the contribution of the supply side of the economy (Ndebbio, 2004; Meisel and Mvogo, 2007). Generally, mobile financial and banking services offer great potential to improve financial inclusion to the poor through inclusive financial services and particularly digital payment services (Gutierrez and Singh, 2013). With its main characteristics being instantaneity, cash holding free, privacy, security, perceived ease of use, compatibility, social influence, …etc. mobile baking is assumed to be more suitable to the behaviour of "*Homo Africanus"* and can therefore improve the inclusiveness of the financial sector and unleash investment and economic development.

In Sub-Saharan Africa, 75% of the population does not have access to any form of formal financial services. This situation contributes to the success of informal finance like ROSCAS and is too important to be ignored in the well documented literature on the positive link between financial and economic development (Ndebbio, 2004; Nguena and Tsafack Nanfosso, 2015). The potential reasons of the failure of the traditional financial system in terms of inclusion are mainly: the long distance to the nearest bank; the difficulty for the population to trust and the willingness to allow a third party like a bank to manage their very limited disposable income…etc. Mobile finance and banking (also known as M-Banking, SMS Banking) is a term used to refer to that act of performing account transactions, payments, credit applications and other banking transactions through a mobile device such as a mobile phone with a link or not to a traditional banking account. The idea is that mobile financial services can work without a link to a traditional banking account while mobile banking services are related to a banking account.

All these new modes of financial transactions constitute what we call financial innovation. Mobile finance and banking has experienced a fast growth globally. According to Telecom Trends International Inc., today there are 1.3 billion mobile phones around the world which have emerged in the past 20 years, compared to the more than 2.5 billion landlines built over the last century. The number of mobile phones is expected to be 4.5 billion by 2016, compared to 1.5 billion TV sets in worldwide use today. In line with this trend, mobile banking seems to be the current trend after micro-finance that has captured more than 90 million customers in the past 30 years. Concerning the specific case of Africa, the number of mobile/cellular phones subscription have significantly increased. Indeed in 2010, only some northern and southern African countries presented good performances; while in 2014, the performance was around more than 130 per 100 subscriptions in the north, west and south of the continent like in South Africa or Botswana, today almost all African countries have shown good performances. Since 2014, internet usage is also higher especially in the northern and southern African countries, where the internet users reach even the 56.8 per 100 subscriptions like in Morocco. Based on this large potential, the question of how mobile finance and banking can be used in facilitating economic development, on the one hand, and mobilising funds for use in economic development, e.g. through micro financial institutions, on the other arises. More specifically, how can these new financial modes help in terms of inclusiveness of finance and thus improve poverty reduction with an inclusive growth?

As emphasised by Maurer (2008) and confirmed in subsequent literature (Jonathan and Camilo, 2008; Thacker and Wright, 2012), scholarly research on the adoption and socioeconomic effects of mobile banking (payments) systems in the developing world is scarce. From a broad point of view, most studies on mobile banking have been theoretical and qualitative in nature (Maurer, 2008; Jonathan and Camilo, 2008; Merritt, 2010; Thacker and Wright, 2012; Asongu,

2013, 2014). Moreover, the few existing empirical works hinges on country-specific and micro-level data (collected from surveys) for the most part (Demombynes and Thegeya, 2012). The purpose of this study is therefore to fill the existing gap by empirically checking if mobile banking development matters for pro poor and inclusive growth in African developing countries.

This paper's specific objectives are: to empirically determine the impact of mobile banking development on workforce productivity growth and inequality reduction in Africa. To the best of our knowledge, the paper is seminal and uses newly available data from the World Bank on mobile phone penetration and mobile banking[1]. In essence, apart from identifying some stylised facts for the case of African countries, wedo an in-depth analysis of the distinguishing characteristics of mobile banking: 'mobile phone used to pay bills' and 'mobile phone used to pay/receive money' and 'internet users per head'. Additionally, the aspect of capitalism has been taken into account by considering the 'economic freedom' index.

The contribution of the paper to the literature is fourfold. Firstly, we deviate from mainstream African mobile literature that is based on qualitative and microeconomic assessments (Maurer, 2008; Jonathan and Camilo, 2008; Merritt, 2010; Thacker and Wright, 2012; Demombynes and Thegeya, 2012). Hence, the paper complements existing literature with a macroeconomic empirical assessment of the impact of mobile banking development on workforce productivity growth and inequality reduction. It can contribute by endorsing or not the findings of Nguena (2019) on mobile banking development determinants. Secondly, the study uses the only mobile banking data available first published by the World Bank in 2013. Thus, we are able to steer clear of recent studies that use mobile penetration as a proxy for mobile banking (Ondiege, 2010; Asongu, 2013). Instead of using only mobile penetration data as a mobile banking proxy, we construct an indicator of mobile finance and banking using "mobile phone usage in the payment of bills", "mobile usage in the sending/reception of money" and "Internet users per head". Thirdly, the empirical study is contemporaneous by using current period data and questioning current financial innovation in comparison to the context of previous studies and therefore can been classified as participating to the new debate on finance and growth nexus. Fourthly, the context of cohabitation of a less developed financial system which is generally a more bank-based than market-based system on the one hand and an increasing and rapid adoption of financial innovations on the other hand for almost all African countries increase the importance of this study linked to the economic welfare objective.

The rest of the paper is organised as follow: the first section presents the literature review on mobile banking development, growth, poverty and income distribution; the second section focuses on mobile finance and banking stylised facts and benchmarking; the third is dedicated to the econometric methodology; the fourth section presents and discusses the results; the fifth and last section concludes the study.

2. Mobile finance and banking development, workforce productivity and income distribution: A selected literature review

2.1. Workforce productivity, poverty and income distribution

This section presents different cross-country investigations which examine the link between workforce productivity, poverty and income distribution. It is clear that effective pro-poor and workforce productivity growth policies may not have to only concentrate on economic growth, but it should also be combined with effective income redistribution policies; the link between growth and inequality are important from a policy standpoint. There has been an intensive debate on this question since the 1950s.

