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4 May 2012

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MPRA Paper No. 38576, posted 05 May 2012 14:36 UTC

How has Mobile Banking Stimulated Financial Development in Africa?

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How has Mobile Banking Stimulated Financial Development in Africa?

Abstract

In the first empirical assessment of the incidence of mobile banking on financial intermediary development in Africa, we use two definitions of the financial system: the traditional IFS (2008) and Asongu (2011) measures of financial sector importance. When the conception of a financial system is based only on banks and other financial institution (IFS, 2008), mobile banking has a negative incidence on traditional financial intermediary dynamics of depth, activity and size. However, when a previously missing informal-financial sector component is integrated into the definition (Asongu, 2011), mobile-banking has a positive incidence on informal financial intermediary development. Three major implications result from the findings. (1) There is a growing role of informal finance in developing countries. (2) The incidence of the burgeoning phenomenon of mobile-banking cannot be effectively assessed at a macroeconomic level by traditional financial development indicators. (3) It is a wake-up call for scholarly research on informal financial intermediary development indicators which will oriented monetary policy; since a great chunk of the monetary base(M0) in less developed countries is now captured by mobile-banking.

JEL Classification: E00; G20; L96; O17; O33

Keywords: Banking; Mobile Phones; Shadow Economy; Financial Development; Africa

1. Introduction

The mobile revolution has transformed the lives of many Africans, providing not just communications but also basic financial access in the form of phone-based money transfer and storage (Jonathan & Camilo, 2008; Demombynes & Thegeya, 2012). The high growth and penetration rates of mobile telephony that is transforming cell phones into pocket-banks in Africa is providing opportunities for countries on the continent to increase affordable and cost effective means of bringing on board a large chunk of the population that hitherto has been excluded from formal financial services for decades. Such a transformation is of interest 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.

At the Connect Africa summit in 2007, Paul Kagame, president of Rwanda asserted: *“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 reported: *“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”*. This paper seeks to assess if these sentiments and slogans reflect the reality of the consequences of mobile phone on financial development in Africa?

Beyond, the need to investigate these perceptions, there is a growing body of work pointing to the imperative of more scholarly research on a phenomenon whose time is now: mobile banking. To the best of our knowledge, one of the most exhaustive accounts on the ‘mobile phone’ development 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). Also, as sustained by Maurer (2008) and confirmed 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. From a broad perspective, most studies on mobile-banking have been theoretical and qualitative in nature (Maurer, 2008; Jonathan & Camilo, 2008; Merritt, 2010; Thacker & Wright, 2012). The few existing empirical works hinge on country-specific and micro-level data(collected from surveys) for the most part(Demombynes & Thegeya ,2012).

This paper aims to assess what incidence mobile banking has had on financial development. By distinguishing its effect on formal and informal financial intermediary sectors, findings could have substantial policy relevance; especially on which financial sectors are benefiting most owing to the soaring phenomenon of mobile banking. The seminal character of this work also adds to the literature by proposing some hitherto unexplored dimensions of financial development which could provide the much needed guidance to policy makers on the financial development empirics of mobile banking. Our contribution to the literature is therefore threefold. Firstly, we complement existing theoretical literature on the mobile-finance nexus by providing the first macroeconomic empirical assessment of the incidence of the phenomenon on financial development¹. Secondly, owing to the debate over which financial sectors are benefiting most from mobile banking, we assess its impact by disentangling financial depth to include a previously missing component. Hence we are able to capture both formal and informal financial intermediary development effects. Thirdly,

¹ “*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).

based on the findings, we provide relevant measures that could guide future search and macroeconomic policy.

The rest of the paper is organized as follows. Section 2 reviews existing literature. Data and methodology are presented and outlined respectively in Section 3. Empirical analysis is covered in Section 4. Section 5 concludes.

2. Existing literature

2.1 Theoretical framework

2.1.1 Mobile penetration and finance

According to Jonathan & Camilo(2009), most mobile transactions² in the developing world enable users to do three things. (a) Store value (currency) in an account accessible via a handset. When the user already has a bank account, this is generally a question of linking to a bank account. 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) Convert cash into and out of the store value account. When the account is linked to a bank account, then users can visit banks to cash-in and cash-out. In many instances, 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 purchases airtime) and transact with an independent retailer working as an agent for the transaction system. (c) Transfer stored value between accounts. Users can generally transfer funds between accounts linked to two mobile phones, by using a set of SMS messages (or menu commands) and PIN codes. The new

² In order to have a mobile money account and make a deposit, a customer must own a cell phone SIM card with the mobile operator and register for a mobile money account. The customer then 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 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 pay bills and to buy phone airtime. Withdrawals (conversion to cash) 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 registered with the same network. In this case, when notice of the transfer is received through an SMS text message, the recipient can receive the cash at a mobile money agent (Demombynes, & Thegeya, 2012).

services offer a way to move money from place to place and present an alternative to the payments system offered by banks, pawn shops, remittance firms...etc. The uptake of m-banking(payments) systems has been particularly strong in the Philippines(where three million customers use systems offered by mobile operators Smart & Globe; Neville,2006); Kenya(where nearly two million users registered with Safaricom M-PESA system within a year of its nationwide rollout, Vaughan,2007; Ivatury & Mas,2008) and South Africa where 450, 000 people use Wizzit('the bank in your pocket'; Ivatury & Pickens, 2006) or one of two other national systems(Porteous,2007).

Demombynes, & Thegeya(2012) have approached the mobile-finance nexus through the concept of savings. They distinguish two types of mobile savings. (a) Basic mobile savings; which is simply the use of a standard mobile money system such as M-PESA to store funds. These basic mobile savings do not earn interest. Bank-integrated mobile savings perspectives have received a great deal of attention as a way to provide banking services to the poor. They have the edge of offering access to basic banking services without requiring proximity to a physical bank branch. Hence, with a bank-integrated mobile savings account, basic banking services can be accessed through a network of mobile phone agents, which in Kenya outnumber the weight of bank branches by a factor of 100 to 1(Mas & Radcliffe, 2011). The term '*partially integrated*' mobile savings system is also used to describe situations where bank account access via mobile phones is contingent on the establishment of a traditional account at a physical bank.

