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Executive Summary

To the best our knowledge, in the first empirical macroeconomic examination of the nexus between financial intermediation and mobile phones, Asongu employs two conflicting financial system definitions in the assessment of how mobile phones have stimulated financial development in Africa. Within the framework of the dominant International Monetary Fund's International Financial Statistics (2008) definition, mobile phones are established to be negatively associated with financial intermediary dynamics of depth, activity and size. Conversely, when the previously neglected informal financial sector is integrated into the conception, definition and measurement of the financial system, mobile phones are positively (negatively) correlated with the informal (formal) financial intermediation sector. The empirical evidence is based on 52 African countries. Causality in the established linkages has been confirmed in subsequent studies by the same author. At least three policy implications derive from the findings. First, the role of informal financial intermediation is increasing to the detriment of formal financial mechanisms. Second, in order to capture the positive effect of mobile phones on finance, it is imperative to integrate the missing informal financial sector component into the IMF definition of the financial system. Third, it is a wake-up call for more scholarly research on: (i) macroeconomic financial development implications of mobile phone penetration and (ii) monetary policy instruments in the face of burgeoning 'mobile phone'-oriented financial intermediation.

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

1. Introduction

In sub-Saharan Africa (SSA), mobile money which in 2014 was worth about 655.8 million USD is projected to reach approximately 1.3 billion USD in 2019. This improving tendency represents important avenues for financial inclusion, improvement of livelihoods and business development (Caulderwood, 2015). According to the narrative, only 23% of adults in the sub-region living below 2USD/day posses a formal bank account. Hence, the mobile phone is offering opportunities of financial access to previously unbanked segments of the population. At the corporate financing level, compared to advanced nations, individuals and firms in the sub-region are short of credit facilities, partly because stock markets are undeveloped and financing by equity is limited (Asongu, 2013a).

The positioning of Asongu (2013a) is motivated by one of the most exhaustive studies in the mobile phone literature which has concluded on the need for more scholarly focus on macroeconomic lines of inquiry, because of scarce macroeconomic empirical evidence on the phenomenon: "*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). This conclusion has been sustained by Thacker and Wright (2012), because 'mobile phone'-oriented lines of inquiry have been essentially based on theoretical and qualitative studies (Maurer, 2008; Jonathan & Camilo, 2008; Merritt, 2010; Thacker & Wright, 2012). Moreover, recent literature (Demombynes & Thegeya, 2012; Asongu, 2013b, 2015ab) is broadly consistent with the perspective that the few empirical papers have been positioned on micro-level and county-specific data, for the most part.

In light of the above, Asongu (2013a) has presented the first macroeconomic assessment on the linkage between mobile phones and financial development in 52 African countries. To this end, the study has employed conflicting definitions of the financial system: (i) a traditional International Financial Statistics (IFS, 2008) definition from the International Monetary Fund (IMF) that neglects the informal financial sector and (ii) an improved definition that incorporates this previously missing informal financial sector. By distinguishing correlations between various financial sectors, the study contributes at the same time to the macroeconomic literature on measuring financial development and responds to the growing field of economic development by means of informal financial sector promotion,

microfinance and mobile banking. It suggests a practicable way to disentangle the correlations between 'mobile phone penetration' and various financial sectors. This is done by: (i) disentangling the existing IFS measurement into its formal and semi-formal components and (ii) integrating the previously missing informal financial sector component.

There is at least a twofold reason for positioning the inquiry on Africa. First, according to Penard et al. (2012), the continent has witnessed an uneven penetration by mobile phones, compared to developed countries in which they have reached points of saturation. Second, developing markets in Africa represent substantial business opportunities because high-end markets in Europe, Asia and North America are experiencing stabilization in the growth of mobile phones.

2. Data and methodology

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 (Ondiege, 2010). The cross-sectional data consists of 2003-2009 average growth rates. Whereas formal financial intermediary development indicators are directly extracted from the FDSD, semi-formal and informal financial indicators are computed from the FDSD, in line with propositions from Asongu (2015c). These propositions have being continuously employed in the African knowledge economy (Asongu, 2014) and globalization (Asongu, 2015d) literature. The financial development indicators employed are dynamics of depth, efficiency, activity and size. The underlying financial indicators are summarized in Table 1.

Table 1: Financial variable definitions

Variables	Signs	Variable definitions	Sources
Economic Financial Depth	M2	Money supply (% of GDP)	World Bank (FDSD)
Financial System Depth	Fdgdp	Liquid liabilities (% of GDP)	World Bank (FDSD)
Banking System Depth	Bdgdp	Banking deposits (% of GDP)	World Bank (FDSD)
Banking System Efficiency	BcBd	Bank credit on Bank deposits	World Bank(FDSD)
Financial System Efficiency	FcFd	Financial credit on Financial deposits	World Bank (FDSD)
Banking System Activity	Prcb	Private domestic credit from deposit banks (% of GDP)	World Bank (FDSD)
Financial System Activity	Prcbof	Private domestic credit from deposit banks and other financial institutions (% of GDP)	World Bank (FDSD)

Financial Size	Dbacba	Deposit bank assets on Central bank assets plus Deposit bank assets	World Bank (FDSD)
Absolute Informal FD	Informal 1	M2-Fd (% of GDP)	World Bank (FDSD)
Relative Informal FD	Informal 2	M2-Fd (% of M2)	World Bank (FDSD)
Informal and Semi-formal FD	Informal & Semi-formal	M2-Bd (% of M2)	World Bank (FDSD)

WDI: World Bank Development Indicators. FDSD: Financial Development and Structure Database. FD: Financial Development. Fd: Financial system deposits. Bd: Banking system deposits. M2: Money supply. GDP: Gross Domestic Product.

