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Abstract

Purpose: We make available new critical macroeconomic financial indicators to the research community. Nothing is more powerful than a phenomenon whose time has come. What is the macroeconomic empirical context of growing mobile banking? Perhaps one of the deepest empirical hollows in the financial development literature has been the equation of financial depth in the perspective of money supply to liquid liabilities. This equation has put on the margin, a burgeoning phenomenon whose time has come: mobile banking.

Design/Methodology: We decompose financial depth into formal, semi-formal and informal sectors and then assess the incidence of mobile banking on each constituent. Thus the IFS (2008) definition of the financial system is extended to incorporate an informal financial sector in line with Asongu(2011). Three hypotheses based on eight propositions are tested using a plethora of endogeneity-robust and HAC standard errors estimation techniques.

Findings: The informal financial sector (a previously missing component in the definition of money supply: M2) is positively affected by mobile banking, while the incidence of mobile banking is negative on formal and semi-formal financial intermediary development. The paper 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 effects of mobile banking on various financial sectors.

Research implications: Since empirical research on the phenomenon has been hampered by lack of data, we make available macroeconomic financial indicators to the research community. The present paper is also in response to the numerous calls on the research gap in the literature that emphasize the need for research on mobile banking. The mobile-finance nexus is gaining momentum, yet relatively little scholarly research explores the incidence of these m-banking/m-payment (systems) on financial development.

Practical implications: (1) There is a burgeoning role of informal finance in developing countries. (2) The incidence of the growing 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 guide monetary policy; since a great chunk of the monetary base (M0) in less developed countries is now captured by mobile banking.

Originality/value: New financial indicators for mobile banking assessment based on insufficiencies in the financial development literature: liquid liabilities as applied to developing countries is misleading because a great chunk of the monetary base does not transit through the banking system but via informal networks like the growing phenomenon of mobile banking.

JEL Classification: E00; G20; L96; O17; O33
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1. Introduction

In the words of Victor Hugo: '*Nothing is more powerful than the idea whose time has come'* (Thacker & Wright, 2012). As of January 2012, there were 5.2 billion mobile connections and only 2.2 billion people with bank accounts. Around the globe, various initiatives use the mobile phone to provide financial services to those without access to traditional banks, yet relatively little scholarly research explores the use of these m-banking/m-payment systems (Jonathan & Camilo, 2008). Hence this present paper is in response to the numerous calls on the research gap in the literature that emphasize the need for research focusing on the context(s) of m-banking/m-payments(Jonathan & Camilo,2008,1; Maurer, 2008; Aker & Mbiti,2010,225; Thacker & Wright,2012,1).

Money transfer schemes have evolved to the next generation of electronic payments: the mobile channel. Money transfer services for both domestic and international remittances are shifting from traditional providers to wireless carriers who are able to compete for consumer market share on the basis of technological ubiquity and affordable cost services. According to Jonathan & Camilo (2008), the spread of mobile phones across the developing world is one of the most remarkable technology stories of the past decade. Buoyed by prepay cards and inexpensive handset, hundreds of millions of first-time telephone owners have made voice calls and text messages part of their livelihoods. However, many of these same mobile users live in informal and/or cash economies without access to financial services. As posited by Porteous (2006) and sustained by Thacker & Wright (2012), there are probably more people with mobile handsets than with bank accounts in the developing world. The various initiatives that use mobile phones to provide financial services to 'the unbanked' take a variety of forms: including long-distance remittances, micropayments and informal airtime bartering schemes; and go by various names including mobile(m)-banking, mobile(m)-transfers or mobile(m)-payments. These payment mechanisms are no longer mere pilots as

they are gaining considerable ground in countries like the Philippines, South Africa and Kenya. However this increasing relevance, scholarly research has been slow to keep even pace.

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 scares. From a broad standpoint, 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 papers hinge on country-specific and micro-level data(collected from surveys) for the most part(Demombynes & Thegeya, 2012). Aker & Mbiti(2010;225) have stated: *"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)…"*. Since empirical research on the phenomenon has been hampered by lack of data, the present paper makes available macroeconomic financial indicators to the research community.

The purpose of this study is therefore to give a macroeconomic context to the growing phenomenon of 'mobile-banking/transfer/payments'. It 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 sector promotion, micro finance and mobile banking. It suggests a practicable way to disentangle the effects of mobile banking on various financial sectors. Its contribution to the literature is fourfold. Firstly, it corrects one of the deepest empirical hollows in the financial development literature which has been the

equation of financial depth in the view of money supply to liquid liabilities : this equation has sidelined a burgeoning phenomenon whose time has come (mobile banking). This first contribution hinges on the thesis that financial depth in the perspective of liquid liabilities as applied to developing countries is very misleading because a great chunk of the monetary base does not transit through the banking system but via informal networks like the growing phenomenon of mobile-transfers (payments/banking). Secondly, the study is in response to a growing call for more scholarly research on the mobile-finance nexus that is gaining momentum around the world. Various initiatives on the use of the mobile phone are cropping-up to provide financial services to those without access to traditional banks, yet relatively little scholarly research explores the incidence of these m-banking/m-payment systems on financial development(Jonathan & Camilo,2008,1; Maurer, 2008; Aker & Mbiti,2010,225; Thacker & Wright,2012,1). Thirdly, since empirical research on the phenomenon has been hampered owing to lack of data, this paper makes available macroeconomic financial indicators to the research community that could practically be used to assess the incidence of mobile banking on financial development. These indicators can easily be computed from existing World Development Indicators (WDIs) and the Financial Development and Structure Database (FDSD). Fourthly, we provide relevant recommendations that could guide future research and macroeconomic policy on financial trends of the growing phenomenon.

