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How do institutions matter in the income-equalizing effect of mobile phone penetration?

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How do institutions matter in the income-equalizing effect of mobile phone penetration?

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Abstract

The object of this paper is to complement theoretical 'mobile penetration' literature with empirical evidence in a dual manner: on the one hand, assess the income-redistributive effect of mobile phone penetration and; on the other hand, the instrumentality of good governance in this nexus. Main findings suggest an equalizing income-redistributive effect, with a higher magnitude in the presence of government quality instruments. It follows that, good governance is a necessary condition for a higher income-equalizing effect of mobile phone penetration. The empirical evidence which deviates from mainstream country-specific and microeconomic survey-based approaches is on 52 African countries. 'Mobile phone'-oriented poverty reduction channels are also discussed.

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1. Introduction

Many lives have been transformed by the mobile revolution, which is providing not just communication but also basic financial access in the forms of phone-based money transfer and storage (Jonathan & Camilo, 2008; Demombynes & Thegeya, 2012). 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 increase cost-effective and affordable means of bringing on board a large part of the population that hitherto has been excluded from formal financial services for decades. At the 2007 'Connect Africa' summit, the president of Rwanda Paul Kagame 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) backs this claim: "*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*". The purpose of this paper is to examine how these sentiments and slogans are reflected in the incidence of 'mobile phone penetration' on income-redistribution in Africa. The assessment is of significant interest not only to banks and Micro Financial Institutions (MFIs) but also to governments, financial regulators as well as development partners who are providing the much needed support to improve the livelihoods of Africans through poverty reduction and sustained economic growth.

Beside the need to examine these sentiments, two imperatives add substance to the motivation of this work: a missing link in the literature and the growing concern over the quality of institutions in the African continent. Firstly, there is an increasing body of work pointing to the imperative of more scholarly research on the phenomenon of mobile penetration[2]. As far as we know, one of the most exhaustive accounts on the 'mobile

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[2] "*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*

penetration' development literature concludes: "*Existing empirical evidence on the effect of mobile phone coverage and services suggests 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). More so, as sustained by Maurer (2008) and supported in subsequent literature (Jonathan & Camilo, 2008; Thacker & Wright, 2012), scholarly research on the adoption and socioeconomic impacts of m-banking (payments) systems in the developing world is scarce. Majority of studies on mobile penetration have been theoretical and qualitative in nature (Maurer, 2008; Jonathan & Camilo, 2008; Merritt, 2010; Thacker & Wright, 2012). The few existing empirical works are based on country-specific and micro-level data mostly collected from surveys (Demombynes & Thegeya, 2012). Secondly, an extensive literature on intuitions and development suggest that Africa is poor because it has poor institutions (Easterly, 2005; Asongu, 2013a,b). Hence, the need to examine what role institutions play in the incidence of mobile penetration on poverty.

The contribution of this paper to the literature is therefore threefold. Firstly, it complements theoretical literature with empirical evidence on the income-redistributive effect of mobile phone penetration. As far as we know, macroeconomic evidence on the poverty incidence of mobile penetration is missing in the literature. Secondly, the study integrates the instrumentality of institutions in the mobile-inequality nexus to assess what role institutions plays, in order to give policy makers the much needed guidance in light of the current debate over institutions and poverty in Africa. Thirdly, contrary to mainstream literature that is focused on country-specific analyses, this paper covers 52 African countries. The choice of Africa as an investigation platform draws from the stubbornly high poverty rate and growing

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variety of factors, including unreliable or nonexistent data on individual level adoption (leading to measurement error)…" Aker & Mbiti (2010, 225).

inequality in the continent (Asongu, 2013c,d). The rest of the paper is organized as follows. Data and methodology are presented and outlined respectively in Section 2. Empirical analysis is covered in Section 3. Section 4 concludes.

2. Data and Methodology

2.1 Data

We examine a sample of 52 African countries with data from African Development Indicators (ADI) and the Financial Development and Structure Database (FDSD) of the World Bank (WB). The 'mobile phone penetration' rate is obtained from the African Development Bank (AfDB). This rate could also account for mobile banking/activities (Ondiege, 2010; Aker & Mbiti, 2010; Asongu, 2013e). Owing to constraints in the time series properties of the mobile penetration measurement, the data structure is cross-sectional and consists of 2003-2009 average growth rates. The measure for inequality is the GINI coefficient which accounts for income disparity among values of the frequency distribution. A value of zero denotes equality whereas, a coefficient of one expresses maximal inequality. The GINI index has been used in recent African inequality literature (Batuo et al., 2010; Asongu, 2013f), as well as in many disciplines investigating inequality (sociology, economics, health science, agriculture…etc).

