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Mobile Phone Penetration, Mobile Banking and Inclusive Development in Africa

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Mobile Phone Penetration, Mobile Banking and Inclusive Development in Africa

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Abstract

The study assesses the role of mobile phones and mobile banking in decreasing inequality in 52 African countries. The empirical procedure involves first, examining the income-redistributive effect of mobile phone penetration and then investigating the contribution of mobile banking services in this relationship. The findings suggest an equalizing income-redistributive effect of 'mobile phone penetration' and 'mobile banking', with a higher income-equalizing effect from mobile banking compared to mobile phone penetration. Poverty alleviation channels explaining this difference in inequality mitigating propensity are discussed.

JEL Classification: E00; G20; L96; O17; O33
Keywords: Banking; Mobile Phones; Shadow Economy; Financial Development; Africa

1. INTRODUCTION

In spite of a recent narrative suggesting that Africa '*is on time*' in some targets of the Millennium Development Goals (MDGs) (Pinkivskiy & Sala-i-Martin, 2014), some stylized facts suggest that the continent's growth is being marred by growing income inequality (Blas, 2014). The latter narrative is in line with Piketty (2014) and is also broadly consistent with a stream of literature on the role of income inequality on poverty (Kalwij & Verschoor, 2007; Fosu, 2011; Fosu, 2014; Adams, 2004; Thorbecke, 2013; Asongu, 2016; Kodila-Tedika & Asongu, 2015)[1]. Depending on the period of study, the former description is in accordance with poverty reduction (Young, 2012) and inequality mitigation (Fosu, 2015) on the African continent[2]. The conclusions of Fosu (2015), which are consistent with Piketty (2015), are valid both for developing economies (Fosu, 2010c) and African nations (Fosu, 2008; Fosu, 2009; Fous, 2010a; Fosu, 2010b)[3]. Based on recent data however, African economies have done relatively well compared to other developing countries (Fosu, 2015). This edge in inclusive growth could be traceable, inter alia, to the phenomenon of mobile telephony.

Many lives have been improved by the mobile revolution that is providing beyond communication, basic financial access in the forms of phone-based money transfer and storage (Jonathan & Camilo, 2008; Demombynes & Thegeya, 2012; Asongu, 2013a; Asongu, 2013b; Asongu, 2015a)[4]. The significant growth and penetration rates of mobile telephony that are

[1] The stream of works has clearly articulated the importance of, inter alia: a good understanding of growth elasticity instruments (Adam, 2014); the direct linkage between inequality and efforts in poverty mitigation (Kakwani, 1993; Datt & Ravallion, 1992; Fosu, 2015; Ali & Thorbecke, 2000) and the relevance of inequality when considering economic growth as a tool in fighting inequality (Easterly, 2000; Ravallion, 1997; Fosu, 2010a; Fosu, 2014).

[2] Some conclusions articulating the two narratives include: "*The study finds that the responsiveness of poverty to income is a decreasing function of inequality*" (Fosu, 2010b: 818); "*The responsiveness of poverty to income is a decreasing function of inequality and the inequality elasticity of poverty is actually larger than the income elasticity of poverty*" (Fosu, 2010c: 1432) and "*In general, high initial levels of inequality limit the effectiveness of growth in reducing poverty while growing inequality increases poverty directly for a given level of growth*" (Fosu, 2011: 11).

[3] Under the assumption that growth is exogenous to industrialisation, the narratives of Fosu and Piketty converge. This convergence is in line with a growing stream of literature on post-2015 Sustainable Development objectives (United Nations: UN, 2013: 7-13; Ncube et al., 2014; Singh, 2014).

[4] Access to and use of bank services remain substantial issues affecting African development (Efobi et al., 2014; Aikaeli, 2011; Muchai, 2013).

transforming cell phones into pocket-banks in Africa is providing countries on the continent with more affordable and cost-effective means of bringing on board a large part of the population that hitherto has been marginalized in formal financial services for decades. At the 2007 'Connect Africa' summit, Paul Kagame, president of Rwanda characteristically emphasized: "*in ten short years, what was once an object of luxury and privilege, the mobile phone has become a basic necessity in Africa*" (Aker & Mbiti, 2010: 208). An article in *The Economist* (2008) also later postulated: "*a device that was a yuppie toy not so long ago has now become a potent for economic development in the world's poorest countries*". In other words, the mobile phone has become an important tool for economic development. This paper seeks to examine how these sentiments and slogans are reflected on income redistribution from 'mobile phone penetration' and 'mobile banking' perspectives. The assessment is of policy relevance not only to banks and Micro Financial Institutions (MFIs) but also to governments, financial regulators as well as development partners who are providing support to improve the livelihoods of Africans through poverty reduction and sustained economic growth.