The rest of the paper is organized as follows. Section 2 states the problem and resulting propositions. Section 3 examines theoretical and empirical literature. Data and methodology are presented and outlined respectively in Section 4. Empirical analysis and corresponding discussion are covered in Section 5. Section 6 concludes.

2. Problem statement and propositions

2.1 Problem statement

2.1.1 Rethinking financial development indicators

Owing to lack of macroeconomic data, very little is known today about the impact of mobile banking across financial intermediary sectors. Perhaps this could explain the relative lack of research on the mobile finance (banking) nexus despite its growing significance in developing countries. Borrowing from Asongu (2011a), financial development indicators have been universally applied without due consideration to regional/country specific financial development realities (contexts). The application of some indicators for example hinges on the presumption that they are generally valid (Gries et al., 2009)[1]; notwithstanding empirical evidence that not all indicators may really be relevant in financial development (Asongu, 2010a). To the best of our knowledge, but for Beck et al.(1999) and Asongu(2010a;2011a), the absence of studies that underline the quality of financial development indicators with respect to contextual development concerns begs the search for the missing link.

It has been well established that the financial depth indicator as applied to developing countries is very misleading as it does not integrate the realities and challenges of financial intermediary development (Demetriades & Hussein, 1996; Khumbhakar & Mavrotas, 2005; Ang & McKibbin, 2007; Abu-Bader & Abu-Qarn; 2008; Asongu, 2011a). Thus a motivation of this paper hinges on an existing debate over the contextual quality of financial development indicators. What best illustrates the missing dimension of the informal financial sector in the macroeconomic indicator of financial depth is a phenomenon whose era has come: 'mobile banking'.

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[1]Gries et al. (2009) state: "In the related literature several proxies for financial deepening have been suggested, for example, monetary aggregates such as M2 on GDP. To date there is no consensus on the on the superiority of any indicator" (page 1851).

2.1.2 Rethinking financial development in the mobile banking (finance) nexus' context

Liquid liabilities as applied to developing countries is inconsistent because a great chunk of the monetary base does not transit through the banking system but via informal networks like the growing phenomenon of mobile banking. As we have highlighted above, maybe one of the deepest empirical hollows in the financial development literature has been the equation of financial depth in the perspective of money supply to liquid liabilities. This equation has put on the margin, a burgeoning phenomenon whose time has come. This inconsistency begs the question of; what is the macroeconomic financial empirical context of growing 'mobile-transfer/payments'? Is this context informal, formal or both?

Beyond the empirical need of distinguishing between formal, semi-formal and informal sectors of financial development, the above questions also cut deep across the conception and definition of the phenomenon (mobile banking) itself. That is, mobile banking could consists of 'informal simple-savings' and 'bank oriented-savings'. Hence this reality further heightens the need to distinguish between the effect of 'simple-savings' which reflects informal financial development (a component of money supply), from that of 'banking-savings' (the liquid liability constituent of money supply). Ultimately, this duality in the conception and definition of savings unravels the misleading assumption that financial depth in the perspective of monetary base is equal to liquid liabilities (as applied in mainstream financial development literature: World Bank 1989; King & Levine, 1993; Beck et al.,1999).

2.1.3 Existing empirical solutions

Money supply (M2/GDP) which represents the money stock has been widely used as a standard measure of liquid liabilities in many studies (World Bank 1989; King & Levine, 1993). While this proxy maybe quasi-true in the developed world, its application to developing countries has faced growing skepticism. Proponents of this anti-thesis stress that in less developed countries; an improvement in M2 may reflect an extensive use of currency

rather than an increase in bank deposits. Owing to the absence of a consensus on the superiority of financial development indicators; especially on this widely used proxy for financial depth (Gries et al., 2009), a number of solutions have been suggested.

Firstly, in an attempt to curtail this shortcoming, Demetriades & Hussein (1996) suggested the subtraction of currency outside banks from M2 in the measurement of liquid liabilities in developing countries. Abu-Bader & Abu-Qarn (2008) amongst others have recently adjusted M2 in the same manner. But these adjustments fail to emphasize that the "adjusted-measure" constitutes the formal and semi-formal financial sectors. Moreover, the informal financial sector is ruled-out as marginal in this adjustment.

Secondly, some authors have sought to address the issue by determining a variable that is broadly indicative of financial depth. They use the first principal component of M2/GDP and a combination of other financial indicators (Khumbhakar & Mavrotas, 2005; Ang & McKibbin, 2007; Gries et al., 2009). By so doing they decrease the dimensionality of the set of variables without losing much information on the one hand; and on the other hand decrease problems related to the quality of M2 as a proxy for liquid liabilities. The set-back of this approach to a solution is that, for the most part financial depth is mixed with concepts of financial activity (private domestic credit/GDP), financial size (deposit bank assets/central bank assets plus deposit money assets), financial allocation efficiency(bank credit/bank deposits)…etc. The contribution of this paper to existing literature(in the context of mobile banking) is to address this problem without mixing-up these financial concepts.