More so banks are beginning to build their own agent networks in order to assume a more competitive bargaining position in accessing mobile service platforms. Fully and partially integrated savings present different types of contracts among the partnering bank and mobile service provider. According to Demombynes & 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 compensates the mobile service provider for access to the network and enjoys the remaining profits. This type of contract more closely looks like 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 surplus is contingent on the relative bargaining power of the bank and mobile service provider. This sort of contract more closely resembles an equity contract between two parties. Equity-like contracts are more likely to be complex and therefore more difficult to negotiate than debt-like contracts, there-by presenting a potential hurdle towards the goal of increasing access.

Ondiege(2010), Chief Economist of the African Development Bank looks at the mobile-finance nexus from four perspectives. Firstly, the mobile phone can serve as a virtual bank card where customer and institution information can be securely stored, thereby avoiding the cost of distributing cards to customers. In fact he postulates, the subscriber identity module (SIM) card inside most (if not all) GSM phones is in itself a smartcard (similar to the virtual bank card). Therefore, the banks customer's PIN and account number can be stored on this SIM card to perform the same functions as the bank virtual card. Secondly, the mobile phone may serve as a point of sale (POS) terminal. As such a mobile phone could be used to transact and communicate with the appropriate financial institution to solicit transaction authorization. These are the same functions of a POS terminal at mails, retail or other stores. A mobile phone can duplicate these functionalities with ease. Thirdly, the mobile phone can also be used as an 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 will also serve as a cash collection and distribution point which basically is the function of an automatic teller machine(ATM).

Fourthly, the mobile phone may be used as an Internet banking terminal. Implying it offers two fundamental customer services: a) ability to make payments and transfers remotely and; b) instant access to any account. Hence the mobile phone device and wireless connectivity bring the internet terminal into the hands of otherwise unbanked customers.

2.1.2 Instrumental variables

In this section, we provide theoretical bases to justify the choice of instrumental variables for the empirical phase of the paper. Thus, we provide theoretical justification to the empirical validity of legal-origins, income-levels, religious-dominations and press-freedom qualities in the finance-growth nexus.

In the first strand, we highlight the basis for legal-origin moment conditions. This could be explained from two stances: the ‘law & finance theory’ and the ‘political and adaptability’ channels. The first stance of the law and finance theory emphasizes that legal institutions influence corporate finance and financial development (La Porta et al., 1998). The law and finance theory stresses that cross-country disparities in (i) contract, company, bankruptcy and security laws, (ii) the legal system’s emphasis on private property rights, and (iii) the efficiency of enforcement, influence the degree of expropriation and hence the confidence with which people purchase securities and take part in financial markets. In the second stance we find theories by Beck et al. (2003) which assess ‘why’ legal origin matter in financial development. They examine two channels by which legal origins may influence financial development: the political³ and adaptability⁴ channels.

³The political mechanism is premised on two standpoints. Firstly, legal traditions differ in the emphasis they attribute to protecting the rights of private investors relative to those of the state. Secondly, private property rights protection forms the foundation for financial development.

⁴ The second mechanism linking legal-origin to financial development is the adaptability channel that is also built on two foundations. Firstly, legal systems differ in their ability to adjust to changing and evolving circumstances. Secondly, when a country’s legal system adapts only slowly to changing circumstances (especially economic), large gaps will open between the financial needs of an economy and the ability of the legal system to support and fulfill those needs.

In the second strand, we provide theoretical justification to the choice of income-level instrumental variables. It has been well documented that wealth-effects, play a substantial role in the finance-growth nexus (Beck et al., 1999; Asongu, 2011a). From theoretical and empirical literature standpoints, considerable differences in wealth existing across countries have substantial effects on cross-country disparities in financial structure and development (Asongu, 2012). Theoretical justification for wealth-effects is grounded on three perspectives. Firstly, financial intermediary development engenders: central banks assets to total assets, deposit money bank assets to total assets, other financial institutions' assets to total assets and deposit money versus central bank assets (Beck et al.1999, p.13). According to this position, central banks loose relative importance as one move from low to high-income countries, whereas other financial institutions gain relative importance in the process. Conversely, deposit money banks gain importance versus central banks with a higher income level. Financial depth also increases with income levels. Secondly, private credit and life insurance companies, the life insurance penetration and the life insurance density increase with GDP per capita. Interestingly, for the first two indicators, the lower-middle income group exhibits the lowest medians (Beck et al., 1999, p.21)⁵. Thirdly, there is a significant variation in size, activity and efficiency of stock markets across income groups. Countries with higher levels of GDP per capita have bigger, more active and more efficient financial markets (Beck et al., 1999, 25)⁶.

In the third strand we lay the theoretical foundation for the empirical validity of the religious instruments. According to Hearn et al.(2011), Islam represents a system of beliefs founded on the interpretation of passages from the Qu'ran and various Had'ith & Sunnah that

⁵ It is also interesting to note that high-income countries demonstrate a life insurance penetration ten times as high as lower-middle income countries and a life insurance density nearly one hundred times higher than low-income countries.

⁶ Let us also note here that, wealthy countries also have larger bond markets and issue more equity and private bonds. Stock markets have soared in size, activity and efficiency over the last three decades owing to significant changes in higher GDP per capita countries.

are short texts regarding customs of the Muslim community and relating experiences of the prophet Mohammed (Pryor, 2007). These form the basis of Shari'ya law, that permeates all areas of the wider Islamic system, including economics, finance, law, politics and government and that have common values of Islamic social justice (Asutey, 2007). The Islamic financial system is founded and regulated on the same Shari'ya principles as the overall economy and society (Iqbal, 1997). These govern the nature of contracts and the design of institutions to guide the market and regulation of participants' behavior. Hence, individuals within an Islamic financial system will be subject to behavioral norms, which give rise to very heterogeneous assumptions to those that form the foundation of regulation in western markets.