Using a cross section of countries, Kuznets (1955) studies the relationship between per capita income and inequality and finds that inequality increases, and then decreases, as per capita

[1] http://blogs.worldbank.org/allaboutfinance/mobile-banking-who-driver-s-seat

income increases. Many authors also test the relationship found by Kuznets. These studies use larger and more accurate databases than those used by preceding ones as well as country specific data, The results of Deininger and Squire (1998) show no evidence of an inverted-U shaped relationship between per capita income and inequality. Also, these authors do not find any evidence of a positive relationship between economic growth and inequality. Thus, accelerated growth is associated with a decline in inequality as often as it is to an increase, or no change at all in inequality.

Following this same reasoning and using an empirical approach based on household surveys for 67 developing economies for the 1981-1994 period, Ravallion and Chen (1997) find no relationship between marginal changes in inequality and polarisation; income distribution improved as often as it worsened in growing economies, and a decline in economic growth is more favorable to inequality than positive economic growth. Goudie and Ladd (1999) specifically hold that there is very small evidence on the fact that economic growth changes income distribution and that countries pursue an economic growth-oriented policy in the absence of a clear link between growth and inequality.

A minority of other studies focus the effects of inequality on poverty. Deininger and Squire (1998) study the effect on poverty of initial and concomitant changes in inequality and find that the poorest 20% suffer the most from the negative effects of inequality on economic growth and that initial inequality hurts the poor through the credit rationing and inability to invest channels. Ravallion (2003) also shows that the poor might benefit more from economic redistribution or reductions in inequality but suffer more than the rich from economic decline.

On the other hand, while many studies show a strong relationship, there are some countries where initially higher inequality may be less successful in reducing poverty; for example, initial models (Harrod-Domar model) show that an increase in inequality leads to higher growth rates. Forbes (2000) applies various estimation methods to data on 45 countries covering the period 1966-1995 and finds evidence against the existence of a negative link between inequality and economic growth; he shows that in the short and medium run, an increase in inequality has a significant positive effect on economic growth. Within a political economy framework, Alesina and Rodrik (1994) show that when inequality is high, it implies that the poor have less voice and accountability, and that the median voter will put pressure for distortionary taxes, which will finally negatively affect savings and reduce growth.

As a conclusion, this controversial literature review can allow us to consider different empirical models of checking the impact of mobile finance and banking development on workforce productivity growth and inequality reduction.

2.2. Mobile finance and banking development and Workforce Productivity Growth and Inequality Reduction

Few studies have explored the role of mobile finance and banking development in workforce productivity Growth and inequality reduction rather than in economic growth and poverty reduction.

Since the seminal paper by Hardy (1980) that studies the effects of telephones per capita on economic growth, a growing number of studies use telecommunications as an important component of economic infrastructure that promotes productivity and growth. The implications of telecommunications infrastructure for economic development are derived from both the direct and indirect economic growth benefits of telecommunications expansion. A more efficient flow of information reduces communication and transaction costs, and an increased information transfer leads to market efficiency and competition as well as the potential for reducing the technological gap.

The literature on the relationship between mobile banking and financial services development proxies and production growth/inequality is diversified. Some studies use time series analysis and apply Granger causality and modified Sims tests, and focus on the strength and direction

of the causal relationship between telecommunication infrastructure investment and economic growth. For example, Cronin et al. (1991, 1993) and Wolde-Rufael (2007) find a bi-directional causal relationship between investment in telecommunications infrastructure and economic growth in the U.S. while Beil et al. (2005) find a uni-directional causality from economic growth to telecommunications investments after applying Granger-Sims causality tests on a 50 years' time series data on the U.S. Dutta (2001) uses data on a cross section of 30 developed and industrialised countries for three different years and finds a bi-directional causality for both developed and industrialised countries. Perkins et al (2005) also find a bi-directional causality in South Africa using a PSS F-test (Pesaran et al., 2001).

However, few studies have attempted to quantify the effect of telecommunications on economic growth by incorporating investments in telecommunications infrastructure explicitly into a macro (aggregate) production function or a cross-country growth framework. Madden and Savage (2000) develop a supply side growth model by extending Mankiw et al. (1992). In their model, teledensity (the number of main telephone lines per 100 persons) and the share of investments in telecommunications in the national income are used as telecommunications capital proxies. The analysis of data on 43 countries over the 1975-1990 period shows a significant positive cross-country relationship between telecommunications capital and economic growth. Roller and Waverman (2001) endogenise telecommunications infrastructure into aggregate economic activity by first specifying a micro model of the demand for and supply of telecommunications infrastructure and jointly estimate the micro model with a macro production function. They find a significant causal relationship between telecommunications infrastructure and aggregate output.

In a more recent study, Datta and Agarwal (2004) extend the cross-country growth framework of Barro (1991) and Levine and Renelt (1992) to examine the effects of telecommunications infrastructure on economic growth. Using a dynamic panel model based on Islam (1995), they use the lagged real gross domestic product (GDP) per capita to test for convergence, while separately testing the direction of causality between teledensity and economic growth using the first-lagged values of teledensity.

While previous studies agree that investment in telecommunications infrastructure is positively correlated with economic growth, fewer studies have investigated the specific role played by mobile telecommunications in economic growth, particularly in regions with a disproportionate rate of growth of mobile telecommunications relative to land-lines. The growth of mobile telephony in sub-Saharan Africa is a typical example of such a case. Due to the highly intensive nature of investments in land-line telecommunications infrastructure, Africa accounted for less than 2 percent of global main telephone lines in 2006, as against 48 percent for Asia (International Telecommunication Union, 2007). However, advancements in mobile phone technology in the last decade, coupled with a relatively cheap mobile phone infrastructure have led to a significant annual growth in mobile telephone penetration in Africa. This is illustrated in the fact that the number of mobile subscribers in Africa became higher than the number of land-lines in 2001 (Gray, 2006) and the number of mobile subscribers in the region increased by 46.2 percent between 2001 and 2005 (ITU, 2007). Also, mobile penetration in Africa by the end of 2006 stood at 22.0 subscribers per 100 persons while Asia had 29.3, and Africa was the only region where mobile telephone services generated more income than land-line telephone services in 2005, accounting for more than 60 percent of total telecommunications income in the region (ITU, 2007). The growth in mobile telephone subscriptions in sub-Saharan countries is illustrated in Figure 1 in the appendix.