Thirdly, Asongu (2011a) earlier addressed this problem in the finance-growth nexus without mixing-up financial concepts. He has provided a practical way of disentangling the effects of formal, semi-formal and informal financial development sectors in the finance-growth nexus. In opposition to other solutions highlighted above, the paper best fits into the context of Asongu (2011a) because it seeks to capture the effect of 'mobile banking' which

from intuition predominantly reflects the semi-formal and informal sectors of the financial system.

2.2 Theoretical basis, definition of terms, propositions and testable hypotheses

2.2.1 Theoretical basis for propositions

'Liquid liabilities' as expressed in terms of M2 is without distinction of financial sectors and rest on the assumption that almost all currency held is linked to a financial sector deposit(IFS,2008). Beck et al., (1999) on presenting a new database on financial development and structure (FDSD) pointed-out: "*Since many researchers have focused on the liability side of the balance sheet, we include a measure of absolute size based on liabilities. Liquid liabilities to GDP equal currency plus demand and interest-bearing liabilities of banks and other financial intermediaries divided by GDP. This is the broadest available indicator of financial intermediation, since it includes all three financial sectors....Liquid liability is a typical measure of financial depth and thus the overall size of the financial sector without distinguishing between financial sectors of the use of liabilities*"(page 11). It is worth emphasizing that in this assertion, almost no distinction is made between different financial sectors in the FDSD; and the hypothesis of all constituents of money supply being linked to the liability side of the balance sheet is questionable for developing countries. Almost all currency held for transaction motives in developed countries are recycled in banks[2]. However, this is subject to controversy in the underdeveloped world and therefore distinction between formal, semi-formal and informal banking sectors is imperative for a critical assessment of the multidimensional effects of 'mobile banking'.

A bias in the definition of 'financial system deposits' (aka liquid liabilities) by the International Monetary Fund (IMF) is also deserving of examination. With respect to the International Financial Statistics (hence IFS), the financial system is made-up of the formal

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[2] Bank deposits are liquid liabilities.

and semi-formal sectors; that is deposit money banks and other financial institutions (see lines 24, 25 and 45 of IFS, October 2008). Whereas this definition could be quasi-true for developed countries, it fails to take account of the informal financial sector in developing and underdeveloped countries. This leaves us with some concern over the role of the informal sector in financial intermediary development and growth; especially at the advent of 'mobile banking'; a fast growing phenomenon whose time has come.

2.2.2 Definition of terms

a) Monetary Supply

This refers to the amount of money in an economy. This is the measure of the money supply that characteristically includes most liquid currencies. Measures of money are classified in levels of M, with the monetary base (M0) being the smallest and lowest M-level. Whereas base money can be described as the most acceptable liquid form of final payment, a broad measure of money supply (M1) adds demand deposits to M0. Less liquid savings accounts like 'time deposits' add up to M1 to define a broader money supply (M2). Large time deposits, institutional money market funds, other larger liquid assets and short-term repurchase in turn sum up to M2 to make-up the broadest money supply (M3). With respect to the context of the current paper, M2 is more appropriate due to the relative undeveloped financial sector of developing countries. In the less developed world, M0 could be assimilated to the informal financial sector, implying the monetary base (M0) for the most part is made-up of informal financial activities. As earlier emphasized, when formal and semi-formal banking sector deposits are integrated into M0, then a broad money supply definition (M2) is obtained. Liquid liabilities should thus be the component of M2 circulating within the banking system (M2-M0).

b) Liquid liabilities

A liquid liability refers to a debt or claim that has been converted into cash as it becomes due. In the context of our work, it is assimilated to bank deposits in current and savings accounts (M2-M0). Whereas in developed countries liquid liabilities could be assimilated to M2 (as M0 is mostly held in the banking sector), in underdeveloped countries M0 quite often does not transit through the banking sector and hence by definition is not a bank liability.

c) Financial system by International Financial Statistics (IFS)

With regard to the IFS (2008), the financial system consists of deposit money banks (formal banking sector) and other financial institutions (semi-formal banking sector)[3]. This definition is ideal for developed countries (where-in M0 is part of the banking sector) but lacking in some substance in the underdeveloped world (where most cash-holders contained in M0 don't have bank accounts). Thus according to this definition, financial depth is M2 without informal finance. Within the framework of this paper, contrary to mainstream literature financial depth corresponds to M2 (including the informal financial sector). By integrating this previously missing component the following propositions are derived.

2.2.3 Propositions

Financial development could either be indirect (financial intermediary development-through the banking sector) or direct (via financial markets). The context of this study is limited to the former type of financial development. Borrowing from Beck et al. (1999), indirect indicators could further be classified into financial development aspects of depth (M2), allocation efficiency[4], activity[5] and size[6]. Amongst these indicators, financial depth is

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[3] See lines 24, 25 and 45 of IFS, October 2008.
[4] Bank credit on bank deposits.
[5] Private domestic credit on GDP.
[6] Deposit bank assets / Central bank assets plus deposit bank assets.

the most widely used in the finance-growth literature. By disentangling this financial depth into its inherent constituents and relaxing the IFS definition of the financial system, the following propositions could be derived.