In the last strand, we highlight a case for the choice of press-freedom instrumental variables. From a theoretical standpoint, press-freedom and the Efficiency Market Hypothesis (EMH) of finance move hand-in-hand. Empirically, freedom of the press is one of the major efficient market channels and only with unrestricted press-freedom can information be rapidly spread and fully incorporated into asset prices (Guo-Ping, 2008).

2.2 Mobile penetration in Africa

Borrowing from Mbiti & Weil (2011), the story of the growth of mobile phones in Africa is one of a tectonic and unexpected change in communications technology. From virtually unconnected in the 1990s, over 60% of Africa now has mobile phone coverage and there are now over ten times as many mobiles as landline phones in use (Aker & Mbiti, 2010). In line with Aker & Mbiti (2010), mobile phone coverage in Africa has grown at staggering rates over the past decade. In 1999, only 11% of the African population had mobile phone coverage, primarily in Northern (Algeria, Egypt, Libya, Morocco and Tunisia) and Southern Africa (Kenya and South Africa). By 2008, 60% of the population (477 million) could get a signal and an area of 11.2 million square kilometers had mobile phone coverage: equivalent to the United States and Argentina combined. By the turn of 2012, it is projected that most

villages in Africa will have coverage with only a handful of countries relatively unconnected. Borrowing from Demombynes, & Thegeya, (2012), Kenya has undergone a remarkable information and communication technology (ICT) revolution. At the turn of the 1990s, less than 3% of Kenyan households owned a telephone and less than 1 in 1000 Kenyan adults had mobile phone service. However, by the end of 2011, 93 percent of Kenyan households owned a mobile phone. This soar is largely credited to the M-PESA mobile-banking network.

Banks are recognizing the potential of reaching millions of prospective customers, especially the rural population who account for more than 60% of Africa's total population and have no access to banking services (Ondiege, 2010). The rural commercial bank branch network is yet underdeveloped. However since above 50% of the adult population in Africa has access to GSMs, mobile banking could enable the rural population to have access to financial services as demonstrated by the cases of Kenya and South Africa. The cost of formal banking in Africa is quite high: in some countries, the minimum deposit can be as high as 50% of per capita GDP. More so, internet and broadband subscription are still low, making internet banking out of reach for most of the population. In this regard, mobile banking can be used to provide financial services to the unbanked. Financial institutions and 'mobile phone' service providers are introducing resourceful methods of bringing these 'unserved' populations into the formal economy using mobile phones. As concerns banks, the main advantages of the mobile phone lie in its capacities to reach everywhere. Its power is in transforming the economics of service delivery, especially by mitigating costs of financial transactions. Mobile banking is a powerful means of delivering savings services to the billions of people worldwide who have a cell phone but not a bank account. It has a number of advantages over traditional banking methods as it breaks down geographical constraints; it also offers other advantages such as immediacy, efficiency and security.

2.3 Scope and positioning of the paper

The proliferation of mobile money in Africa has generated research attempting to explain the roots of the phenomenon as well as understanding its effects. Existing literature has focused on the rapid growth of mobile money (Kimenyi & Ndung'u, 2009)⁷, arguing that the initial success of the mobile money transfer industry can be attributed to the high demand for remittances generated by rural/urban migration (Comninou et al., 2008) and its rapid scaling is due to mobile providers' growth strategy (Jack & Suri, 2011). Other papers have examined the economic impact of mobile banking (Jonathan & Camilo, 2008; Aker & Mbiti, 2010; Mbiti & Weil, 2011). For the most part these studies in Africa have been country-specific (Mbiti & Weil, 2011; Demombynes & Thegeya, 2012), based on micro-data (Mbiti & Weil, 2011; Demombynes, & Thegeya, 2012) and greased with theoretical postulations (Porteous, 2006; Jonathan & Camilo, 2008; Ondiege, 2010; Demombynes & Thegeya, 2012) without empirical backing. No wonder, Maurer (2008) earlier lamented the scarcity of empirical research focusing on the adoption and socioeconomic impacts of m-banking (payments).

At the Connect Africa summit in 2007, Paul Kagame, President of Rwanda asserted: *"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 reported: *"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"*. This paper seeks to assess if these sentiments and slogans reflect the reality of the consequences of mobile phone on financial development in Africa?

Beyond, the need to investigate these perceptions, there is a growing body of work pointing to the imperative of more scholarly research on a phenomenon whose time is now: mobile penetration. To the best of our knowledge, one of the most exhaustive accounts on the

⁷ They attribute the rapid growth in mobile money in Kenya to four factors: a conducive legal and tax environment, private-public policy dialogue, strategic and prudent macroeconomic policies, and a guarantee for the existence of a contestable market discouraging dominance by initial entrants.

‘mobile phone’ development 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). Also, as postulated by Maurer (2008) and confirmed 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. From a broad perspective, most studies on mobile-banking have been theoretical and qualitative in nature (Maurer, 2008; Jonathan & Camilo, 2008; Merritt, 2010; Thacker & Wright, 2012). The few existing empirical studies hinge on country-specific and micro-level data(collected from surveys) for the most part(Demombynes & Thegeya ,2012).

In this paper we assess what incidence mobile banking has had on financial development. By distinguishing its effect on formal and informal financial intermediary sectors, findings could be of substantial policy relevance; especially on mastering which financial sectors are benefiting most owing to the soaring phenomenon of mobile banking. Previous research on the mobile-finance nexus has been country-specific and limited to micro-economic data (Demombynes, & Thegeya, 2012). Hence the seminal character of this work also adds to the literature by proposing some hitherto unexplored dimensions of financial development. Hence it provides new indicators as well as the much needed guidance to policy makers on the financial empirics of ‘mobile banking’. In summary, our contribution to the literature is threefold. Firstly, we complement existing theoretical literature on mobile banking by providing the first macroeconomic empirical assessment of the incidence of the phenomenon on financial development. Secondly, owing to the debate over which financial

sectors are benefiting most from mobile banking, we assess its impact by disentangling financial depth to integrate a previously missing component. Hence we are able to capture both formal and informal financial intermediary development effects. Thirdly, based on the findings, we provide relevant measures that could guide future search and macroeconomic policy.