According to Vodafone (2005), in a typical developing country, an increase of 10 mobile phones per 100 people boosts GDP growth by 6% while Ovum (2006) holds that the mobile services industry contributed $7.8 billion towards GDP in India. Enriquez et al. (2007) estimate the contribution of mobile operators and mobile-related companies and find that mobile related

companies in China companies contribute twice as much to GDP, as mobile operators. Deloitte (2008) finds that in all the 6 countries studied (Bangladesh, Malaysia, Pakistan, Serbia, Thailand, and Ukraine), mobile phones have a significant effect on GDP while Sang et al. (2012) find that mobile phone expansion is an important determinant of the rate of economic growth in sub-Saharan Africa.

Overall, studies with an explicit focus on mobile finance and banking development especially for the case of Africa are relatively missing in the literature. Additionally, the majority of studies focus on the impact of telecommunication, mobile telephony, 3G technology, mobile data services, and mobile phone penetration on economic growth instead of focusing on mobile finance and banking development and workforce productivity growth and inequality reduction. The need to empirically answer our research question for the case of African countries is therefore important to contribute to the existing literature.

3. Mobile finance and banking in Africa: stylized facts and statistical analysis

Developing countries and African countries in particular could use mobile banking as an opportunity to provide financial services to the unbanked individuals where the number of mobile phones is more than the number of bank accounts. Africa has one of the highest rates of mobile penetration with a high growth rate of mobile phone subscribers and a low number of bank branches. Mobile banking is a cost-effective way of offering financial services in Africa. The fast-growing Smartphone market in Africa can be attributed to floor prices and more variants being put into the market and this is directly correlated with the growth of mobile banking. On the other hand, broadband connectivity has still not reached many places in Africa, and Internet usage is much lesser, compared to mobile phone diffusion.

In order to present the results of our benchmarking exercise, it is important to point out that mobile penetration is a necessary but insufficient condition for mobile banking. Mobile penetration is affected by regulation in the mobile phone market whereas mobile banking is affected by regulations in the banking industry. However, as shown in the figures in the appendix, the two are symbiotic and positively related.

Moreover, there is an unclear link between mobile banking development indices and workforce productivity growth and inequality reduction in Africa. As shown in the figures in the appendix, depending on the proxy of mobile banking development, there is either a positive or negative relationship with workforce productivity growth and inequality reduction.

Considering this information and conjectures, we need to implement an econometric assessment of the situation.

4. Data, model and econometric Strategy:

4.1. Data

We examine a sample of 54 African countries using data from African and Governance Development Indicators (ADI and GDI) and the Financial Development and Structure Database (FDSD) of the World Bank (WB). The mobile banking data is from the World Bank and the index of economic freedom is from the Heritage Foundation. The other database from *Gate Foundation* and *Mastercard Foundation* are not suitable to our investigation and not available for African countries. Full information about data description can been found in table A1 and A2 in appendix.

- ***Principal Component Analysis***

The potentially high degree of substitution between internet users, mobile bills and mobile send/received variables imply that some information could be redundant. Therefore, we employ Principal Component Analysis (PCA) to mitigate the redundancy of common information in the dependent variables. PCA is a widely employed statistical technique that is used to reduce a large group of correlated variables into a smaller set of uncorrelated variables which represent a substantial degree of variation in the original dataset. These common factors are called

principal components (PCs). The criterion used to retain common factors is from Kaiser (1974) and Jolliffe (2002) who recommend only PCs which have eigenvalues greater than the mean value (greater than one). The underlying logic for using PCA is that, given the potentially high correlation (degree of substitution) between mobile banking and mobile phone penetration, more general policy implications maybe obtained if the dependent variables are represented by a common factor.

Table 1: PCA result for the construction of the Mobile finance and banking index

Principal Components	Component Matrix (Loadings)			Proportion	Cumulative Proportion	Eigen Value
	MBills	MSR	Internet			
First PC	0.805	0.809	0.690	0.896	0.896	1.596
Second PC	-0.805	0.809	0.690	0.156	1.000	0.386

Source: Author construction. PC: Principal Component. MBill: Mobile phone used to pay bills. MSR: Mobile phone used to send and receive money. Internet: Internet users (per head).

Without going into the depths of the PCA technique, as it can be seen from Table 1 above, the first principal component (PC) of both mobile bills and mobile send and received accounts for around 80% of the variation in all three constituents while it account for 69% for the case of internet user. The criteria applied to determine how many common factors to keep are taken from Kaiser (1974) and Jolliffe (2002). Kaiser (1974) recommends dropping factors with an eigenvalue less than one.

4.2. Model and methodology

In order to check the impact of mobile banking development on workforce productivity growth and inequality reduction, we use the following model based on the Cobb-Douglas function:

$$\begin{cases} (WorkforceGrowth)_{i,t} = \alpha_0 + \alpha_1 (MobileBanking)_{i,t} + \alpha_2 f(X_{i,t}) + \varepsilon_{i,t} \\ \varepsilon_{i,t} \sim iidN(0, \sigma_\varepsilon^2) \end{cases} \quad (1)$$

Where the left side includes variables on workforce productivity growth and inequality reduction such as GDP per capita growth, poverty and Gini indexes[2]; and the right side includes variables on mobile banking (Mobile banking index, mobile bills, mobile sent/received, internet users) and other control variables identified in the literature as fundamental factor of workforce productivity growth and inequality reduction including Technological innovation; Economic policy; Business and Bank; Economic development and Physical Capital; External flows; Human Development; Institutional and Knowledge Economy areas.

The estimation approach for the first model follows the study conducted by Andrianaivo and Kpodar (2011) which are among the few panel data studies that focus on the effects of mobile Information and Communication Technologies on economic growth. In these papers, the issue of reverse causality between mobile telecoms expansion and economic growth is addressed by specifying a dynamic panel data model and estimating the parameters using either Generalized Method of Moments (GMM) techniques or Least Square Dummy Variables (LSDV).

The econometric approach used is the LSDV. The choice of this approach is motivated by two main factors. Firstly, this technique fits more to the fact we do not have a large sample and time series (Baltagi, 2001). Secondly, in the contrary of fixed effect method, the regression model fulfills all conditions of the Gauss-Markov theorem with the assumption of explanatory variables as non-stochastic, LSDV estimators are unbiased, consistent, and linear efficient (BLUE). Thirdly, LSDV as.a panel data technique allows the best exploitation of the

[2] We have three models to estimate for robustness purposes; however, only relevant results according to our research question will be discussed.

information contained in the dataset such as the cross country variation in the sample (at a given point in time, different countries are characterised by different levels of mobile banking) and the time series variation (for each country, mobile data usage substantially varies over time).