Table 1: Summary of propositions

Panel A: GDP-based financial development indicators			
Propositions	Name(s)	Formula	Elucidation
Proposition 1	Formal financial development	Bank deposits/GDP	Bank deposits[7] here refer to demand, time and saving deposits in deposit money banks.
Proposition 2	Semi-formal financial development	(Financial deposits – Bank deposits)/ GDP	Financial deposits[8] are demand, time and saving deposits in deposit money banks and other financial institutions.
Proposition 3	Informal financial development	(Money Supply – Financial deposits)/GDP	
Proposition 4	Informal and semi-formal financial development	(Money Supply – Bank deposits)/GDP	
Panel B: Measures of financial sector importance			
Proposition 5	Financial intermediary formalization	Bank deposits/ Money Supply(M2)	From 'informal and semi-formal' to *formal* financial development (formalization)[9].
Proposition 6	Financial intermediary 'semi-formalization'	(Financial deposits - Bank deposits)/ Money Supply	From 'informal and formal' to *semi-formal* financial development (Semi-formalization)[10]
Proposition 7	Financial intermediary 'informalization'	(Money Supply – Financial deposits)/ Money Supply	From 'formal and semi-formal' to *informal* financial development (Informalisation)[11]
Proposition 8	Financial intermediary 'semi-formalization and informalization'	(Money Supply – Bank Deposits)/Money Supply	Formal to '*informal and semi-formal*' financial development: (Semi-formalization and informalization)[12]

N.B: Proposition 5, 6, 7 add up to unity (one); arithmetically spelling-out the underlying assumption of sector importance. Hence, when their series properties are considered in empirical analysis, the evolution of one sector is to the detriment of other sectors and vice-versa.

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[7] Lines 24 and 25 of International Financial Statistics (IFS); October 2008.

[8] Lines 24, 25 and 45 of IFS, October, 2008.

[9] In undeveloped countries M2 is not equal to liquid liabilities (liquid liabilities equal bank deposits: bd). Whereas in undeveloped countries bd/M2<1, in developed countries bd/M2 is almost equal to 1. This indicator measures the rate at which money in circulation is absorbed by the banking system. Financial formalization here is defined as the propensity of the formal banking system to absorb money in circulation.

[10] This indicator measures the level at which the semi-formal financial sector evolves to the detriment of formal and informal sectors.

[11] This proposition show the rate at which the informal financial sector is developing at the cost of formal and semi-formal sectors.

[12] The proposition appreciates the deterioration of the formal banking sector to the benefit of other sectors (informal and semi-formal). From common sense, propositions 5 and 8 should be perfectly antagonistic, meaning the former (formal financial development at the expense of other sectors) and the later (formal sector deterioration) should display a perfectly negative coefficient of correlation (See Appendix 2).

Propositions in Table 1 are based on a rethinking of the IFS (2008) definition of the financial system as elucidated in Section 2.1 above and summarized in Appendix 4. The Asongu (2011a) definition integrates a previously missing component of informal finance into the definition of the financial system. Thus the empirical section is this paper is based on this definition which incorporates the informal financial sector into the financial system. The propositions invite the following hypotheses.

2.2.4 Testable hypotheses

Hypothesis 1: The informal financial sector (a previously missing component in the definition of money supply: M2) is significantly impacted by mobile banking.

Hypothesis 2: Disentangling different components of the existing measurement (financial system) into formal (banking sector) and semi-formal (other financial institutions) sector indicators could improve understanding of the mobile-finance nexus.

Hypothesis 3: Introducing measures of sector importance could ameliorate the ability to understand how improvements of shares in different sectors of the financial system are affected by the mobile banking phenomenon. To put this in other terms, the need to evaluate how one financial sector develops at the expense of another (and vice-versa) and the incidence of mobile banking on these changes could be crucial in grasping the mobile-finance nexus. .

3. Theoretical framework

3.1 The mobile-finance nexus

With respect to Jonathan & Camilo (2009), most mobile transactions[13] in the developing world enable users to do three things. (a) Store value (currency) in an account accessible via a handset. Should the user already have a bank account; the task becomes that 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 to and out of the store value account. When the account is connected to a bank account, then users can visit banks to cash-in and cash-out. In many cases, users can also visit the GSM providers' retail stores. In a great many 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 connected to two mobile phones, by using a set of SMS messages (or menu commands) and PIN codes. The new services offer a way to move money from place to place and present an alternative to the payments system offered by banks, remittance firms, pawn shops …etc. The uptake of m-banking systems has been particularly significant 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 the Safaricom M-PESA system within a year of its nationwide rollout, Vaughan,2007; Ivatury & Mas,2008)

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[13] 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).

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 examined the mobile-finance nexus through the concept of savings. They distinguish two categories 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 generate interest. Bank-integrated mobile savings 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 close proximity to a physical bank branch. With a bank-integrated mobile savings account, basic banking services can be accessed through a network of mobile phone agents, which in Kenya surpass the weight of bank branches by a factor of 100 to 1(Mas & Radcliffe, 2011). The term '*partially integrated*' mobile savings system is also employed to describe situations where bank account access via mobile phones is contingent on the establishment of a traditional account at a physical bank.