The adopted methodology consists of regressing adopted financial development variables on mobile phone penetration, conditional on a plethora of control variables to mitigate potential issues of variable omission bias. The Ordinary Least Squares (OLS) approach is based on Heteroscedasticity-consistent standard errors and RAMSEY's Regression Equation Specification Error Test (RESET) is employed to assess the validity of specifications.

3. Empirical results

For brevity and lack of space we summarise the main findings by presenting only: (i) estimates corresponding to the independent variable of interest and (ii) the information criteria used to assess the validity of specifications. While Table 2 employs traditional financial development indicators, Table 3 uses financial sector indicators which are based on a rethinking of the mainstream financial system definition. We notice from Table 2 that mobile phone is negatively correlated with financial development dynamics of depth, activity and size. On the contrary, when the IFS (2008) definition is relaxed in Table 3, mobile phone penetration is negatively (positively) linked to the formal (informal) financial sector. Failure to reject the null hypothesis of RAMSEY's RESET implies that the specifications are valid because non-linear combinations of the independent variables do not explain financial development.

Table 2: Linkage between mobile phone penetration and traditional financial indicators

	Dependent variables: Traditional financial intermediary dynamics						
	Financial Depth		**Financial Efficiency**		**Financial Activity**		**Fin. Size**
	Economic Financial Depth	Financial System Depth	Banking System Efficiency	Financial System Efficiency	Banking System Activity	Financial System Activity	Financial System Size
Constant	**1.216****	**1.268*****	**1.254*****	2.236	**1.009*****	**1.507****	**1.517*****
	(0.015)	**(0.002)**	**(0.002)**	(0.142)	**(0.004)**	**(0.022)**	**(0.000)**
Mobile Phone Penetration	**-0.512***	**-0.579****	-0.205	-0.711	**-0.405****	**-0.675***	**-0.310****
	(0.068)	**(0.015)**	(0.368)	(0.384)	**(0.046)**	**(0.060)**	**(0.030)**
Adjusted R^2	0.383	0.504	0.359	0.189	0.388	0.353	0.521
RAMSEY RESET	**0.616**	**0.436**	**0.466**	**2.097**	**1.834**	**2.371**	**1.639**
	(0.551)	**(0.653)**	**(0.633)**	**(0.159)**	**(0.189)**	**(0.123)**	**(0.219)**
Fisher	**19.038*****	**19.419*****	**5.954*****	2.154	**5.016*****	**2.818****	**4.891*****
	(0.000)	**(0.000)**	**(0.000)**	(0.103)	**(0.003)**	**(0.039)**	**(0.002)**
Observations	52	52	52	52	52	52	52

*,**,***: significance levels of 10%, 5% and 1% respectively. Heteroscedasticity Consistent (HC) standard errors. P-values in brackets. Fin: Financial.

Table 3: Linkage between mobile phone penetration and financial sector importance

	Dependent variables: Measures of financial sector importance			
	Informal 1	Formal	Informal 2	Informal & Semiformal
Constant	-0.051	**1.266*****	-0.368	-0.364
	(0.743)	**(0.002)**	(0.203)	(0.209)
Mobile Phone Penetration	0.066	**-0.579****	**0.340****	**0.341****
	(0.437)	**(0.015)**	**(0.046)**	**(0.046)**
Adjusted R^2	0.108	0.505	0.520	0.510
RAMSEY RESET	**1.654**	**0.474**	**0.097**	**0.165**
	(0.220	**(0.630)**	**(0.907)**	**(0.165)**
Fisher	**4.690*****	**19.220*****	**5.826*****	**6.309*****
	(0.004)	**(0.000)**	**(0.001)**	**(0.000)**
Observations	52	52	52	52

*,**,***: significance levels of 10%, 5% and 1% respectively. Heteroscedasticity Consistent (HC) standard errors. P-values in brackets. Informal 1: Absolute informal financial development. Informal 2: Relative informal financial development. Informal & Semiformal: Relative informal and semi-formal financial development.

4. Conclusion

Hitherto, the appropriate role of policy has been either to boost the formal financial sector or mitigate the informal financial sector in developing economies. Such measures have been motivated, inter alia, by requirements for monetary policy effectiveness. Policy makers who have been viewing their financial development challenges from mobile phone penetration exclusively from both perspectives should be getting their assessments badly wrong. There is a growing body of literature sustaining that liberalization policies have for the

most part benefited the informal financial sector to the detriment of the formal financial sector (Asongu, 2015d). This tendency has been amply reflected in the findings contained in this article.

We have also observed that financial development benefits from mobile phones cannot be appreciated with traditional financial intermediary indicators, essentially because we have employed all dimensions identified by the Financial Development and Structure Database (FDSD) of the World Bank. It follows that a rethinking of this traditional indicators is required for a holistic appraisal of burgeoning information and communication technologies. Some initial steps in this direction include: (i) incorporating the informal financial sector into the financial system definition in developing countries and (ii) overtly acknowledging that the IMF's IFS (2008) financial system definition is not relevant to developing countries because a great chunk of the monetary base circulates outside formal financial establishments. The advent of mobile banking has consolidated above arguments.

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