In the regressions, we shall control for the macroeconomic environment (*inflation, financial depth*), and *government expenditure*. The limitation to only three control variables is due to constraints in the Overidentifying Restrictions (OIR) test for instrument validity[3]. The following discussion is relevant to expected signs of the control variables in relation to inequality. We expect: high *inflation* to fuel inequality (Albanesi, 2007) whereas low *inflation* should reduce it (Bulir, 1998; Lopez, 2004); *financial depth* decreases uneven income distribution (Kai & Hamori, 2009); the impact of *government expenditure* depends on the

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[3] 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 cases of exact-identification (instruments equal to endogenous explaining variables) and under-identifications (instruments less than endogenous explaining variables) an OIR test is by definition not possible.

quality of institutions, especially if budget allocated for poverty reduction investments is not tainted with corrupt practices (Ndikumana & Baliamoune-Lutz, 2008).

In this paragraph, we devote space to providing justification for the choice and intuitive basis of the instrumental variables. This justification is essential for the relevance of the empirical analysis because a theoretical basis for the instruments is imperative for sound and consistent interpretation of estimated coefficients. In other words, while the object of this article is to assess the effect of mobile penetration on inequality, it also indirectly aims to examine how government institutions are instrumental in the nexus. Therefore, we investigate how three main aspects of how governance plays-out in the mobile-inequality nexus: (1) the process by which those in authority are selected and replaced (political governance: voice & accountability and political stability); the manner in which governments formulate, implement policies as well as deliver services (economic governance: regulatory quality and government effectiveness) and; the respect of citizens and state institutions that govern interactions among them (intuitional governance: rule of law and corruption control). Hence, instruments for the quality of formal institutions include: *the rule of law*, *regulation quality*, *corruption-control*, *government effectiveness*, *political stability* (*no violence*) and *voice & accountability*.

Details about the variables' sources, descriptive statistics and correlation analysis (showing the basic correlations between key variables employed in this paper) are presented in the appendices. The summary statistics (Appendix 1) of the variables used in the cross-sectional regressions reveal that, there is quite a degree of variation in the data utilized such that one should be reasonably confident that estimated relationships should emerge. Definitions and corresponding sources of the variables are reported in Appendix 3. The interest of the correlation matrix (Appendix 2) is to manage issues resulting from overparametization and multicolinearity. Based on the correlation coefficients, there do not seem to be any serious concerns with respect to the relationships to be modeled.

2.2 Methodology

2.2.1 Ordinary Least Squares (OLS)

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

$$Inequality = \sigma_0 + \sigma_1 Mobile + \sigma_2 M2 + \sigma_3 Gov + \sigma_4 Inflation + \varepsilon \tag{1}$$

where, *Inequality* denotes the GINI coefficient, *Mobile* is the mobile phone penetration rate, *Inflation* is the inflation rate, *M2* stands for financial depth, *Gov* represents government expenditure and, ε is the error term. Robustness 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 tackled. While, autocorrelation in the residuals and heteroscedasticity are tackled 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 avoid issues of multicolinearity and overparametization.

2.2.2 Instrumental Variable estimation

Given the research questions under consideration, OLS only provide a baseline of the mobile-inequality nexus. Corresponding estimates have to be compared with models that instrument the nexus with government quality indicators. To this effect, in accordance with recent inequality literature (Asongu, 2013d), the paper adopts a Two-Stage Least Squares (2SLS) Instrumental Variable (IV) estimation technique. IV estimation solves the puzzle of

endogeneity and hence, avoids the inconsistency of estimated coefficients by OLS when the exogenous variables are endogenous (correlated with the error term in the main equation). The 2SLS estimation will entail the following steps:

First-stage regression:

$$Mobile_i = \gamma_0 + \gamma_1(Instruments)_i + \gamma_2 X_i + \upsilon_i \qquad (2)$$

Second-stage regression:

$$Inequality_i = \beta_0 + \beta_1(Mobile)_i + \beta_2 X_i + \mu_i \qquad (3)$$

In the first and second equations, υ_i and μ_i respectively denote the error terms. Instrumental variables are: *control of corruption*, *government effectiveness*, *voice & accountability*, *rule of law*, *regulation quality* and *political stability*. *X* representing control variables entail: *financial depth, inflation and government expenditure*. *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 the instruments are exogenous to the endogenous components of the main explaining variable (Mobile channel) and; (3) ensure 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 ensured with alternative specifications and modeling with robust HAC standard errors.