Banks are starting to build their own agent networks in a bid to assume a more competitive bargaining position in accessing mobile service platforms. Partially and fully integrated savings present different types of contracts among the partnering bank and mobile service provider. With respect 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). Therefore the bank compensates the mobile service provider for access to the network and enjoys the remaining profits. This sort of contract more closely looks like a debt contract among 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 dependent on the relative bargaining

power of the bank and mobile service provider. This type of contract more closely looks like an equity contract between two parties. Equity-like contracts are more likely to be complex and hence 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 views the mobile-banking nexus from four standpoints. Firstly, the mobile phone can serve as a virtual bank card where institution and customer information can be securely stored, there-by avoiding the cost of distributing cards to customers. In fact he postulates, the subscriber identity module (SIM) card inside most (if not all) mobile phones is in itself a smartcard (similar to the virtual bank card). Thus, 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 play the role of a point of sale (POS) terminal. As such a mobile phone could be used to communicate and transact with the appropriate financial institution to solicit transaction authorization. These are similar 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 substituted for an ATM. A POS is therefore used to pay for goods and services at the store. If cash and access to savings were to be assimilated to 'goods and services', that customers buy and store, then the POS will also serve as cash 'collection and distribution' point which basically is the function of an automatic teller machine(ATM). Fourthly, the mobile phone could be used as an Internet banking terminal. Meaning it could provide 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 disposal of otherwise unbanked customers.

3.2 Bases for instruments

The bases for the choice of instrumental variables are elucidated in this section. Thus we provide theoretical justification to the empirical validity of legal-origin, income-level, religious-domination and press-freedom instrumental variables.

3.2.1 Legal origins and financial development

This section elucidates the law and finance theory. We devote space to spell-out the difference in how legal heritage continue to shape private property rights protection, investor protection laws and financial development in our era. In this section, we also explain two mechanisms via which legal-origin may influence the contracting environment: the political and adaptability mechanisms.

a) Law, enforcement and financial development

The first strand of the law and finance theory stresses that legal institutions influence corporate finance and financial development (La Porta et al., 1998). The law and finance theory emphasizes that cross-country differences in (i) contract, company, bankruptcy and security laws, (ii) the legal system' 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. As asserted by La Porta et al.(2000) and backed by Beck & Levine(2005) the law and finance view follows naturally from the evolution of corporate finance theory during the past half century. A country's contract, company, security and bankruptcy laws, as well as the enforcement of these laws fundamentally influence the rights of securities holders and the operation of financial systems. Debt and equity are viewed by Modigliani & Miller (1958) as legal claims on the cash flow of firms; statutory law and the degree to which courts enforce those laws shape the types of contracts that are used to address agency problems (Jensen & Meckling,

1976). Financial economists have increasingly focused on the control that financial securities bring to their owners and the effect of different legal rules on corporate control (Hart, 1995).

Concerning how legal establishments should influence corporate finance and financial development, within a broad vision there are differing opinions regarding the degree to which legal systems should support the private contractual arrangements and the degree to which the legal system should have specific laws concerning shareholder and creditor rights. With respect to the Coasians (Coase, 1960), the legal system should simply enforce private contracts. Thus effective legal establishments permit knowledgeable and experienced financial market participants to design a vast array of sophisticated private contracts in a bid to improve complex agency problems (Coase, 1960; Stigler, 1964; Easterbrook & Fischel, 1991). The law and finance theory three-point view has already been highlighted in the introduction of this strand. Whether assuming a Coasian dependence on enforcing complex private contracts or an approach that augments the support of private contracts with company, bankruptcy, securities law…etc, the law and finance's first part postulates that the degree of protection of private investors is a paramount determinant of financial development.

b) From legal-origin to finance: political and adaptability mechanisms

In the second strand we stress theories by Beck et al. (2003) which assess 'why' legal origin matter in financial development. They assess two mechanisms by which legal origins may influence financial development: the political and adaptability channels.

The political mechanism is based on two premises. Firstly, legal traditions differ in the emphasis they attribute to protecting the rights of private investors in comparison to those of the state. Secondly, private property rights protection makes-up the foundation for financial development. Hence historical based differences in legal origin can help explain existing disparities in financial development with regard to this component of law and finance (La Porta et al., 1998). A great many scholars postulate that the Civil law has tended to support

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the rights of the State, vis-à-vis private property rights, that is quite the opposite in Common law. Therefore Civil law countries have provided for legal systems which have unhealthy implications for financial development. A powerful State with a responsive civil law at its disposal will tend to divert the flows of society's resources towards favored ends, which is not conducive (appealing) to competitive financial markets. More so a powerful State will have difficulty credibly committing to not interfere in financial markets, which will also obstruct financial development. Thus, the law and finance theory emphasizes that Civil law countries will have feebler property rights protection and lower thresholds of financial development than countries with other legal traditions. In contrast, Common law has historically tended to side with private property owners against the State. According to this perspective, instead of becoming a tool of the state, Common law has acted as a powerful arm in the brandishing of private property rights. Rajan & Zingales(2003) stress that governments in Civil law countries were more effective than governments in Common law countries in stretching the role of government at the cost of financial market growth during the Interwar period 1919-1939. They attribute this difference to the heavy task of the judiciary vis-à-vis the legislature. Thus, the law and finance theory stresses that the British Common law supports financial development to a greater extent than Civil law systems.

The second channel binding legal origin to financial development is the adaptability channel that is also built on two premises. Firstly, legal systems differ in their ability to adjust to changing and evolving conditions. Secondly, if a country's legal system adapts only timidly 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. An influential, though by no means unanimous position of inquiry stresses that legal systems that embrace case and judicial discretion tend to adhere more efficiently to changing conditions than legal systems that adapt rigidly to formalistic procedures and that rely more strictly on

judgments narrowly based on statutory law(Coase, 1960). Posner (1973) argues that although, legislators consider the impact on particular individuals and interest groups when writing statutes, judges are forbidden from considering the deservedness of specific litigants and therefore more likely to render decisions premised on objective efficiency criteria (Rubin, 1982, 205). It follows that Common law systems are much more efficient than statutory-based systems because inefficient laws are routinely litigated and re-litigated projecting the law toward more efficient outcomes (Rubin, 1977; Priest, 1977). In another line of thinking, some authors argue that statutory law evolves slowly and is subject to a greater degree of inefficient political pressures than Common law (Posner, 1973; Bailey & Rubin, 1994).