Beyond the need to assess these sentiments and slogans, there is a growing body of literature emphasizing the imperative for more scholarly research on the burgeoning phenomenon of mobile penetration[5]. Little research attention has been focused on the adoption and socioeconomic impacts of mobile (m)-banking (payments) systems in the developing world (Maurer, 2008; Jonathan & Camilo, 2008; Thacker & Wright, 2012; Asongu, 2015a). Most studies on mobile penetration have been theoretical and qualitative in nature (Maurer, 2008; Jonathan & Camilo, 2008; Merritt, 2010; Thacker & Wright, 2012), with the few existing empirical works hinging on country-specific and micro-level data mostly collected from surveys (Demombynes & Thegeya, 2012; Asongu, 2015a). As far as we have reviewed (and to

[5] "*Relative to the spread of some other technologies that have been introduced in sub-Saharan Africa-improved seeds, solar cook stoves and agricultural technology-mobile phones adoption has occurred at a staggering rate on the continent. Yet few empirical economic studies have examined mobile phone adoption. This could be due to a variety of factors, including unreliable or nonexistent data on individual level adoption (leading to measurement error)*…" Aker & Mbiti (2010: 225).

the best of our knowledge), one of the most exhaustive accounts in the 'mobile penetration' literature concludes: "*Existing empirical evidence on the effect of mobile phone coverage and services suggest that the mobile phone can potentially serve as a tool for economic development in Africa. But this evidence while certainly encouraging remains limited. First, while economic studies have focused on the effects of mobile phones for particular countries or markets, there is little evidence showing that this has translated into macroeconomic gains*…." (Aker & Mbiti, 2010: 224).

The contribution of this paper to the literature is therefore threefold. First, it complements existing literature with empirical evidence on the income-redistributive effects of mobile phone penetration. To the best of our knowledge, macroeconomic evidence on the poverty effects of mobile penetration is scarce in the literature (Asongu, 2013a; Asongu, 2013b; Asongu, 2015a). Second, the study integrates the contribution of financial development dynamics in the mobile-inequality relationship in order to assess its role mobile banking. Such should give policymakers the much needed guidance on the concerns of how mobile penetration and mobile banking distinctly affect income equality. Third, contrary to mainstream literature that is focused on country-specific analyses, this paper is based on 52 African nations. The choice of Africa as the investigation platform arises from its growing inequality and stubbornly high poverty rates (Asongu, 2013a; Anyanwu, 2005; Anyanwu, 2011; Anyanwu, 2013).

The rest of the paper is organized as follows. Section 2 provides the theoretical framework. Data and methodology are presented and outlined in Section 3. Section 4 covers the empirical analysis. We conclude with Section 5.

2. THEORETICAL FRAMEWORK OF THE MOBILE-BANKING NEXUS

There are four main strands along which the effect of mobile phone penetration on mobile banking can be discussed (Asongu 2013a; Asongu, 2013b; Asongu, 2015a). The first

avenue captures the usefulness of mobile transactions (store of value, conversion of cash and, transfer of stored value). The concepts of savings (basic or partially integrated) in mobile banking are discussed in the second strand. The third strand links mobile banking to Global System for Mobile Communications (GSM) phones, while the fourth presents some statistics on the proliferation of mobile telephony in Africa.

In the first strand, Jonathan & Camilo (2008) have emphasized that most mobile transactions[6] in the developing world enable users to do three main things. (a) Store value (currency) in an account accessible with the help of a handset. When the user already has a bank account, linkage to a bank account generally is the challenge. If the user does not have an account, then the process creates a bank account for him/her or creates a pseudo bank account, held by a third party or the user's mobile operator. (b) Conversion of cash into and out of the store value account. When the account is connected to a bank account, users can visit banks to cash-in and cash-out. In many cases, users can also visit the GSM providers' retail stores. In most flexible services, a user can visit a corner kiosk or grocery store (maybe the same one where he/she buys airtime) and enter into a transaction with an independent retailer serving as an agent for the transaction system. (c) Transferring stored value between accounts. Users can generally transfer funds between accounts linked to two GSMs, by using a set of Short-Message-Services (SMS) (or menu commands) and Personal Identification Number (PIN) codes. The new services offer a means to move money from place to place and present an alternative to the payment system offered by remittance firms, banks, pawn shops…etc. The uptake of m-banking (payments) systems has been particularly significant in the Philippines