5. Presentation and discussion of estimation results:

In this section, we present and discuss the results of our main empirical investigations concerning the impact of mobile finance and banking development on workforce productivity growth and inequality reduction.

5.1. Mobile finance and banking development and workforce productivity growth and inequality reduction

Table 1: Impact of mobile finance and banking on workforce productivity growth and inequality reduction (Panel data estimation).

		GDP Per Capita growth			Gini			Poverty	
Mobile Banking Development and Technological innovation	Internet users	**0.175****	**0.043*****	---	**-0.01*****	**-0.01*****	**---**	**-0.52****	**---**
		(0.015)	**(0.000)**		**(0.000)**	**(0.000)**		**(0.008)**	
	Mobile billing	**0.042****	---	---	---	**-0.97****	---	**-0.053****	---
		(0012)				**(0.021)**		**(0.019)**	
	Mobile S/R	---	**0.007***	---	**0.01*****	---	**---**	---	**---**
			(0.086)		**(0.000)**				
	Mobile banking	-2.65	**0.422*****	**1.729*****	**---**	**---**	**-0.68****	**---**	-0.001
		(0.375)	**(0.000)**	**(0.000)**			**(0.009)**		(0.348)
	Economic freedom	**1.058*****	**0.175*****	**---**	**-0.009*****	0.124	---	0.14	---
		(0.000)	**(0.000)**		**(0.000)**	(0.245)		(0.702)	
Economic policy	Trade openness	**1.05*****	---	0.315	-2.377	-3.008	**-0.22*****	0.031	**-0.008****
		(0.000)		(0.112)	(0.433)	(0.199)	**(0.008)**	(0.342)	**(0.022)**
	Financial openness	0.458	---	0.155	---	---	-0.411	---	0.086
		(0.428)		(0.455)			(0.183)		(0.175)
	Money Supply	---	---	**0.191***	---	---	0.529	---	-1.001
				(0.076)			(0.806)		(0.444)
	CMP	---	---	**0.102***	---	---	**-0.078****	---	-0.177
				(0.058)			**(0.016)**		(0.753)
	Public Investment	---	---	-0.971	---	---	**1.22*****	---	**0.01*****
				(0.354)			**(0.000)**		**(0.007)**
Business / Bank	Net Interest Margin	**-1.22****	---	-2.65	2.067	-0.093	**-1.42****	1.083	**0.78*****
		(0.003)		(0.185)	(0.709)	(0.808)	**(0.015)**	(0.301)	**(0.001)**
	Domestic credit	-2.030	---	-2.68	---	---	**-1.68*****	---	**-2.15****
		(0.249)		(0.184)			**(0.000)**		**(0.035)**
	Interest Rate Spread	---	---	1.058	---	---	3.082	---	1.452
				(0.866)			(0.113)		(0.682)
	Bank Density	---	**3.89****	**2.96****	---	---	1.022	---	0.175
			(0.012)	**(0.025)**			(0.529)		(0337)
	Return on Assets	---	0.632	**-9.6*****	---	---	0.328	---	1.002
			(0.556)	**(0.008)**			(0.193)		(0.997)
	Return on Equity	---	-0.04	**0.78****	---	---	-0.017	---	-1.447
			(0.585)	**(0.013)**			(0.670)		(0.887)
Economic development and capital	Infrastructure	5.009	---	**1.435***	-2.099	-1.093	**-0.86*****	-0.409	**-1.55****
		(0.922)		**(0.064)**	(0.222)	(0.603)	**(0.000)**	(0.189)	**(0.026)**
	Population growth	---	1.62	-35.18	---	---	0.448	---	0.117
			(0.804)	(0.105)			(0.341)		(0.102)
	Urban population	---	**12.0*****	**17.27*****	---	---	1.547	---	0.448
			(0.000)	**(0.000)**			(0.391)		(0.993)
External Flows	Foreign Investment	0.289	---	1.09**	0.306	0.139	**-0.496***	---	-1.008
		(0.133)		(0.029)	(0.312)	(0.362)	**(0.062)**		(0.229)
	Foreign Aid	---	0122	2.099	0.185	-0.051	-0.002	---	-0.018
			(0.288)	(0.422)	(0.285)	(0.502)	(0.989)		(0.575)
	Remittances	---	---	0.009	-0.187	**-0.75*****	-0.060	**-0.009****	0.001
				(0.339)	(0.431)	(0.000)	(0.814)	(0.017)	(0.113)
Human Development	Human Development	0.056	---	-0.081	---	0.045	---	1.89	---
		(0.427)		(0.966)		(0.272)		(0.978)	
	Household expenditure	---	---	1.007	0.054	---	---	---	---
				(0.109)	(0.839)				
	Domestic Savings	---	---	-0.001	---	-0.341	-0.286	-0.504	-0.777
				(0255)		(0.152)	(0.221)	(0.348)	(0.969)
	Net transfer	---	---	0.089	---	---	-3.098	---	-1.55
				(0.599)			(0.822)		(0.333)
Institutional Economy	Education	-0.099	0.006	-1.449	**2.51*****	---	**-1.49*****	---	**-0.646*****
		(0.437)	(0.111)	(0.118)	**(0.000)**		**(0.000)**		**(0.002)**
	Governance	---	---	1.001	-3.627	0.922	**-17.8*****	1.001	**-2.05*****
				(0.221)	(0.736)	(0.934)	**(0.003)**	(0.444)	**(0.001)**
	Constant	-28.65	**-432*****	**-468*****	**-85.8*****	**-216*****	-96.68	**-12.6****	88.12
		(0.375)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.109)	**(0.018)**	(0.447)
LSDV R^2		0.981	0.903	0.985	0.901	0.809	0.999	0.706	0.802
LSDV Fisher		**41.9*****	**42.4*****	**98.06*****	**29.95*****	**29.5*****	**37.5*****	**18.9*****	**24.7*****
Observations		25	190	25	251	238	145	109	145

Source: Author calculation. LSDV: Least Squares Dummy Variable. ***; **; *: significant levels at 1%, 5% and 10% respectively.