3.2.2 Wealth-effects in financial development

This section aims to justify our selection of income-level instrumental variables in the empirical phase of the paper. As established by Beck et al. (1999) and sustained by Asongu (2010b, 2011a) financial development varies with wealth. Therefore theoretical and empirical literature show considerable disparities across countries with respect to wealth[14]. This theory could be explained from three main positions: financial intermediary development; private credit & life insurance and stock market development.

The first stance on financial intermediary development engenders: central bank assets to total financial assets, deposit money bank assets to total financial assets, other financial institutions assets to total financial assets and deposit money versus central bank assets (Beck et al, 1999,13). With respect to this position, central banks loose relative importance as one move from low to high-income countries, whereas other financial institutions gain relative importance. Deposit money banks gain relevance versus Central banks with a higher income

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[14] "*To assess the size and activity of financial intermediaries across countries, we use the World Bank classification of countries according to their income levels (World Development Indicators 1998). We can distinguish between four country groups; high income countries with a GNP per capita in 1997 higher than $9,656, upper middle income countries with a GNP per capita between $3,126 and $9,655,lower middle income countries with a GNP per capita between $786 and $3,125 and low income countries with a GNP per capita of less than $786*"(Beck et al.,1999, p.13).

level. Financial depth improves with income levels. Deposit money banks and other financial institutions are bigger and much more active in rich countries, while central banks are smaller. As stressed by Beck et al. (1999), from the 1960s to 1980s central bank assets increased and then decreased again in the 1990s. They emphasized that the 'deposit money banks versus central bank assets' rise and drop was mainly accounted for by low-income countries.

The second stance focuses on private domestic credit and life insurance across income groups (Beck et al., 1999,21). 'Private credit by other financial institutions' embodies bank-like institutions, insurance companies, private pension and provident funds, pool investment schemes and development banks; whereas insurance development entails life insurance companies, life insurance penetration and life insurance density. With respect to this position, private credit by all five categories of 'other financial institutions' augment as we move from low to high-income countries. Private credit by life insurance companies, the life insurance penetration and the life insurance density augments with GDP per capita. Interestingly, for the first two measures, the lower-middle income group portrays the lowest medians. It is also interesting to note 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.

In the third stance, we have stock market development across income groups. Stock market development is in 6 categories: stock market capitalization, stock market total value traded, stock market turnover, private bond market capitalization, equity issues and long-run private debt. This position suggests that there is a significant variation in size, activity and efficiency of stock markets across income groups. Countries with higher thresholds of GDP per capita have bigger, more active and more efficient financial markets (Beck et al., 1999, 25). Wealthy countries also possess larger bond markets and issue more equity and private

bonds. Stock markets have soared in size, activity and efficiency over the last three decades largely as a result of significant changes in higher GDP per capita countries.

3.2.3 Theoretical background to religion in finance

This section aims to elucidate the theoretical foundation for the empirical validity of the religious instruments. Borrowing from Hearn et al.(2011), Islam engenders a system of beliefs founded on the interpretation of passages from the Qu'ran and various Had'ith and Sunnah that are short texts concerning 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 (as integral parts) and that have common values of Islamic social justice(Asutey,2007). The Islamic financial system is premised and regulated on the same Shari'ya principles as the overall economy and society (Iqbal, 1997). These govern the nature of contracts and the shape of institutions to support the market and regulation of participants' behavior. Individuals within an Islamic financial system will be subject to behavioral norms that give rise to very heterogeneous assumptions to those that form the premise of regulation in western markets.

3.2.4 Press-freedom and finance

In this section, we make a case for the choice of press-freedom instrumental variables. From a theoretical stance, press-freedom and the Efficiency Market Hypothesis (EMH) of finance move hand-in-glove. Empirically, freedom of the press is one of the major efficient market mechanisms and only with unrestricted press-freedom can information be rapidly spread and fully incorporated into asset prices (Guo-Ping, 2008; Asongu,2012).

3.3 Scope and positioning of the current paper

The purpose of this study is to give a macroeconomic context to the growing phenomenon of 'mobile-banking/transfer/payments'. It 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 sector promotion, micro finance and mobile banking. It suggests a practicable way to disentangle the effects of mobile banking on various financial sectors. Its contribution to the literature is fourfold. Firstly, it corrects one of the deepest empirical hollows in the financial development literature which has been the equation of financial depth in the view of money supply to liquid liabilities: this equation has sidelined a burgeoning phenomenon whose time has come (mobile banking). This first contribution hinges on the thesis that financial depth in the perspective of liquid liabilities as applied to developing countries is very misleading because a great chunk of the monetary base does not transit through the banking system but via informal networks like the growing phenomenon of mobile-transfers (payments/banking). Secondly, the study is in response to a growing call for more scholarly research on the mobile-finance nexus that is gaining momentum around the world. Various initiatives on the use of the mobile phone are cropping-up to provide financial services to those without access to traditional banks, yet relatively little scholarly research explores the incidence of these m-banking/m-payment systems on financial development(Jonathan & Camilo,2008,1; Maurer, 2008; Aker & Mbiti,2010,225; Thacker & Wright,2012,1). Thirdly, since empirical research on the phenomenon has been hampered owing to lack of data, this paper makes available macroeconomic financial indicators to the research community that could practically be used to assess the incidence of mobile banking on financial development. These indicators can easily be computed from existing World Development Indicators (WDIs) and the Financial Development and Structure

Database (FDSD). Fourthly, we provide relevant recommendations that could guide future search and macroeconomic policy on financial trends of the growing phenomenon.