[6] In order to have a mobile money account and make a deposit, a customer is supposed to own a cell phone SIM card with the mobile operator and register for a mobile money account. Then the customer makes cash deposits at the physical offices of one of the operator's mobile money agents. These cash deposits create electronic money credit in the account. Customers can then make person-to-person transfers of mobile money credit to the accounts of other mobile money users in the same network. They can also use their mobile money credit to buy phone airtime and pay bills. Conversion to cash (withdrawals) could be made at the offices of the network's mobile money agents. There is also a possibility for a mobile money customer to make a transfer to someone who is not subscribed to the same network. In this case, when notice of the transfer is received via an SMS text message, the recipient can pick-up the cash at a mobile money agent (Demombynes, & Thegeya, 2012).

(where three million customers use systems offered by mobile operators Smart & Globe; Neville, 2006) Kenya, where nearly two million users subscribed to Safaricom's MPESA system within a year of its nationwide rollout (Vaughan, 2007; Ivatury & Mas, 2008) and South Africa where 450, 000 people were using Wizzit by 2007 ('the bank in your pocket', Ivatury & Pickens, 2006) or one of two other national systems (Porteous, 2007).

The concept of savings is elucidated in the second stream. The mobile-finance nexus has been approached through this concept (Demombynes & Thegeya, 2012). Demombynes & Thegeya (2012) distinguish between two types of mobile savings: (a) *Basic mobile* savings; which is merely the use of a standard mobile money system such as M-PESA to store funds. These basic mobile savings do not generate interest. Bank-integrated mobile savings are increasingly being considered as a means of providing banking services to the poor. They have the appealing role of offering access to basic banking services without requiring proximity to a physical bank branch. Therefore, with a bank-integrated mobile savings account, basic banking services can be accessed via a network of mobile phone agents, which in Kenya significantly outnumber the weight of bank branches (Mas & Radcliffe, 2011). (b) The term '*partially integrated'* mobile savings system is also used to describe situations in which bank account access via mobile phones depends on the opening of a traditional account at a physical bank. Banks are beginning to build their own agent networks in a bid to assume a more competitive bargaining position in accessing mobile service platforms. Fully and partially integrated savings present different types of contracts among the mobile service providers and partnering banks. According to Demombynes and Thegeya (2012), on the one hand, a *partially integrated* product clearly delineates the role of the bank (which provides and owns banking services) from that of the mobile service provider (which provides mobile telephony infrastructure and controls the agent network). Thus, the bank rewards the mobile service provider for access to the network and retains the remaining profits. This type of contract more closely resembles a

debt contract between parties. On the other hand, a *fully integrated* solution may not draw the same distinction between bank and mobile service providers. In this case, the distribution of any surplus is contingent on the relative bargaining power of the mobile service provider and the bank. This sort of contract more closely looks like an equity contract between two parties. Equity-oriented contracts are more likely to be complex and hence more difficult to negotiate than debt-like contracts. This ultimately presents a potential hurdle towards the goal of increasing access.

The third aspect of the mobile phone literature dissects with great acuteness the manner in which mobile banking is linked to GSM phones (Asongu, 2013a). Ondiege (2010), Chief Economist of the African Development Bank, has assessed the mobile-finance nexus from four perspectives. *Firstly*, the mobile phone can serve as a virtual bank card where institutional and customer information can be securely stored, thereby mitigating the cost associated with distributing cards to customers. In fact, Ondiege postulates that the subscriber identity module (or SIM) card within most (if not majority of) GSM phones is in itself a smartcard (the same as the virtual bank card). It follows that a bank customer's PIN and account number can be stored on this SIM card to serve functions similar to those of a bank virtual card. *Secondly*, the mobile phone could play the role of a point of sale (POS) terminal. As such, a mobile phone could be used to communicate and transact with the appropriate financial institutions to solicit authorization for transactions. These are the same functions of a POS terminal at retail, mail or other stores. A mobile phone can duplicate these functions with ease. *Thirdly*, the mobile phone can also be used as an automatic teller machine (ATM). A POS is thus used to pay for goods and services at the store. If cash and access to savings were to be considered as 'goods and services' that customers buy and store, then the POS would also serve as a cash collection and distribution point which basically is the function of an ATM. Fourthly, the GSM may be used as an Internet banking terminal. By implication, it offers two fundamental customer services: a)

the ability to remotely make payments and transfers and b) instant access to any account. Hence, wireless connectivity and the mobile phone device bring the internet terminal into the hands of otherwise unbanked customers.