3. Data and methodology

3.1 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). Freedom indicators originate from Freedom House while the mobile penetration measure is obtained from the African Development Bank (AfDB). In line with existing literature we proxy for ‘mobile banking/activities’ with the ‘mobile penetration’ rate (Ondiege, 2010; Aker & Mbiti, 2010). Owing to constraints in the time series properties of the mobile penetration measurement, data structure is cross-sectional and consists of 2003-2009 average growth rates. While 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 (2011a). Instrumental variables include legal-origins, religious-dominations, income-levels and press-freedom qualities as justified theoretically in Section 2.1.2. These instruments have been largely documented in development literature (Beck et al., 2003; Stulz & Williamson, 2003) as well as recent African growth (Agbor, 2011) and finance literature (Asongu, 2011bcde). Summary statistics with presentation of countries (Appendix 1), correlation analysis (Appendix 2) and definition of variables (Appendix 3) are detailed in the appendices.

In a bid for clarity in presentation, we classify selected variables into two main strands below.

3.1.1 Financial intermediary development

a) Financial depth

Borrowing from the FDSO and recent African finance literature (Asongu, 2011bcd), this paper measures financial depth from two standpoints: overall-economic and financial system perspectives with indicators of broad money supply ($M2/GDP$) and financial system deposits ($Fdgd$) respectively. While the former denotes the monetary base plus demand, saving and time deposits, the later indicates liquid liabilities. Since we are dealing exclusively with developing countries, we distinguish liquid liabilities from money supply because a substantial chunk of the monetary base does not transit through the banking sector (Asongu, 2011bc). The two indicators are in ratios of GDP (see Appendix 3) and both can robustly cross-check each other as either account for over 97% of information in the other (see Appendix 2).

b) Financial efficiency

By financial intermediation efficiency here, this study neither refers to a profitability-oriented concept nor to the production efficiency of decision making units in the financial sector (through Data Envelopment Analysis: DEA). What we seek to highlight is the ability of banks to effectively fulfill their fundamental role of transforming mobilized deposits into credit for economic operators (agents). We adopt proxies for banking-system-efficiency and financial-system-efficiency (respectively ‘bank credit on bank deposits: $Bcbd$ ’ and ‘financial system credit on financial system deposits: $Fcfd$ ’). Like with financial depth, these two financial allocation efficiency proxies can cross-check each other as they represent more than 83% of variability in one another (see Appendix 2).

c) *Financial size*

With respect to the FDSI we measure financial intermediary size as the ratio of “deposit bank assets” to “total assets” (deposit bank assets on central bank assets plus deposit bank assets: *Dbacba*).

d) *Financial activity*

By financial intermediary activity here, the work highlights the ability of banks to grant credit to economic operators. We proxy for both banking system intermediary activity and financial system intermediary activity with “private domestic credit by deposit banks: *Pcrb*” and “private credit by domestic banks and other financial institutions: *Pcrbof*” respectively. The later measure cross-checks the former as it represents more than 92% of information in the former (see Appendix 2).

e) *Formal, informal and semi-formal financial developments*

In line with Asongu(2011a): formal financial development is the ratio of bank deposits(liabilities)⁸ on GDP(or M2) in absolute (or relative) terms; *absolute* informal financial development(*Informal 1*) is measured as the difference between money supply(M2) and financial system deposits⁹ in percentage of GDP; *relative* informal financial development(*Informal 2*)¹⁰ is measured as the difference between money supply and financial system deposits in percentage of M2; informal and semi-formal financial development¹¹ is the difference between M2 and bank deposits as a percentage of M2.

⁸ Bank deposits here refer to demand, time and saving deposits in deposit money banks. See Lines 24 and 25 of International Financial Statistics (IFS); October 2008 for the definition of *formal* financial intermediary development.

⁹ Financial deposits are demand, time and saving deposits in deposit money banks and other financial institutions. See Lines 24, 25 and 45 of IFS, October, 2008.

¹⁰ This is a measure of sector importance in financial development. That is, from *formal* and *semi-formal* to ‘*informal*’ financial development: (Informalization). This proposition appreciates the deterioration of the *formal* and *semi-formal* banking sectors to the benefit of the *informal* sector. See Asongu (2011a).

¹¹ This is also a measure of sector importance in financial development. That is, from *formal* to ‘*semi-formal and informal*’ financial development: (Semi-informalisation and informalization). This proposition appreciates the deterioration of the *formal* banking sector to the benefit of other sectors (informal and semi-formal). See Asongu (2011a).

3.1.2 Other variables

Control exogenous variables include economic considerations of inflation and economic prosperity (GDP growth). Only two control variables are used owing to constraints in the Overidentifying restrictions (OIR) Sargan-test for instrument validity in the Instrumental Variable (IV) estimation approach¹².

3.2 Methodology

3.2.1 Endogeneity

Aker & Mbiti(2010;225) state: “*But while these studies provide some evidence of the positive relationship between mobile phones and economic growth, they are plagued by endogeneity problems. Mobile penetration rates are subject to significant measurement errors, leading to potential bias in the coefficient estimates*”. Also, while mobile phones have a bearing on financial development the reverse effect cannot be ruled-out, as some banking-service applications in the financial industry may require the use of mobile phones. We are thus confronted here with an issue of endogeneity owing to reverse-causality and omitted variables, since mobile banking is correlated with the error term in the equation of interest. To address this issue we employ an estimation technique that takes account of the endogeneity issue.

3.2.2 Estimation technique

Given the concern for endogeneity, we borrow from Beck et al.(2003) and recent African finance literature(Asongu, 2011de) by adopting a Two-Stage-Least-Squares(TSLS) estimation approach. Instrumental Variable (IV) estimation addresses the puzzle of endogeneity and hence avoids the inconsistency of estimated coefficients by Ordinary Least

¹² An OIR restrictions test to examine instrument validity is only possible in the presence of over-identification. That is, the instruments must be greater than the endogenous explaining variables by at least one degree of freedom. In cases of exact-identification (instruments=endogenous explaining variables) and under-identification (instruments <endogenous explaining variables), this OIR-Sargan test is not applicable.

Squares (OLS) when the exogenous variables are correlated with the error term in the main equation. The TSLS-IV estimation method adopted by this study will entail the following steps.