4. Data and methodology

4.1 Data

Owing to the methodological orientation of this paper, justification for a broad database in the choice of data is not much of an empirical constraint. The empirical analysis is based on 52 African countries. While financial propositions are computed from the Financial Development and Structure Database (FDSD), other variables (but for mobile penetration and press-freedom) are obtained from African Development Indicators (ADI) of the World Bank (WB). Freedom indicators originate from Freedom House whereas the mobile penetration measure is obtained from the African Development Bank (AfDB). The data structure is cross-sectional and consists of 2003-2009 average growth rates, due to constraints in the time series properties of the mobile penetration measurement. In line with existing literature we proxy for 'mobile banking/activities' with the 'mobile penetration' rate (Ondiege, 2010; Aker & Mbiti, 2010). Control exogenous variables include economic considerations (inflation & GDP growth), globalization (trade and financial liberalizations) and political-institutional quality (democracy). The endogenous variables are Propositions 1-8 suggested in the theoretical framework above (see Table 1). Instrumental variables include legal-origins, religious-dominations, income-levels and press-freedom qualities as theoretically justified in Section 3.2. These instruments have been largely documented in development literature (Beck et al., 2003; Stulz & Williamson, 2003) as well as recent African finance (Asongu, 2011bcdef) and growth (Agbor, 2011) literature. Summary statistics with presentation of countries (Appendix 1), correlation analysis (Appendix 2) and definition of variables (Appendix 3) are presented in the appendices.

4.2 Methodology

4.2.1 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 error, leading to potential bias in the coefficient estimates*". Whereas mobile phones have a bearing on financial development the reverse effect cannot be ruled-out, as some applications in the banking industry may require the use of mobile phones. We are therefore confronted here with an issue of endogeneity owing to reverse-causality and omitted variables, since the mobile penetration rate is correlated with the error term in the equation of interest. To address this issue we shall investigate the presence of endogeneity with the Hausman-test and should the results match our concerns (null hypothesis rejected), we employ an estimation technique that takes account of the endogeneity issue.

4.2.2 Estimation technique

Given the concern for endogeneity, we borrow from Beck et al. (2003) and recent African finance literature (Asongu, 2011def) in 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 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:

$$MobileChannel_{it} = \gamma_0 + \gamma_1(legalorigin)_{it} + \gamma_2(religion)_{it} + \gamma_3(incomelevel)_{it}$$
$$+ \gamma_4(pressfreedom)_{it} + \alpha_i X_{it} + \upsilon \qquad (1)$$

Second-stage regression:

$$\Pr opositions_{it} = \gamma_0 + \gamma_1(Mobile)_{it} + \beta_i X_{it} + \mu \tag{2}$$

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 banking' and 'propositions' are the endogenous variables in the first and second equations respectively.

In the specification of the models, we lay emphasis on the following: (1) justify the choice of a TSLS over an OLS estimation technique with the Hausman-test for endogeneity; (2) verify the instruments are exogenous to the endogenous components of explaining variables, conditional on other covariates (control variables); (3) ensure the instruments are valid and not correlated with the error-term in the main equation with an Over-identifying Restrictions (OIR) test.

4.2.3 Robustness checks

For robustness purposes, the empirical analysis: (1) uses alternative propositions; (2) employs two distinct interchangeable sets of instruments; (3) accounts for endogeneity; (4) models with Heteroscedasticity and Autocorrelation Consistent(HAC) standard errors; (5) uses OLS with HAC standard errors and RAMSEY RESET(specification tests) for models that reflect strict exogeneity in the explaining variables after the Hausman test.

5. Empirical analysis

5.1 Presentation of results

This empirical section examines two key issues: (1) the ability of the exogenous components of mobile banking to explain financial intermediary development propositions and; (2) the ability of the instruments to account for financial intermediary development

propositions beyond the mobile banking channel. To make theses investigations, 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 based 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 propositions beyond the mobile banking channel. Hence a rejection of the null hypothesis is a rejection of the stance that the instruments explain financial development propositions only through the mobile banking channel. Ultimately, this result (rejection of null hypothesis) questions the validity of the instruments and substance of the mobile banking channel in accounting for cross-country variations in financial intermediary propositions. While Table 2 entails the regressions of propositions using the TSLV-IV estimation technique, Table 3 investigates the mobile-finance nexus with OLS. The choice of an OLS estimation technique as complement to the TSLS approach is contingent on results of the Hausman test. The null hypothesis of this test is the stance that OLS estimates are consistent and efficient; hence a rejection of this null hypothesis points to the issue of inconsistency in OLS estimates owing to endogeneity and hence lends credit to the choice of the IV estimation approach. Overwhelmingly, the null hypothesis of the Hausman is not rejected for most specifications, which lends credit to alternative modeling by OLS with robust HAC standard errors and RAMSEY RESET. In Table 2 the regressions are duplicated with the robust set of instruments and the same results are found. Both Tables 2-3 consist of regressions with (Panel B) and without (Panel A) HAC standard errors.