The results presented in table 1 above show that there is an overall positive impact of mobile banking development on workforce productivity growth and inequality reduction. More specifically, mobile banking positively impacts on GDP per capita with a higher rate when we consider our index. Also, independently of the proxy of mobile banking used the sign is positive. Additionally, there is a negative impact of both the mobile banking index and other proxies on Gini and poverty index. When we consider the economic freedom index, there is a positive impact on GDP per capita and negative impact on Gini.

The control variables also present the expected sign with an exception for the case of net interest margin, return on asset for the case of GDP per capita growth and public investment for the case of Gini. This may imply that business and bank activities/profit is not useful when we consider its importance in terms of workforce productivity growth and inequality reduction on the one hand and that states focusing on increasing investment cannot help have good results in terms of inequalities reduction.

Overall, our estimates have the expected signs and we can therefore extrapolate the usefulness of mobile banking development for the case of Africa in terms of workforce productivity growth and inequality reduction.

5.2. Robustness check

In order to make sure that our results are robust, we implement additional estimations replacing, adding or removing some variables, changing the specification and estimation method. When changing the specification, we are guided by the maximisation of the number of observations relatively to the one of the main estimation under the constraint of the number of predictors. Our results are conclusive since we have the same sign and significant variables as in the main results discussed. By replacing some variables by their proxy, we were able to verify whether we have the same result independently to the fact that we use different measure for the same variable.

Overall, from the estimation results, we can see that the results remain unchanged in terms of sign and significance of coefficients. In addition, Our overall findings remain unchanged when controlling for mobile finance and banking development with alternative indices.

6. Conclusion and policy recommendation:

This paper uses a new database on mobile finance and banking across countries and several econometric techniques to investigate the impact of mobile finance and banking on workforce productivity growth and inequality reduction in Africa.

The paper starts by using a theoretical framework and highlighting stylised facts. Mainly, the statistical analysis revealed that there is a positive link between mobile finance and banking development and workforce productivity growth and inequality reduction in Africa.

The estimation of our model of workforce productivity growth and inequality reduction using different specification have shown a positive impact of the mobile finance and banking index on both workforce productivity growth and inequality reduction in Africa.

Overall, African governments in their pursuit of good performance in terms of mobile banking development should implement policies mainly oriented toward the development of mobile finance and banking sector.

7. Appendices:

Figure 1: Mobile sent/received and mobile phone penetration in Africa

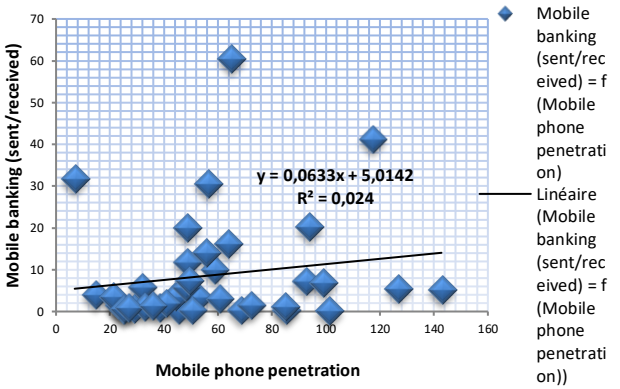


Figure 2: Mobile bills and mobile phone penetration in Africa

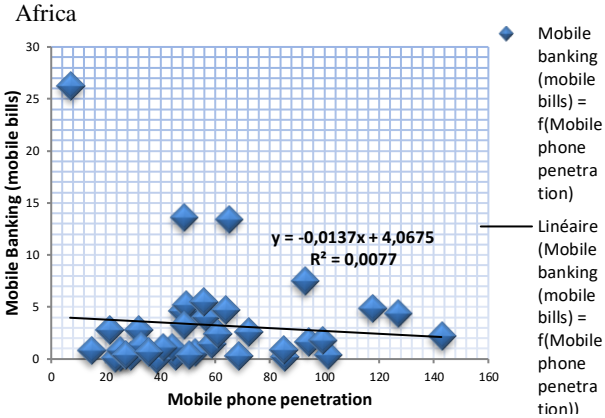


Figure 3: Internet users and & mobile phone penetration in Africa

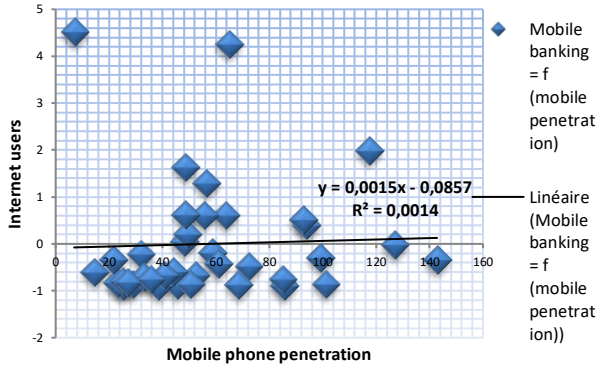


Figure 4: Mobile sent/received and mobile bills in Africa

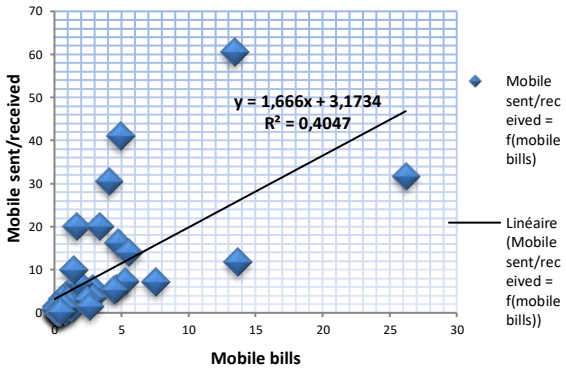
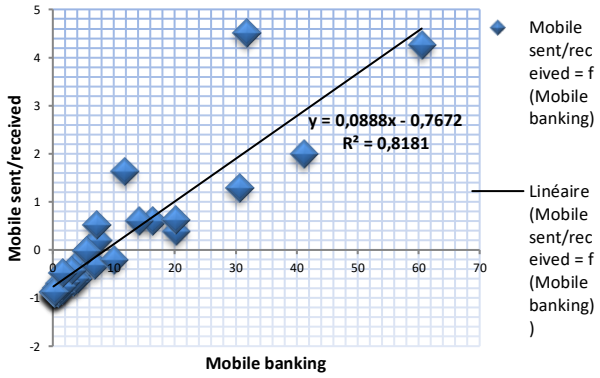
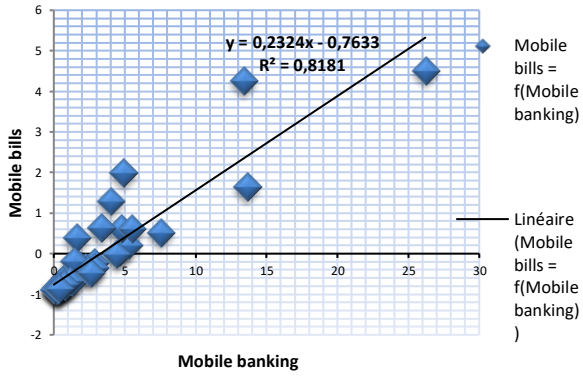