The fourth strand presents a clearer picture of the proliferation of mobile telephony with some statistics. The debate on the growth of mobile phones in Africa is one of a tectonic and unexpected change in communications technology (Mbiti & Weil, 2011). From virtually unconnected in the 1990s, more than 60 percent of Africa now has mobile phone coverage and there are currently over ten times as many mobiles as landline phones in use (Aker & Mbiti, 2010). Aker & Mbiti have further stressed how African mobile phone coverage has progressed at a staggering rate over the past decade. In 1999, only 11 percent of the African population had mobile phone coverage, primarily in Eastern Africa (Kenya), Southern Africa (South Africa) and North Africa (Egypt, Algeria, Libya, Morocco and Tunisia). According to the authors, in 2008, 60 percent of the population (477 million) could get a signal and an area of 11.2 million square kilometers (equivalent to the United Sates and Argentina combined) had mobile phone coverage. Their projections indicate that , by the end of 2014 most villages in Africa would have been connected. Indeed, according to Demombynes and Thegeya (2012), Kenya has undergone a remarkable information and communication technology (ICT) revolution. At the turn of the 1990s, less than 3 percent of Kenyan households owned a telephone and less than 1 in 1000 Kenyan adults had mobile phone service (Demombynes & Thegeya, 2012). However, by the turn of 2011, 93 percent of Kenyan households owned a mobile phone. The M-PESA mobile banking network is largely credited for this increase in adoption rate.

In the light of the above points, it will be interesting to know if mobile phone penetration and mobile banking have had any substantial effect on poverty and inequality on the continent. Clearly underlining the distinct role of mobile phone penetration from that of mobile-banking in the mobile-inequality nexus could lead to substantial policy implications,

especially with growing inequality and stubbornly high poverty rates despite more than two decades of financial reforms (Asongu, 2013a). This account is consistent with a 2015 World Bank report on Millennium Development Goals which revealed that extreme poverty has been decreasing in all regions of the world with the exception of Africa (World Bank, 2015), in spite of the continent enjoying more than two decades of growth resurgence (Obeng-Odoom, 2013, 2015).

This paper also extends a new stream of macroeconomic literature on mobile phone penetration and financial sector competition, most notably mobile phone penetration is more positively correlated with the informal financial sector (Asongu, 2013a), the positive role of institutions in the income-equalizing effect of mobile phone penetration (Asongu, 2013b), financial channels that are more pro-poor given the instrumentality of investment (Asongu, 2013c), the incidence of financial reforms on inequality through financial sector competition (Asongu, 2013d) and the nexuses among inequality, liberalization, knowledge economy and financial sector competition (Asongu, 2014, 2015b). Whereas inclusive development can be both relatively pro-poor (Dollar & Kraay, 2003) and absolute pro-poor (Ravallion & Chen, 2003), the concept of relative pro-poor development is used in this study because inequality is the outcome variable. As recently shown by Mlachila et al. (2014), absolute pro-poor development is growth that yields poverty reduction, while relative pro-poor development leads to decreasing inequality.

3. DATA AND METHODOLOGY

3.1 Data

We investigate a sample of 52 African countries with data from African Development Indicators (ADI), the Financial Development and Structure Database (FDSD), and the African Development Bank (AfDB). The ‘mobile phone penetration’ rate is obtained from the AfDB.

This rate could also be used as a proxy for mobile banking/activities (Ondiege, 2010; Aker & Mbiti, 2010; Asongu, 2013a). Due to constraints in the time series properties of the mobile penetration indicator, the data structure is cross-sectional and consists of 2003-2009 average growth rates. Financial intermediary instrumental variables are obtained from the FDSD, while the dependent and control variables are collected from ADI. The measure for inequality is the GINI coefficient which accounts for the disparity among values of the frequency income distribution. A value of zero means equality whereas; a coefficient of one denotes maximum inequality. The GINI index has been used in recent Africa inequality literature (Batuo et al., 2010), as well as in many fields investigating inequality (sociology, economics, health science, agriculture…etc).