3. Empirical results

This empirical section addresses four main issues: (1) the ability of 'mobile phone penetration' to explain income-inequality conditional on other covariates (control variables); (2) the possibility of non-linear combinations of the fitted values explaining the response variable; (3) the ability of formal institutions to explain inequality beyond the mobile channel and; (4) the instrumentality to formal institutions in the inequality-mobile nexus. The first issue

is addressed by the significance and signs of estimated coefficients in the left hand side of the table, the second depends on the result of RAMSEY's RESET, the third is contingent on the outcome of the Sargan OIR test while, the fourth concern depends on the three preceding issues. The intuition behind the RESET is that, if non-linear combinations of the exogenous 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 model. The null hypothesis of this test is the stance that, non-linear combinations of the fitted values have no explanatory power on income-inequality. Hence, failure to reject the null hypothesis lends credit to the linear model specification. The null hypothesis of the Sargan test is the position that instruments are valid in explaining inequality through no other mechanisms beside the mobile channel (conditional on the control variables). Thus, a rejection of the null hypothesis implies the instruments suffer from endogeneity as they are correlated with the error term in Eq. (3). The Hausman test precedes every IV estimation technique. Its null hypothesis is the stance that, OLS estimates are efficient and consistent. Hence, the rejection of the null hypothesis points to the inconsistency of OLS owing to endogeneity and lends credit to the choice of the 2SLS estimation strategy as means of assessing the instrumentality of formal institutions in the inequality-mobile nexus.

Table 1 reports regressions of inequality on the 'mobile phone penetration' (mobile) channel. While the first half of the table reports OLS results, the second entails corresponding 2SLS values. As concerns the first issue, mobile penetration has a positive income redistributive effect. On the second issue, while Models 1-2 do not validate the linearity assumption, Model 3 is rightly linearly specified. For the third issue, since the null hypotheses of the Sargan OIR are not overwhelmingly rejected, government quality instruments do not explain inequality beyond the mobile phone channel conditional on other covariates (control variables). To address the fourth issue, OLS specifications provide a baseline and we compare

their corresponding estimates with those of 2SLS. The resulting conclusion is that, formal institutions are instrumental in the positive income redistributive effect of mobile phone penetration. This is because, in the absence of good governance instruments (OLS specifications), the corresponding magnitudes of the mobile-inequality nexus are lower. The significant control variable has the right sign. High inflation (above 117% in the mean from Appendix 1) fuels inequality, in line with Albanesi (2007).

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

	Dependent Variable: GINI Index					
	Ordinary Least Squares (OLS)			Two-Stage Least Squares (2SLS)		
	Model 1	Model 2	Model 3	Model 1*	Model 2*	Model 3*
Constant	**83.924***	**84.365***	**95.127***	**136.91***	**129.037***	**137.011***
	(0.000)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Mobile penetration	**-23.558***	**-24.791**	**-32.743***	**-53.840***	**-49.488***	**-56.840***
	(0.007)	**(0.015)**	**(0.004)**	**(0.001)**	**(0.003)**	**(0.000)**
Financial depth	-5.045	-3.108	-10.426	-11.965	-14.457	-23.227
	(0.441)	(0.692)	(0.164)	(0.237)	(0.261)	(0.159)
Gov't Expenditure	---	0.107	-0.055	---	0.203	0.074
		(0.571)	(0.754)		(0.718)	(0.899)
Inflation	---	---	**0.851****	---	---	1.161
			(0.014)			(0.228)
RAMSEY RESET	5.723***	5.284**	**1.298**	---	---	---
	(0.008)	(0.019)	**(0.306)**			
Hausman	---	---	---	**6.023***	5.333	**9.164***
				(0.049)	(0.148)	**(0.057)**
Sargan OIR	---	---	---	**3.556**	**2.168**	**0.754**
				(0.469)	**(0.538)**	**(0.685)**
Adjusted R²	0.268	0.281	0.465	0.275	0.257	0.422
Fisher	**4.167***	**2.615***	**4.462***	**5.972***	**3.783***	**5.733***
Observations	52	52	52	52	52	52
Instruments		Not Applicable			Government Quality Indicators	

*;**;***: significance levels of 10%, 5% and 1% respectively. HAC: Heteroscedasticity and Autocorrelation Consistent. P-values in brackets. Gov't: Government. RESET: Regression Equation Specification Error Test. OIR: Overidentifying Restrictions Test.