Figure 5: Mobile sent/received and mobile banking in Africa



Source: Authors calculation.

Figure 6: Mobile bills and mobile banking in Africa



Source: Authors calculation.

Figure 7: Mobile banking and pro poor growth in Africa

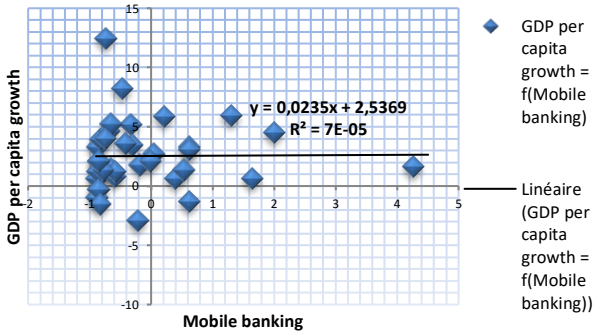


Figure 8: Mobile bills and pro poor GDP in Africa

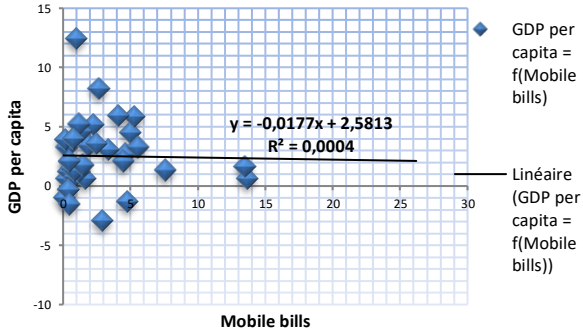


Figure 9: Mobile sent/received and pro poor GDP in Africa

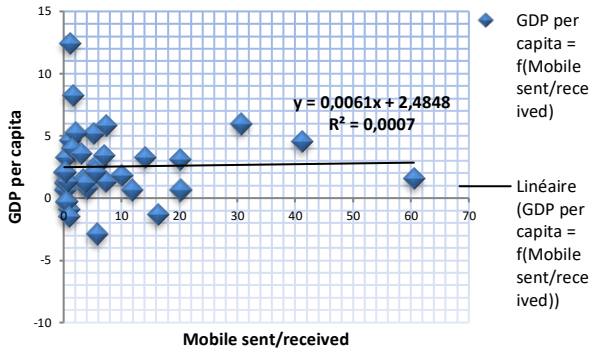


Figure 10: Mobile banking and pro poor GDP in Africa

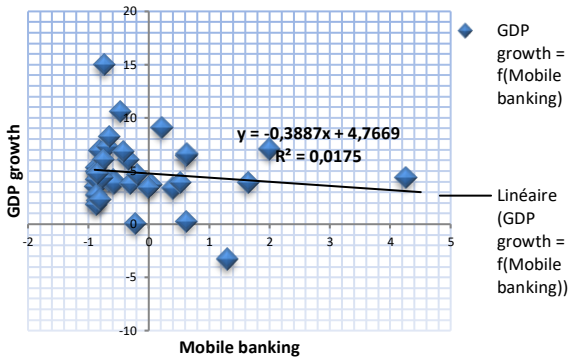


Figure 11: Mobile bills and & pro poor GDP in Africa

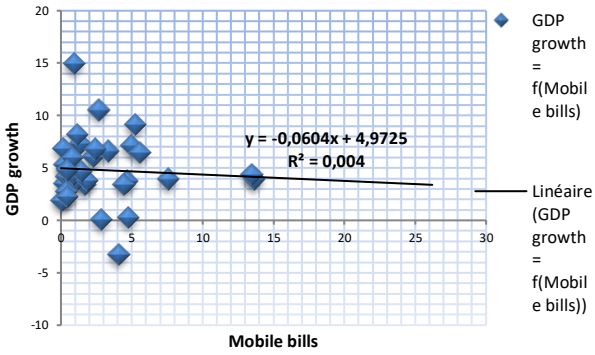
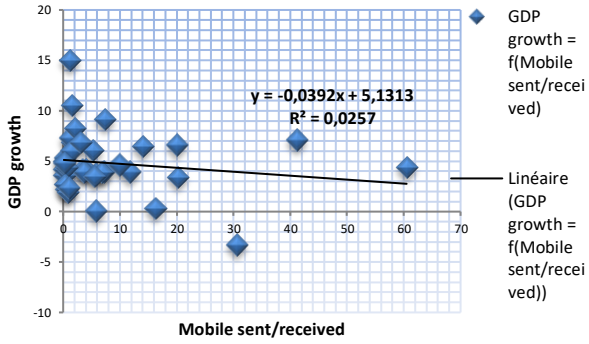


Figure 12: Mobile banking and pro poor GDP in Africa



Source: Authors calculation based on mobile banking data from world bank.
http://blogs.worldbank.org/allaboutfinance/mobile-banking-who-driver-s-seat

Table A.1: Mobile finance and banking development impact on workforce productivity growth and inequality reduction.