In the regressions, we shall control for the macroeconomic environment (*inflation, government expenditure*) and institutional quality (rule of law). The limitation to only three control variables is due to constraints in the overidentifying restrictions test for instrument validity. In essence, the presence of five instruments and four explanatory variables leaves us with just one degree of freedom needed for the test[7]. The following discussion is relevant to expected signs of control variables (with respect to inequality). We expect: high *inflation* to increase inequality (Albanesi, 2007), whereas low *inflation* should mitigate it (Bulir, 1998; Lopez, 2004); the impact of *government expenditure* depends on efficient management of resources, especially if the budget allocated for poverty reduction investments is not tainted with corrupt practices (Ndikumana & Baliamoune-Lutz, 2008) and more generally, respect for the *rule of law* should have a mitigating effect on inequality.

In this paragraph, we devote space to providing justification for the choice of instrumental financial development variables. This justification is essential for the relevance of

[7] An OIR test is only employable in the presence of over-identification. That is, the instruments must be higher than the endogenous explaining variables by at least one degree of freedom. In the case of exact-identification (instruments equal to endogenous explaining variables) and under-identification (instruments less than endogenous explaining variables) an OIR test is by definition not possible.

the empirical analysis because a theoretical basis for the instruments is imperative for sound and consistent interpretation of estimated coefficients, in view of the research questions under consideration. We have already presented a case for the close link between 'mobile phone penetration' and mobile-banking in the theoretical section of this paper. The objective of this study is not only to examine the effect of mobile penetration on inequality, but it is also to evaluate the involvement of the financial sector in this relationship. With the financial intermediary development dynamics integrated into the equation, the effect of 'mobile phone penetration' becomes that of 'mobile banking' because the formal financial sector is instrumental in the effect of 'mobile phone penetration' on inequality. Borrowing from recent African mobile banking literature (Asongu, 2013a), we employ financial intermediary dynamics of depth, efficiency, activity and size. Hence, instruments include: financial depth (money supply and liquid liabilities), financial efficiency (financial system credit on financial system deposits), financial activity (private domestic credit by domestic banks and other financial institutions) and, financial size (deposit money bank assets on deposit money bank assets plus central bank assets).

Details about the variables' sources, descriptive statistics and correlation analysis (showing the basic correlations among key variables used in this study) are presented in the appendices. The summary statistics (Appendix 1) of the variables used in the cross-sectional regressions show that there is a considerable a level of variation in the data utilized such that one should be reasonably confident that sound estimated relationships should emerge. Definitions and corresponding sources of the variables are also reported in Appendix 1. The interest of the correlation matrix (Appendix 2) is to manage issues resulting from overparameterization and multicollinearity. Based on the correlation coefficients, there are no major issues with respect to the associations to be modeled.

3.2 Methodology

2.2.1 Ordinary Least Squares (OLS)

Due to the cross-sectional structure of our data, we employ an empirical specification used in the inequality literature for this type of data structure (Andrés, 2006). The model to be estimated is as follows:

$$Inequality = \sigma_0 + \sigma_1 Mobile + \sigma_2 Inflation + \sigma_3 Gov + \sigma_4 RL + \varepsilon \quad (1)$$

where, *Inequality* denotes the GINI coefficient, *Mobile* is the mobile phone penetration rate, *Inflation* is the inflation rate, *Gov* represents government expenditure, *RL* is the rule of law and, ε is the error term. Robustness checks of the analysis will be ensured with: (1) use of alternative specifications (2) modeling with Heteroscedasticity and Autocorrelation Consistent (HAC) standard errors and (3) RAMSEY's Regression Equation Specification Error Test (RESET) for validity of model specification. Since we are modeling with Ordinary Least Squares (OLS), the four basic concerns of this approach are also addressed. Whereas, autocorrelation in residuals and heteroscedasticity are addressed with HAC standard errors, the assumption of linearity is verified with RAMSEY's RESET. As we have already highlighted above, the correlation analysis in Appendix 2 has helped us to mitigate the problems of multicollinearity and overparameterization.

2.2.2 Instrumental Variables estimation

Given the research questions under consideration, OLS only provide a baseline of the mobile-inequality nexus within the context of mobile phone penetration. Corresponding estimates have to be compared with models that instrument the relationship with financial development dynamic indicators for the mobile banking context. To this effect, in accordance with recent inequality literature (Asongu, 2013a), the paper adopts a Two-Stage Least Squares (2SLS) Instrumental Variables (IV) estimation technique. IV estimation addresses the puzzle of

endogeneity and hence, avoids the inconsistency of estimated coefficients by OLS when the explanatory variables are endogenous or correlated with the error term in the equation of interest.