First-stage regression:

$$\begin{aligned} MobileChannel_{it} = & \gamma_0 + \gamma_1(legalorigin)_{it} + \gamma_2(religion)_{it} + \gamma_3(incomelevel)_{it} \\ & + \gamma_4(pressfreedom)_{it} + \alpha_i X_{it} + v \end{aligned} \quad (1)$$

Second-stage regression:

$$Finance_{it} = \gamma_0 + \gamma_1(Mobile)_{it} + \beta_i X_{it} + \mu \quad (2)$$

The independent control variables are represented by X in the two equations. In Eq.(1) and Eq.(2), v and u respectively denote the disturbance terms. Legal-origins, dominant-religions, income-levels and press-freedom qualities represent the instruments. ‘Mobile penetration’ and ‘financial development dynamics’ are the endogenous variables in the first and second equations respectively.

In the specification of the models, we lay emphasis on the following: (1) verify the instruments are exogenous to the endogenous components of explaining variables, conditional on other covariates (control variables); (2) ensure the instruments are valid and not correlated with the error-term in the main equation with an Over-identifying Restrictions (OIR) test.

3.2.3 Robustness checks

For robustness purposes, the empirical analysis: (1) uses alternative measures of financial development; (2) employs two distinct interchangeable sets of instruments; (3) accounts for endogeneity; (4) models with Heteroscedasticity and Autocorrelation Consistent (HAC) standard errors.

4. Empirical analysis

4.1 Presentation of results

This empirical section addresses two main issues: (1) the ability of the exogenous components of mobile banking to explain financial intermediary development dynamics and; (2) the ability of the instruments to account for financial intermediary development dynamics beyond the mobile banking channel. To make these assessments, we employ the TSLS-IV estimation approach with legal-origins, income-levels, religious-dominations and press-freedom qualities as instrumental variables. While the first issue is addressed by the significance of estimated coefficients, the second is contingent on results of the Sargan-OIR test. The null hypothesis of the Sargan test is the position that, the instruments do not explain financial development dynamics beyond the mobile banking channel. Hence a rejection of the null hypothesis is a rejection of the stance that the instruments explain financial development dynamics only through the mobile banking channel. In other words, this rejection questions the validity of the instruments and substance of the mobile banking channel in accounting for cross-country variations in financial intermediary dynamics. While Table 1 entails regressions of traditional financial intermediary dynamics of depth, activity, efficiency and size on the mobile banking channel, Table 2 reflects the mobile-finance nexus with measures of financial sector importance. The imperative here is to examine how the phenomenon of mobile banking is playing-out in the development of formal, semi-formal and informal financial intermediary sectors. For both tables, regressions are; (1) performed with and without HAC standard errors and; (2) duplicated with the robust set of instruments (and the same results are found).

Table 1 below assesses the impact of mobile banking on traditional financial intermediary dynamics. While Panel A, is not robust to HAC standard errors, Panel B is. The first issue which is addressed by the significance of estimated coefficients is valid for financial intermediary dynamics of depth, activity and size. The negative mobile banking

elasticities of finance point to the deterioration of the traditional financial intermediary dynamics owing to the phenomenon of mobile penetration. This negative incidence is more pronounced in financial system activity than in banking system activity and also more witnessed in financial system deposits than in economic financial depth. Two facts explain these disparities in weight of elasticities. (1) Mobile-banking has a greater negative incidence on 'financial system activity' than 'banking system activity' because the former entails the semi-formal banking activity which should also be negatively affected by the phenomenon. The interpretation is valid on the condition that, the phenomenon also negatively affects semi-formal financial intermediation activity (the difference between financial system activity and banking system activity). This is only logical because semi-formal finance according to the IFS (2008) definition of the financial system entails specialized non-bank and other financial institutions like rural banks, post banks, credit unions...etc. From intuition and common-sense, mobile banking should therefore negatively impinge on semi-formal banking activities because of their quasi-formal settings. In plainer terms, credit (financial activity) allocated by the semi-formal financial sector also reduces owing to mobile banking. (2) Financial system depth is more negatively affected by mobile banking than economic financial depth. This is only logical from common-sense and theoretical postulations elucidated at the first phase of this paper. Economic financial depth is overall money supply (M2) and is made-up of the financial system's depth (formal and semi-formal depths) as well as the informal financial sector depth (which is a great chunk of the monetary base: M0, in developing countries) that does not transit through the banks and other financial institutions recognized by the financial system(IFS,2008). Hence it is only logical that, mobile-penetration has a less negative incidence on overall economic financial depth. Another supposition resulting from this interpretation is the fact that, the less negative incidence on overall economic financial depth

attests to a hypothetical positive incidence of mobile banking on the informal financial sector (which is still not a component of the financial system according to the IFS, 2008 definition).

The second issue is addressed by the Sargan OIR test, overwhelming failure to reject the null hypothesis of this test points to the validity of the instruments and suggests that they (instruments) do not explain the financial intermediary dynamics beyond the mobile banking channel. With respect to both issues, results of Panel A are robust to those of Panel B.

Note should be taken of the fact that, Table 1 is based on the IFS(2008) definition of the financial system which is comprised of only the formal banking system and other financial institutions(semi-formal banking sector). Regressions in Table 2 however, relax the IFS (2008) assumption and integrate a previously missing component of the financial system (informal sector) into the conception and definition of the financial system; in line with Asongu, (2011a). This redefinition of the financial system is premised on two counts: (1) theoretically, the growing phenomenon of mobile-banking is escaping the grasp of the formal and semi-formal financial sectors; (2) empirically our findings in Table 1 fail to demonstrate a positive mobile-finance nexus, which logically implies, the phenomenon may be positively captured by a missing component in the IFS (2008) conception and definition of the financial system.