4. Concluding remarks

The object of this paper has been to complement theoretical mobile penetration literature with empirical evidence in a dual manner: on the one hand we have assessed the income-redistributive effect of mobile phone penetration and; on the other hand, the instrumentality of good governance in the nexus. Main findings suggest an equalizing income-redistributive effect, with a higher magnitude in the presence of government quality instruments. It follows that good governance is a necessary condition for a higher income-

equalizing effect of mobile phone penetration. It is worthwhile to point-out that, mobile phones represent long-term economic growth investments for the disadvantaged in income-distribution. Therefore, 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. Our findings have shown that these hopes and aspirations resulting from the use of mobile phones are more perceptible when formal institutions are strong.

The appealing income-redistributive effect of mobile banking could be explained from several perspectives. Firstly, mobile phones can assist households' budget when faced with unpredictable shocks which drive poverty. The probability of a poor family incurring drastic loss due to an unpredictable shock is certainly mitigated and lowered when families are able to respond to the shock in a more timely fashion with the help of a mobile phone. Thus, the mobile phone could have the greatest effects on poverty reduction during vulnerable shock experiences through driving down costs associated to the shock. Better financial management and coping with shock include, among others: incurring lower travel costs, more efficient action, less trauma and improved access to information. Secondly, 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). Therefore, the significant growth and penetration rates of mobile telephony that is transforming cell phones into pocket-banks in Africa is providing countries in the continent with increase affordable and cost-effective means of bringing on board a large part of the population that has until now been excluded from formal financial services for decades. Thirdly, mobile phones could empower women to run existing businesses more efficiently (or to engage in small businesses), thus enabling them to bridge the gap between gender income-inequality.

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
	Financial Depth (M2)	0.339	0.242	0.079	1.022	52
	Government Expenditure (% of GDP)	11.015	12.229	0.0549	65.461	52
Instrumental Variables	Rule of Law (Estimate)	-0.703	0.667	-2.419	0.950	52
	Regulation Quality (Estimate)	-0.680	0.617	-2.497	0.623	52
	Voice and Accountability (Estimate)	-0.640	0.706	-1.882	0.862	52
	Political Stability (Estimate)	-0.523	0.914	-2.877	0.909	52
	Corruption Control (Estimate)	-0.634	0.595	-2.227	0.967	52
	Government Effectiveness (Estimate)	-0.680	0.609	-1.667	0.697	52

S.D: Standard Deviation. Min: Minimum. Max: Maximum. Obser: Observations. CPI: Consumer Price Index. M2: Money Supply. GDP: Gross Domestic Product. But for the mobile penetration rates which source from the African Development Bank, the variables are gathered from African Development Indicators of the World Bank and the Financial Development and Structure Database (M2).

Appendix 2: Correlation matrix

GINI Index	Mobile Penetration	Control Variables			Government Quality Instrumental Variables						
		Inflation	M2	Gov't	RL	RQ	V&A	PolS	CC	GE	
1.000	-0.335	0.161	0.170	-0.003	0.115	-0.105	0.256	0.304	0.329	0.093	GINI
	1.000	-0.031	-0.496	0.174	-0.367	-0.295	-0.259	-0.271	-0.387	-0.538	Mobile
		1.000	-0.092	0.146	-0.258	-0.435	-0.184	-0.157	-0.201	-0.161	Inflation
			1.000	-0.248	0.665	0.438	0.351	0.386	0.570	0.608	M2
				1.000	0.014	0.044	0.022	0.131	0.025	-0.034	Gov't
					1.000	0.882	0.746	0.829	0.931	0.920	RL
						1.000	0.708	0.681	0.840	0.881	RQ
							1.000	0.669	0.753	0.697	V&A
								1.000	0.764	0.684	PolS
									1.000	0.907	CC
										1.000	GE

M2: Financial depth. Gov': Government Expenditure. RL: Rule of Law. RQ: Regulatory Quality. V&A: Voice and Accountability. PolS: Political Stability. CC: Corruption-Control. GE: Government Effectiveness.

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