The 2SLS estimation will entail the following steps:

First-stage regression:

$$Mobile = \gamma_0 + \gamma_1(Instruments) + \beta X + \upsilon \quad (1)$$

Second-stage regression:

$$Inequality = \lambda_0 + \lambda_1(Mobile) + \beta X + \mu \quad (2)$$

In the first and second equations, υ and μ respectively represent the error terms. Instrumental variables are: *money supply (M2), liquid liabilities (financial system deposits), financial efficiency, financial activity and financial size*. *X* representing control variables entails: *inflation, government expenditure and the rule of law*. *Inequality* is the GINI coefficient.

We adopt the following steps in the IV analysis: (1) justify the choice of a 2SLS over an OLS estimation technique with the Hausman-test for endogeneity; (2) verify that the financial development instruments are exogenous to the endogenous components of the main explanatory variable (Mobile channel) and (3) ensure that the instruments are valid and not correlated with the error-term in the main equation with an Over-identifying Restrictions (OIR) test. Further robustness checks are performed with alternative specifications and modeling with robust HAC standard errors.

4. EMPIRICAL ANALYSIS

4.1 Presentation of results

This empirical section addresses four main concerns: (1) the ability of 'mobile phone penetration' to explain income-inequality conditional on other covariates or control variables,

(2) the possibility of non-linear combinations of the fitted values explaining inequality, (3) the ability of financial development dynamics to explain inequality beyond the mobile channel and (4) the difference between the effects of 'mobile phone penetration' and 'mobile banking' in the inequality-mobile nexus. The first concern is addressed by the significance and signs of estimated coefficients, the second depends on the results of RAMSEY's RESET, the third is contingent on the outcome of the Sargan OIR test while the fourth concern depends on a comparative analysis between OLS baseline estimates and their corresponding 2SLS values. The intuition behind the RESET is that, if non-linear combinations of the independent variables have any power in explaining the response variable, then the model is misspecified. Therefore, the RESET is a general specification test for the linear regression estimation. The null hypothesis of this test is the stance that non-linear combinations of the fitted values have no explanatory power on inequality. Hence, failure to reject the null hypothesis confirms the validity of the linear model specification. The null hypothesis of the Sargan test is the position that financial instruments are valid in explaining inequality via no other mechanisms beside the mobile channel (conditional on the control variables). Thus, a rejection of the null hypothesis implies that the instruments suffer from endogeneity as they are correlated with the error term in Eq. (2). The Hausman test precedes every IV estimation procedure. Its null hypothesis is that OLS estimates are efficient and consistent. Hence, the rejection of the null hypothesis points to the inconsistency of OLS because of endogeneity and lends credit to the choice of the 2SLS estimation strategy as means of assessing the influence of financial development in the inequality-mobile nexus.

Table 1 below reports regressions of inequality on the mobile phone penetration (mobile) channel. Whereas, the first half of the table reports OLS results, the second presents their corresponding 2SLS estimates. With respect to the first concern, mobile penetration has a positive income redistribution effect or an equalizing income effect. On the second issue, all

models validate the linearity assumption, implying they are rightly linearly specified since the null hypotheses of the RESET are not overwhelmingly rejected. For the third issue, the null hypothesis of the Sargan OIR test is rejected for Model 3*; an indication of a negative 'mobile banking' inequality nexus. In other words, financial development dynamics are instrumental in the equalizing income effect of mobile phone penetration. To tackle the fourth concern, OLS estimates provide a baseline and we compare their estimates with those of 2SLS. The resulting conclusion is that 'mobile banking' has a higher income equalizing effect than 'mobile phone penetration'. This is because, in the absence of financial development dynamics with OLS specifications, the magnitude of the 'mobile penetration'-inequality nexus is lower.

The significant control variables have the right signs. High inflation (above 117 percent in the mean from Appendix 1) fuels inequality, in accordance with Albanesi (2007). Institutional quality in the perspective of *rule of law* reduces income-inequality. Inflation could increase mobile inequality because the effect is felt to a greater magnitude by the low-income strata of the population. The *rule of law* reduces inequality because it essentially provides a favourable environment for the equitable distribution of the fruits of economic prosperity.