Table 1: Impact of mobile banking on traditional financial intermediary dynamics

Panel A: Regressions without HAC Standard Errors							
	Financial Depth		Financial Efficiency		Financial Activity		Fin. Size
	Economic fin. depth	Financial Sys depth	Banking Sys Efficiency	Financial Sys Efficiency	Banking Sys Activity	Financial Sys Activity	Financial Sys Size
Constant	1.142*** (1.142)	1.458*** (0.000)	1.593 (0.201)	2.635*** (0.007)	1.343*** (0.000)	2.018*** (0.000)	2.041*** (0.003)
Mobile Banking	-0.502** (0.023)	-0.729*** (0.000)	-0.291 (0.569)	-1.218 (0.161)	-0.656*** (0.000)	-1.029*** (0.000)	-0.738*** (0.009)
Inflation	-0.001 (0.890)	-0.0003 (0.972)	-0.0003 (0.360)	-0.048 (0.228)	-0.009 (0.305)	-0.012 (0.398)	-0.0001 (0.408)
GDP Growth	---	---	-0.066 (0.741)	0.103 (0.594)	---	---	0.0004 (0.996)
Sargan -OIR	5.499 (0.239)	5.899 (0.206)	2.400 (0.493)	3.262 (0.352)	7.052 (0.133)	5.545 (0.235)	2.090 (0.553)
Adjusted R ²	0.068	0.212	-0.022	-0.028	0.251	0.212	0.089
Fisher	2.577*	6.105***	0.624	1.541	6.582***	6.139***	3.119**
Observations	51	51	51	51	51	51	51
Instruments	Constant, Lower Middle Income, Middle Income, English, Christian, Free, Partially Free.						
Robust instruments	Constant, Upper Middle Income, Low Income, French, Islam, Not Free.						

Panel A: Regressions with HAC Standard Errors							
	Financial Depth		Financial Efficiency		Financial Activity		Fin. Size
	Economic fin. depth	Financial Sys depth	Banking Sys Efficiency	Financial Sys Efficiency	Banking Sys Activity	Financial Sys Activity	Financial Sys Size
Constant	1.142** (0.027)	1.458*** (0.000)	1.593 (0.153)	2.635 (0.100)	1.343*** (0.001)	2.018** (0.024)	2.041*** (0.000)
Mobile Banking	-0.502* (0.077)	-0.729*** (0.001)	-0.291 (0.583)	-1.218 (0.288)	-0.656*** (0.004)	-1.029** (0.036)	-0.738*** (0.000)
Inflation	-0.001 (0.874)	-0.0003 (0.966)	-0.0003 (0.180)	-0.048 (0.155)	-0.009 (0.181)	-0.012 (0.280)	-0.0001 (0.426)
GDP Growth	---	---	-0.066 (0.589)	0.103 (0.535)	---	---	0.0004 (0.995)
Sargan -OIR	5.499 (0.239)	5.899 (0.206)	2.400 (0.493)	3.262 (0.352)	7.052 (0.133)	5.545 (0.235)	2.090 (0.553)
Adjusted R ²	0.068	0.212	-0.022	-0.028	0.251	0.212	0.089
Fisher	1.677	5.583***	0.800	0.976	4.019**	2.194	5.586***
Observations	51	51	51	51	51	51	51
Instruments	Constant, Lower Middle Income, Middle Income, English, Christians, Free, Partially Free.						
Robust instruments	Constant, Upper Middle Income, Low Income, French, Islam, Not Free.						

*, **, ***: significance levels of 10%, 5% and 1% respectively. Fin: Financial. Sys: System. HAC: Heteroscedasticity and Autocorrelation Consistent. OIR: Overidentifying Restrictions. P-values in brackets

Table 2 below is based on the Asongu (2011a) definition of the financial system which integrates the previously missing informal financial sector component into the IFS (2008) definition. Instead of using traditional indicators of financial development based on dynamics of depth, efficiency, activity and size as captured by Table 1, we employ measures of sector importance. Hence we distinguish between the formal, semi-formal and informal sectors. We use two indicators of informal finance (absolute and relative measures) to distinguish between

the growth in absolute terms of the informal sector (*Informal 1*) conditional on GDP and relative growth of the informal sector (*Informal 2*) contingent on M2. Hence the later measures the relative importance of the informal sector with respect to the two other sectors, encapsulated in the IFS, (2008) definition. In other words, *Informal 2* appreciates how the informal financial sector evolves at the expense of the formal and semi-formal financial sectors. The last indicator (*Informal & Semiformal*) appreciates the extent to which informal and semi-informal finance progresses to the detriment of the formal banking sector. While the 2nd to the 5th columns of Table 2 are TSLS-IV regressions without HAC standard errors, the 6th to the 9th columns reflect their counterparts with HAC standard errors.

Like in the previous table, two main issues outlined in the introduction of this section are assessed. Looking at the first concern, the following could be noticed. (1) Mobile-banking has a positive incidence on informal financial development; both in absolute and relative terms. Its positive elasticity with respect to the absolute measure (*Informal 1*) is less pronounced than that in respect of the relative indicator (*Informal 2*). A logical deduction is that, the informal sector grows more owing to improvements of M2 than in GDP growth. Hence growth of the informal sector is more pronounced at the expense of the formal and semi-formal sectors (constituents of M2) than to the detriment of many other macroeconomic variables (constituents of GDP). Plainly put, the share of informal finance is more relevant in M2 growth than in GDP growth. (2) The mobile-banking elasticity of ‘informal and semi-formal financial development’ (0.854) is higher than that of ‘informal financial development’ (0.853). A logical interpretation that follows is that, financial deposits (depth) of the semi-formal financial institutions increase only by a thin margin owing to mobile banking. (3) The incidence of mobile banking on formal financial development has the right negative sign, albeit not significant. This broadly confirms the results in Table 1. However note should be taken of the fact that, the formal banking sector of Table 2 entails only bank deposits(depth),

while the financial depth of Table 1 is made-up of financial system deposits. This difference therefore partly elucidates the insignificance of the negative sign.

With regard to the second concern, failure to reject the null hypothesis of the Sargan-OIR test in all regressions point to the validity of the instruments. It follows that the instruments explain indicators of financial sector importance through no other mechanisms than the mobile banking channel. Ultimately the instruments are not correlated with the error term in the equation of interest and hence do not suffer from endogeneity. The regressions are duplicated with the second set of robust instruments and the same findings are noticed.