Variables category	Proxy
Mobile Finance and Banking Development (4)	Internet users / head, Mobile Billing, Mobile S/R, Mobile Banking
Economic policy (5)	CMP, Trade openness, financial openness, public investment, M3
Business/Bank (6)	Investment incentives (Domestic credit, NIM, IRS, Bank density, ROA, ROE)
Economic development and physical capital (3)	Market size, market growth, market structure (Infrastructure, Popg, Population)
Institutional Economy (3)	Governance, Education (SSE).
External Flows (3)	FDI, Development Assistance, Remittances
Human development (4)	Net transfer, HDI, HHCExp, Domestic savings

Source: Author calculation. CMP: Credible Monetary Policy. Mobile S/R: Mobile phone used to send and receive money. M3: Money Supply. GFCF: Gross Fixed Capital Formation. NIM: Net Interest Margin. IRS: Interest Rate Spread. ROA: Return on Assets. ROE: Return on Equity. GDPg: GDP growth. Popg: Population growth. SSE: Secondary School Enrolment. Ubanpop: Urban population. FDI: Foreign Direct Investment. HDI: Human Development Index. HHCExp: Household Consumption Expenditure.

Table A.2: Variable definitions of the full data base

Categories	Variables	Signs	Definitions	Source
Mobile Banking / Technological innovation	Internet users / head	Internet	Internet users (per head)	ITU
	Mobile Billing	MBills	Mobile phone used to pay bills (% of Adults)	WDI
	Mobile S/R	MSR	Mobile phone used to send and receive money (% of Adults)	WDI
	Mobile Banking	MB	First principal component of MBills and MSR	PCA
	Economic freedom	Ecofree	Right to control his own labor and property (0-90)	THF

	Public Investment	PUBIV	Gross Public Investment (% of GDP)	WDI
	Financial openness	Kaopen	Economy capital account degree of openness	Chin & Ito
Economic	Public spending	PSpend	Public spending on education, total (% of GDP)	WDI
policy	Trade openness	Tropen	Imports + Exports of Good and Services (% of GDP)	WDI
	Financial Depth	M3	Money Supply (% of GDP)	WDI
	Credible Mon. Pol.	CPM	Quadratic function using current, high and low inflation (0-1)	QUA
	Domestic Invt.	GFCF	Gross Fixed Capital Formation (% of GDP)	WDI
	Domestic credit	BCRED	Domestic credit to private sector by banks (% of GDP)	WDI
	Interest Margin	NIM	Net Interest Margin (%)	WDI
Business and	Interest Spread	IRS	Interest Rate Spread (Lending rate minus Deposit rate, %)	WDI
Bank	Bank Density	Bbrchs	Commercial bank branches (per 100 000 adults)	WDI
	Bank Return 1	ROA	Return on Assets (annual %)	WDI
	Bank Return 2	ROE	Return on Equity (annual %)	WDI
	Workf. prod. growth	GDPPC	GDP per capita Growth (annual %)	WDI
Economic	Economic Prosperity	GDPG	GDP Growth (annual %)	WDI
development	Inequality	INEQ	Gini index	WDI
and Capital	Pop. Growth	Popg	Population growth rate (annual %)	WDI
	Population	Pop	Population ages 15-64 (% of total)	WDI
	Infrastructure 1	Road	Roads paved (% of total roads)	WDI
	Infrastructure 2	Elec	Electricity production from hydroelectric (% of total)	WDI
	Domestic Invt.	GFCF	Gross Fixed Capital Formation (% of GDP)	WDI
	Foreign Invt.	FDI	Foreign Direct Investment net inflows (% of GDP)	WDI
External flows	Remittances	Remi	Remittance inflows (% of GDP)	WDI
	Foreign Aid	NODA	Net Official Development Assistance (% of GNI)	WDI
	Net transfers	TRANS	Net current transfers from abroad (constant LCU)	WDI
Human	Human dev.	HDI	Human Development Index	WDI
Development	HC Expenditure	HCE	Household Final Consumption Expenditure (% of GDP)	WDI
	Domestic Savings	DSav	Gross Domestic Savings (% of GDP)	WDI
Institutional	Governance	Gov	Voice and accountability	WGI
Economy	Education	Hucap	Secondary School Enrolment (% of Gross)	WDI

Source: Author calculation. Eco: Economic. Pop: population. Invt: Investment. HC: Household Consumption. THF: The Heritage Foundation. PCA: Principal Component Analysis. QUA; Quadratic transformation; CPM: Credible Monetary Policy; ITU: International Telecommunication Union. WDI: World Development Indicators of the World Bank. WGI: World Governance Indicators. GNI: Gross National Income. S/R: Sending and Receiving.

8. References:

Alesina, A., and Rodrik D., (1994), "Distributive Politics and Economic Growth", *Quarterly Journal of Economics,* 465-490.

Andrianaivo and Kpodar, (2011), "ICT, Financial Inclusion, and Growth Evidence from African Countries" (April 2011), IMF Working Papers.

Asongu, S. A., (2013). "How has mobile phone penetration stimulated financial development in Africa", *Journal of African Business*, 14(1), pp. 7-18.

Asongu, S. A., (2014). "The impact of mobile phone penetration on African inequality", *International Journal of Social Economics*: Forthcoming.

Baltagi, B. H. (2001) Econometric Analysis of Panel Data. 2nd edition; Mass Market Paperback; Publisher: Wiley (1849); ASIN: B01FEP0JME

Barro, R. (1991) "Economic Growth in a Cross Section of Countries", Quarterly Journal of Economics, Vol.106, No.2, 407-443

Beil, R., G. Ford, and J. Jackson (2005) "On the Relationship between Telecommunications Investment and Economic Growth in the United States", International Economic Journal, Vol.19, No.1, 3-9.

Cronin, F., E. Colleran, P. Herbert, and S. Lewitzky (1993a) "Telecommunications and Economic Growth: The Contribution of Telecommunications Infrastructure Investment to Aggregate and Sectoral Productivity", Telecommunications Policy, Vol.17, No.9, 677-690.

Cronin, F., E. Parker, E. Colleran, and M. Gold (1991) "Telecommunications Infrastructure and Economic Growth: An Analysis of Causality", Telecommunications Policy, Vol.15, No.6, 529-535.