Table 1: Effect of mobile penetration and banking on inequality (with HAC standard errors)

	Dependent Variable: GINI Index					
	Mobile Phone Penetration			**Mobile Banking**		
	Ordinary Least Squares (OLS)			**Two-Stage Least Squares (2SLS)**		
	Model 1	Model 2	Model 3	Model **1***	Model **2***	Model **3***
Constant	**75.527*** **	**77.914*** **	**79.845*** **	**77.331*** **	**78.884*** **	**136.744*** **
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Mobile	**-21.569*** **	**-24.001*** **	**-26.160*** **	**-23.403** **	**-25.842** **	**-79.336*** **
	(0.002)	**(0.002)**	**(0.002)**	**(0.028)**	**(0.023)**	**(0.000)**
Inflation	**0.443** **	**0.647***	**0.696** **	0.534	0.626	**1.734***
	(0.032)	**(0.067)**	**(0.037)**	(0.136)	(0.223)	**(0.053)**
Gov't Expenditure	---	0.016	0.043	---	0.374	0.970
		(0.921)	(0.807)		(0.511)	(0.217)
Rule of Law	---	---	-1.876	---	---	**-35.465** **
			(0.519)			**(0.024)**
RAMSEY RESET	**1.868**	**1.542**	**1.374**	---	---	---
	(0.174)	**(0.245)**	**(0.285)**			
Hausman	---	---	---	0.316	1.0392	**12.471** **
				(0.853)	(0.791)	**(0.014)**
Sargan OIR	---	---	---	11.589***	6.113**	**0.006**
				(0.008)	(0.047)	**(0.935)**
Adjusted R^2	0.327	0.406	0.382	0.392	0.346	0.086
Fisher	7.027	**5.746*** **	**5.205*** **	**3.904** **	**2.820***	**6.753*** **
Observations	52	52	52	52	52	52
Instruments	Not Applicable			Constant; M2; Fdgdp; Pcrbof; dbacba; fcfd		

*;**;***: significance levels of 10%, 5% and 1% respectively. HAC: Heteroscedasticity and Autocorrelation Consistent. P-values in brackets.

4.2 Discussion of results and policy implications

Before we move to the discussion of results, it is worthwhile pointing-out that mobile phones represent long-term economic growth investments for the disadvantaged in income-distribution. It follows that many households maybe willing to cope with unpleasant sacrifices (such as reduction in food consumption or sanitation in the perceived short-term) in the hope that the mobile phone would improve their opportunities with income and jobs in the long-term. The first strand will focus on the reasons for which mobile penetration has a positive income redistributive effect, while the second will elucidate why the income-equalizing magnitude of mobile-banking is higher in comparison to 'mobile phone penetration'.

4.2.1 Why does mobile penetration mitigate income-inequality?

The equalizing incidence of mobile phone penetration could be explained from two main angles: the absorption of shocks which drive poverty and the empowering of women as well as the 'income-disadvantaged' to engage in business activities.

Firstly, mobile phones can assist household budgets when confronted with unpredictable shocks that fuel poverty. Consequently, the probability of a poor family incurring drastic losses due to an unpredictable shock is certainly mitigated and lowered when families are able to respond to the shocks in a timely manner. Therefore, the mobile phone could have the greatest effects on poverty by mitigating the costs associated with shock experiences. More efficient financial connection for coping with shocks include: incurring lower travel costs, more efficient action, less trauma and improved access to information. Immediate positive feedbacks of income saving and cost mitigation are found, particularly during vulnerable circumstances like death or illness in the family. It is also interesting to cite security increases for poor families via reduced loss of poverty. For example, a family's ability to scale-down the number of overnight hospital days or capacity to avoid transportation costs during desperate

situations are some principal cost-saving strategies implemented with the quick dial of the mobile phone. In a nutshell, the communication (mobile phone) device provides a means of timely response, reduced surprises, multi-tasking and planning during shocks. It also reduces the time required to physically search for individuals during difficult ordeals.

Secondly, this communication device could empower women to engage in small business activities, as well as the ability to run existing businesses more efficiently. Hence, enabling them to bridge the gap between gender income inequality. Also, the low income strata faction of the population which previously had low political connections and was unprivileged with regard to information indispensable for successfully doing business could more quickly get to know changes in market dynamics (like price, demand, market conditions, new market rules…etc) that are essential for the smooth-running of a business.

To the best of our knowledge, the two explanations or inferences above are scarce in the literature and should be interesting for future research.

4.2.2 Why is the inequality mitigation effect higher in mobile-banking?

We have discussed two mechanisms through which the mobile phone could reduce inequality and poverty. The propensity of these channels to mitigate inequality will increase if the mobile phone is adapted to mobile banking activities. On the first point, responding in a timely manner to poverty mitigating shocks is a good advantage but responding to a shock with the possibility of receiving financial assistance is even better. This is because most shocks are associated with one form of financial liability or the other, which could be addressed with the help of mobile transfers (payments and receptions). In the same vein, the ability of the poorer gender or segment of the population to engage in business activities or run those already existing properly, depends to a great extent on mobile-banking. Business indispensably requires payment and reception of financial transactions which could be substantially eased if the business person, in addition to his/her ability to make timely demands for commodities

(through mobile phones), also has the ability to financially comply with the corresponding transactions (via mobile banking).