Table 2: Impact of mobile banking on financial sector importance measures

	Regressions without HAC Standard errors				Regressions with HAC Standard errors			
	Informal 1	Formal	Informal 2	Informal & Semiformal	Informal 1	Formal	Informal 2	Informal & Semiformal
Constant	-0.304*** (0.005)	1.667** (0.014)	-1.253*** (0.008)	-1.244*** (0.007)	-0.304 (0.123)	1.667*** (0.008)	-1.253*** (0.004)	-1.244*** (0.004)
Mobile Banking	0.233*** (0.000)	-0.617 (0.112)	0.853*** (0.001)	0.854*** (0.001)	0.233*** (0.009)	-0.617 (0.130)	0.853*** (0.002)	0.854*** (0.001)
Inflation	-0.0008 (0.765)	0.003 (0.861)	-0.011 (0.347)	-0.008 (0.470)	-0.0008 (0.674)	0.003 (0.838)	-0.011 (0.168)	-0.008 (0.283)
GDP Growth	-0.004 (0.792)	-0.079 (0.452)	0.028 (0.697)	0.023 (0.745)	-0.004 (0.794)	-0.079 (0.490)	0.028 (0.589)	0.023 (0.629)
Sargan -OIR	0.545 (0.908)	1.430 (0.698)	1.414 (0.702)	1.483 (0.686)	0.545 (0.908)	1.430 (0.698)	1.414 (0.702)	1.483 (0.686)
Adjusted R ²	0.310	0.021	0.174	0.182	0.310	0.021	0.174	0.182
Fisher	5.194***	1.559	4.608***	4.623***	3.030**	2.528*	12.666***	11.100***
Observations	51	51	51	51	51	51	51	51
Instruments	Constant, Lower Middle Income, Middle Income, English, Christians, Free, Partially Free.							
Robust Instruments	Constant, Upper Middle Income, Low Income, French, Islam, Not Free							

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

4.2 Further discussion of results, policy implications and future directions

Before we delve into further discussion of the results, it is imperative to outline the intuition motivating this paper. (1) Some voices have expressed sentiments on the instrumentality of mobile-phones in African development (The Economist, 2008; Aker & Mbiti, 2010, 208). This paper has assessed if these sentiments and slogans are material with respect to financial development. (2) “*The 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). (3)As postulated by Maurer (2008) and confirmed in subsequent literature (Jonathan & Camilo, 2008; Thacker & Wright, 2012), scholarly research on the adoption and socioeconomic impacts of m-banking systems in the developing world is scarce. From a broad perspective, most studies on mobile banking have been theoretical and qualitative in nature (Maurer, 2008; Jonathan & Camilo, 2008; Merritt, 2010; Thacker & Wright, 2012). The few existing empirical studies hinge on country-specific and micro-level data(collected from surveys) for the most part(Demombynes & Thegeya , 2012).

In this paper we have assessed what incidence mobile banking has had on financial development. By distinguishing its effect on formal and informal financial intermediary sectors, findings have been of substantial policy relevance as to which financial sectors are benefiting most owing to the soaring phenomenon of mobile banking. Previous research on the mobile-finance nexus has been country-specific and limited to micro-economic data (Demombynes, & Thegeya, 2012). Beyond the use of macroeconomic variables, the seminal character of this work has added to the literature by proposing some hitherto unexplored dimensions of financial development which could provided the much needed guidance to policy makers on the financial empirics of mobile banking. Our contribution to existing literature has been threefold. Firstly, we have complemented existing theoretical literature on the mobile-finance nexus by providing the first macroeconomic empirical assessment of the incidence of ‘mobile banking’ on financial development. Secondly, owing to the debate over which financial sectors are benefiting most from mobile banking, we have assessed its impact by disentangling financial depth to include a previously missing component. Hence we have

been able to capture both formal and informal financial intermediary development effects. Thirdly, based on the findings, we will provide relevant policy measures that could guide future search and macroeconomic policy.

In this first empirical assessment of the incidence of mobile banking on financial intermediary development in Africa, we have used two definitions of the financial system: the traditional IFS (2008) and Asongu (2011a) measures of financial sector importance. Two broad findings have been established. (1) When the financial system is based only on banks and other financial institution (IFS, 2008), mobile banking has a negative incidence on traditional financial intermediary dynamics of depth, activity and size. (2) However, when a previously missing informal-financial sector component is integrated into the definition (Asongu, 2011a), mobile banking has a positive incidence on informal financial intermediary development. Mobile banking is therefore a powerful means of delivering savings services to the millions of people in Africa who have a cell phone but not a bank account. It has a number of advantages over traditional banking methods as it breaks down geographical constraints; it also offers other advantages such as immediacy, efficiency and security. This could partly explain the reason the incidence of the phenomenon has been positive for the informal financial sector to the detriment of the formal banking system.

Three major implications result from the findings. (1) There is a growing role of informal finance in developing countries. (2) The incidence of a burgeoning phenomenon of mobile banking cannot be effectively assessed at a macroeconomic level by traditional financial development indicators. (3) It is a wake-up call for scholarly research on informal financial intermediary development indicators which will oriented monetary policy; since a great chunk of the monetary base(M0) in less developed countries is now captured by mobile banking(informal financial activities).

Beside rethinking monetary policy transmission mechanisms, other future research directions could include: (1) ascertaining whether and how mobile phones can lead to poverty reduction through growth and financial development; (2) an assessment of short, medium and long-term incidences of mobile phones on financial development is also worthy of note; (3) consequences of regulation on mobile banking; (4) last but not the least, monetary policy tools that could fight inflation resulting from mobile banking activities.

5. Conclusion

In the first empirical assessment of the incidence of mobile banking on financial intermediary development in Africa, we have used two definitions of the financial system: the traditional IFS (2008) and Asongu (2011a) measures of financial sector importance. When the financial system is based only on banks and other financial institution (IFS, 2008), mobile banking has a negative incidence on traditional financial intermediary dynamics of depth, activity and size. However, when a previously missing informal-financial sector component is integrated into the definition (Asongu, 2011a), mobile-banking has a positive incidence on informal financial intermediary development. Three major implications result from the findings. (1) There is a growing role of informal finance in developing countries. (2) The incidence of a burgeoning phenomenon of mobile banking cannot be effectively assessed at a macroeconomic level by traditional financial development indicators. (3) It is a wake-up call for scholarly research on informal financial intermediary development indicators which will oriented monetary policy; since a great chunk of the monetary base(M0) in less developed countries is now captured by mobile banking(informal financial activities).