Cronin, F., E. Parker, E. Colleran, and M. Gold (1993b) "Telecommunications Infrastructure Investment and Economic Development", Telecommunications Policy, Vol.17, No.6, 415-430

Datta, A. and S. Agarwal (2004) "Telecommunications and Economic Growth: A Panel Data Approach", Applied Economics, Vol.36, No.15, 1649-1654.

Deininger, K., and Squire, L., (1998), "A New Data Set Measuring Income Inequality", *The World Bank Economic Review*, 10(3): 565-91.

Deloitte (2008), "Economic Impact of Mobile Communications in Serbia, Ukraine, Malaysia, Thailand, Bangladesh and Pakistan", *Report prepared for Telenor ASA*. January 2008

Demombynes, G., and Thegeya, A. (2012). "Kenya's Mobile Revolution and the Promise of Mobile Savings". *World Bank Policy Research Working Paper*, No. 5988.

Dutta, A. (2001) "Telecommunications and Economic Activity: An Analysis of Granger Causality", Journal of Management Information System, Vol.17, No.4, 71-95

Enriquez, Luis; Schmitgem, Stefan; and Sun, George, (2007), "The true value of mobile phones to developing markets". *Research in Brief*. McKinsey Quarterly.

Goudie, A., and Ladd. P., (1999), "Economic growth, Poverty and Inequality", *Journal of International Development*, Vo. 11, Issue 2, pages 177-195.

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

Gutierrez, E. and S. Singh, (2013), "What Regulatory Frameworks Are More Conducive to Mobile Banking? Empirical Evidence from Findex Data", *World Bank Policy Research Working Paper* N° 6652.

Hardy, Andrew P., (1980), "The role of the telephones in economic development". *Telecommunications Policy*, vol 4, no4, December 1980, p278-86

International Telecommunication Union (2007) "Telecommunication/ICT Markets and Trends in Africa", Geneva, Switzerland.

Islam, N. (1995) "Growth Empirics: A Panel Data Approach", Quarterly Journal of Economics, Vol.110, No.4, 1127-1170.

Jolliffe, I. T. (2002), Principal Component Analysis (2nd Ed.) New York: Springer.

Jonathan, D., and Camilo, T. (2008). "Mobile banking and economic development: Linking adoption, impact and use". *Asian Journal of Communication*, 18(4), 318-322.

Kaiser, H. F., (1974). "An index of factorial simplicity" *Psychometrika* 39, pp. 31–36.

King R.G., Levine R. (1993a), "Finance and Growth: Schumpeter might be right", Quaterly journal of economics, vol. 108, PP. 717-737

King Robert G. et Ross Levine (1993b), "Finance, Entrepreneurship and Growth: Theory and Evidence", Journal of Monetary Economics, 32 (3), 513-542.

Kuznets, S., (1955), "Economic Growth and Income Inequality", *American Economic Review.*

Levine, R. and D. Renelt (1992) "A Sensitivity Analysis of Cross-Country Growth Regressions", American Economic Review, Vol.82, No. 4, 942-963.

Madden, G. and S. Savage (2000) "Telecommunications and Economic Growth", International Journal of Social Economics, Vol.27, No.7, 893-906.

Mankiw, N., D. Romer, and D. Weil (1992) "A Contribution to the Empirics of Economic Growth", Quarterly Journal of Economics, Vol.107, No.2, 407-437

Maurer, B. (2008). "Retail electronic payments systems for value transfers in the developing world". Department of Anthropology, University of California.

Meisel, L. and Mvogo, J.-P. (2007), «Quelle politique de développement financier en zone franc ?», Agence Française de développement (AFD), Octobre 2007, N°=23 ;

Merritt, C. (2010). "Mobile Money Transfer Services: The Next Phase in the Evolution in Person-to-Person Payments". Federal Reserve Bank of Atlanta, *Retail Payments Risk Forum White Paper*.

Nguena, C. L. (2019), "On financial Innovation in Developing Countries: Mobile Banking & Financial Services Determinants in Africa", *Journal of Innovation Economics and Management*, No. 29 – 2019/2

Nguena, C. L. and R. Tsafack Nanfosso (2014a), "Déterminants Microéconomiques du Déficit de Financement des PME au Cameroun", *African Development Review* : vol. 26, No. 2, 2014, pp. 372-383 ;

Nguena, C. L. and R. Tsafack Nanfosso (2014b), "On the Sensitivity of Banking Activity Shocks: Evidence from the CEMAC Sub-region", *Economics Bulletin*, Vol. 34 N°=1, 2014, pp. 354-372;

Nguena, C. L. and R. Tsafack Nanfosso (2015), "Importance des Politiques Financières dans la Croissance Economique en zone CEMAC: Approche en Données de Panel", *African Development Review*: Vol. 27, No. 1, 2015, pp. 52–66;

Ndebbio, J. E. U. (2004), "Financial Deepening Economic Growth and Development: Evidence from Selected SSA Countries", *African Economic and Research Consortsium*, RP 142.

Ondiege, P. (2010). "Mobile Banking in Africa: Taking the Bank to the People". *Africa Economic Brief*, 1(8), 1-16.

Perkins, P., J. Fedderke, and J. Luiz (2005) "An Analysis of Economic Infrastructure Investment in South Africa", South African Journal of Economics, Vol.73, No.2, 211-228.

Pesaran, M., Y. Shin, and R. Smith (2001) "Bounds testing Approaches to the Analysis of Level Relationships", Journal of Applied Econometrics, Vol.16, No.3, 289-326

Ravallion, M., and Chen S., (1997), "What Can New Survey Data Tell Us about Recent Changes in Distribution and Poverty?", *World Bank Economic Review,* Vol. 11, No. 2, pp 357-82.

Ravallion, M., and Chen S., (2003), "Measuring Pro-Poor Growth", *World Bank Policy Research Working Paper* No. 2666.

Röller, L. and L. Waverman (2001) "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach", American Economic Review, Vol.91, No.4, 909-923.

Thacker, K. U. M and Wright, G. A. N. (2012). "Building Business Models for Money". *MicroSave Briefing* Note No.116.

Vodafone (2005), "Africa: The impact of mobile phones". *Vodafone Policy Paper Series*. Number 2. March 2005.

Wolde-Rufael, Y. (2007) "Another Look at the Relationship between Telecommunications Investment and Economic Activity in the United States", International Economic Journal, Vol.21, No.2, 199-205.