Ultimately, many lives have been transformed by the mobile revolution thanks to basic financial access in the form of phone-based money transfer and storage (Jonathan & Camilo, 2008; Demombynes & Thegeya, 2012). Hence, the significant growth and penetration rates of mobile telephony that is transforming cell phones into pocket-banks in Africa is providing countries on the continent with increasingly affordabe and cost-effective means of bringing on board a great proportion of the population that has until now been excluded from formal financial services for decades. Other positive effects of mobile banking have already been covered in Section 2.

5. CONCLUSIONS

The study has assessed the role of mobile phones and mobile banking in decreasing inequality in 52 African countries. The empirical procedure has consisted of: first, examining the income-redistributive effect of mobile phone penetration and then investigating the influence of financial development dynamics in this relationship. The findings suggest an equalizing income-redistributive effect of 'mobile phone penetration' and 'mobile banking', with a higher income-equalizing effect from mobile banking compared to mobile phone penetration. Poverty alleviation channels explaining this difference in inequality mitigating propensity have been discussed.

The poverty alleviation channels which we identified are crucial in addressing Africa's extreme poverty tragedy in the post-2015 sustainable development agenda. There is evidently room for further research on (i) other inclusive development variables and (ii) comparative country-specific case studies, for more targeted policy implications.

Appendices

Appendix 1: Summary statistics, definitions and sources

		Mean	S.D	Min	Max	Obser.
GINI Coefficient		43.100	7.702	29.760	65.770	52
Mobile Penetration : Seven year average growth rate (% of population)		1.674	0.217	1.043	2.242	52
Control Variables	Inflation (annual % of CPI)	117.95	764.60	1.953	5304.8	52
	Government Expenditure (% of GDP)	11.015	12.229	0.0549	65.461	52
	Rule of Law (Estimate)	-0.703	0.667	-2.419	0.950	52
Instrumental Variables	Financial Depth (M2)	0.339	0.242	0.079	1.022	52
	Liquid Liabilities (Fdgdp)	0.273	0.226	0.042	0.895	52
	Financial Efficiency (Fcfd)	0.712	0.382	0.259	2.458	52
	Private domestic credit (Pcrbof)	0.208	0.244	0.027	1.423	52
	Financial Size (Dbacba)	0.765	0.210	0.063	1.074	52

S.D: Standard Deviation. Min: Minimum. Max: Maximum. Ober: Observations. CPI: Consumer Price Index. M2: Money Supply. GDP: Gross Domestic Product. Fdgdp: Financial system deposits. FcFd: Financial system credit on Financial system deposits. Pcrbof: Private domestic credit from domestic banks and other financial institutions. Dbacba: Deposit money bank assets on 'Central bank assets plus Deposit money bank assets'.

Sources: Mobile penetration data is obtained from the African Development Bank. Control variables are gathered from African Development Indicators of the World Bank, while financial instrumental variables are from the Financial Development and Structure Database of the World Bank.

Appendix 2: Correlation matrix

GINI Index	Mobile Penetration	**Control variables** Inflation	Gov't	RL	**Financial dynamic Instrumental variables** M2	Fdgdp	FcFd	Pcrbof	Dbacba	
1.000	-0.335	0.161	-0.003	0.115	0.170	0.216	-0.493	-0.089	0.077	GINI
	1.000	-0.031	0.174	-0.367	-0.496	-0.590	-0.243	-0.551	-0.352	Mobile
		1.000	0.147	-0.258	-0.092	-0.054	-0.194	-0.123	-0.160	Inflation
			1.000	0.014	-0.248	-0.206	-0.152	-0.141	0.233	Gov't
				1.000	0.665	0.727	0.226	0.567	0.479	RL
					1.000	0.974	0.042	0.577	0.281	M2
						1.000	0.169	0.695	0.360	Fdgdp
							1.000	0.772	0.372	FcFd
								1.000	0.382	Pcbof
									1.000	Dbacba

Gov't: Government Expenditure. RL: Rule of Law. M2: Financial Depth. Fdgdp: Financial Liabilities. FcFd: Financial System Efficiency. Pcrbof: Financial System Activity. Dbacba: Financial Size.

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