Appendices

Appendix 1: Summary statistics and presentation of countries

		Panel A: Summary Statistics				
		Mean	S.D	Min.	Max.	Obsr.
Financial Depth	Economic System Depth(M2)	0.339	0.242	0.079	1.022	44
	Financial System Depth(Fdgdg)	0.273	0.226	0.042	0.895	44
Financial Efficiency	Banking System Efficiency(BcBd)	0.706	0.344	0.252	2.249	51
	Financial System Efficiency(FcFd)	0.712	0.382	0.259	2.458	35
Financial Activity	Banking System Activity(Pcrb)	0.185	0.175	0.027	0.715	44
	Financial System Activity(Pcrbof)	0.208	0.244	0.027	1.423	44
Financial Size	Financial System Size(Dbacba)	0.765	0.210	0.063	1.074	51
Formal F.D	Banking System Deposits(Bdgdg)	0.271	0.225	0.042	0.892	44
Informal F.D 1	Absolute Informal F.D	0.066	0.054	-0.145	0.217	44
Informal F.D 2	Relative Informal F.D	0.239	0.173	-0.336	0.727	44
Informal & Semi-formal	Relative Informal and Semi-formal F.D Development	0.246	0.173	-0.336	0.727	44
	Mobile Phone Penetration	1.674	0.217	1.043	2.242	52
	Inflation	117.95	764.60	1.953	5304.8	44
	GDP growth	4.760	3.087	-6.959	12.894	50
Instrumental Variables	English Common law	0.384	0.491	0.000	1.000	52
	French Civil law	0.615	0.491	0.000	1.000	52
	Christian	0.615	0.491	0.000	1.000	52
	Islam	0.384	0.491	0.000	1.000	52
	Upper Middle Income	0.192	0.397	0.000	1.000	52
	Lower Middle Income	0.230	0.425	0.000	1.000	52
	Low Income	0.576	0.498	0.000	1.000	52
	Middle Income	0.423	0.498	0.000	1.000	52
	Total Freedom	0.163	0.346	0.000	1.000	52
	Partial Freedom	0.362	0.432	0.000	1.000	52
	No Freedom	0.474	0.473	0.000	1.000	52

Panel B: Presentation of Countries

Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo Democratic Republic, Congo Republic, Ivory Coast, Djibouti, Egypt, Equatorial Guinea, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Mali, Malawi, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Togo, Tunisia, Uganda, Zambia, Zimbabwe, Tanzania, Comoros.

S.D: Standard Deviation. Min:Minimum. Max: Maximum. Obser.:Observations. F.D: Financial Development.

Appendix 2: Correlation analysis

Formal Financial Development(FD)							Informal & Semi-formal FD			Mobile Penetration	Inflation	GDP Growth		
Financial Depth			Financial Efficiency		Financial Activity		Fin. Size	Informal 1	Informal 2	Informal & Semi-formal				
M2gdp	Fdgdg	Bdgdg	BcBd	FcFd	Pcrb	Pcrbof	Dbacba							
1.000	0.974	0.974	-0.124	0.042	0.750	0.577	0.281	0.399	-0.361	-0.364	-0.496	-0.092	-0.234	M2gdp
	1.000	0.999	-0.064	0.169	0.825	0.695	0.360	0.185	-0.534	-0.536	-0.590	-0.054	-0.208	Fdgdg
		1.000	-0.062	0.166	0.824	0.694	0.362	0.186	-0.532	-0.538	-0.593	-0.055	-0.210	Bdgdg
			1.000	0.837	0.359	0.349	0.313	-0.282	-0.135	-0.156	-0.239	-0.045	-0.072	BcBd
				1.000	0.589	0.772	0.372	-0.531	-0.476	-0.461	-0.243	-0.194	-0.116	FcFd
					1.000	0.922	0.447	-0.083	-0.590	-0.597	-0.586	-0.151	-0.197	Pcrb
						1.000	0.382	-0.312	-0.654	-0.652	-0.551	-0.123	-0.185	Pcrbof
							1.000	-0.238	-0.567	-0.585	-0.352	-0.160	0.171	Dbacba
								1.000	0.605	0.596	0.238	-0.185	-0.177	Informal 1
									1.000	0.983	0.477	-0.213	-0.048	Informal 2
										1.000	0.492	-0.208	-0.039	Inf & Semi
											1.000	-0.031	0.255	Mobile P.
												1.000	-0.569	Inflation
													1.000	GDP growth

M2gdp: Economic financial depth. Fdgdg: Financial system depth. Bdgdg: Banking system depth. BcBd: Banking system efficiency. FcFd: Financial system efficiency. Pcrb: Banking system activity. Pcrbof: Financial system activity. Dbacba: Financial system size. Informal 1: Absolute informal financial development. Informal 2: Relative informal financial development. F.D: Financial Development. Fin: Financial.

Appendix 3: Variable definitions

Variables	Signs	Variable definitions	Sources
Economic Financial Depth	M2	Money supply(% of GDP)	World Bank(FDSD)
Financial System Depth	Fdgd	Liquid liabilities(% of GDP)	World Bank(FDSD)
Banking System Depth	Bdgd	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)
Mobile Phone Penetration	Mobpen	Seven year average growth rate(% of population)	AfDB
Inflation	Infl	Consumer Price Index (annual %)	World Bank(WDI)
Economic Prosperity	GDPg	GDP Growth (annual %)	World Bank(WDI)
Freedom	Free	Press Freedom Quality	Freedom House

WDI: World Bank Development Indicators. FDSD: Financial Development and Structure Database. FD: Financial Development. AfDB: African Development Bank. Fd:Financial system deposits. Bd: Banking system deposits. M2: Money supply.

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