In Table 2 below, while Panel A summarizes results without HAC standard errors, those of Panel B are HAC consistent. With respect to the first issue, the following could be established. (1) Mobile banking mitigates formal financial development. This finding is valid for Propositions 1 & 5 which reflects absolute and relative measures of formal financial

development. In plainer terms, the negative mobile elasticity of formal finance means that deposits in the formal financial intermediary sector are decreasing at the advent of mobile banking. These deposits are decreasing both in proportions of GDP (Proposition 1) and M2 (Proposition 5). While for Proposition 5, the deposits in the formal financial sector are decreasing to the advantage of semi-formal or informal financial sectors (or both); with respect to Proposition 1, deposits are decreasing to the advantage of all variables that constitute the GDP. (2) Results for Propositions 2 & 6 show that the incidence of mobile-banking on semi-formal financial development is negative but not significant. This implies, specialized non-bank and other financial institutions like rural banks, post banks, credit unions…etc, making-up the semi-formal financial sector are also witnessing decreasing deposits(savings) with the burgeoning of mobile banking. However we do not base our interpretation of the incidence of mobile banking on semi-formal finance on regressions of Propositions 2 & 6 because they betray a negative explanatory power. We shall deduce the effect on this financial sector from results of the last two set of propositions. (3)Informal financial development is positively affected by mobile banking, with the relative effect (Proposition 7) more pronounced than the absolute effect (Proposition 3). A logical inference is that, the informal sector grows more owing to improvements in M2 than in growth of GDP. Hence growth of the informal sector is more pronounced at the expense of the formal and semi-formal sectors (constituents of M2) than at the expense of other macro economic variables (constituents of GDP). Plainly put, the share of informal finance is more relevant in M2 growth than in GDP growth. (4) Semi-formal and informal financial development owing to mobile banking is positive (Propositions 4 & 8), however the effect is by a thin margin less significant than the effect on informal financial development (Propositions 3 & 7 respectively). This slight difference in corresponding weight of elasticities could be explained by the negative incidence of mobile banking on semi-formal financial development. Therefore

it logically follows that mobile banking has been beneficial only to the informal sector of the financial system. This is further evidenced by the magnitudes and signs of mobile banking elasticities pertaining to Propositions 5 and 8: -0.886 and +0.886 respectively.

We regard to the second issue which is addressed by the results of OIR test, it could be established that the instruments are valid since the null hypothesis of the Sargan OIR test is not overwhelmingly rejected. This implies the instruments do not suffer from endogeneity and explain the propositions through no other mechanisms but mobile banking channels. The findings of Panel A are consistent with those of Panel B. When regressions pertaining to both panels are replicated with the second set of instruments, no significant difference in results is found.

Despite the appealing nature of the results in Table 2, two apprehensions have caught our attention. (1) But for Propositions 5, 7 & 8, the null hypothesis of the Hausman test is not rejected in the other estimations. Failure to reject the null of this test points to the consistency and efficiency of estimates modeled by OLS. Hence we are poised to replicate the regressions by OLS in Table 3. (2) The need for an OLS estimation is further evidenced by results of the Craig-Donald Statistics which show that, the relative bias of TSLS over OLS have critical values that exceed the 30% significance level[15].

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[15] TSLS: Two Stage Least Squares. For the Cragg-Donald minimum eigenvalue, critical values (significance levels) for TSLS bias over OLS are 15.72(5%), 9.48(10%), 6.08(20%), 4.78(30%).

Table 2: Effect of Mobile Banking on Proposition (TSLS)

Panel A: Regressions without HAC Standard errors

	Prop. 1	Prop.2	Prop.3	Prop.4	Prop.5	Prop.6	Prop.7	Prop.8
Constant	**1.460*****	-0.001	**-0.316*****	**-0.318*****	**2.184*****	-0.005	**-1.179*****	**-1.184*****
	(0.000)	(0.913)	**(0.003)**	**(0.003)**	**(0.000)**	(0.948)	**(0.001)**	**(0.001)**
Mobile Banking	**-0.728*****	-0.001	**0.227*****	**0.226*****	**-0.886*****	-0.006	**0.893*****	**0.886*****
	(0.000)	(0.913)	**(0.000)**	**(0.000)**	**(0.000)**	(0.890)	**(0.000)**	**(0.000)**
Inflation	-0.001	0.0006	-0.001	-0.0004	0.007	0.002	-0.010	-0.007
	(0.918)	(0.167)	(0.705)	(0.883)	(0.444)	(0.213)	(0.298)	(0.444)
Hausman	4.010	2.738	3.529	3.577	**7.779****	2.456	**8.525****	**7.779****
	(0.134)	(0.254)	(0.171)	(0.167)	**(0.020)**	(0.292)	**(0.014)**	**(0.020)**
Sargan –OIR	**5.930**	**4.160**	**0.543**	**0.554**	**2.130**	**3.988**	**2.239**	**2.130**
	(0.204)	**(0.384)**	**(0.969)**	**(0.967)**	**(0.711)**	**(0.407)**	**(0.691)**	**(0.711)**
Cragg-Donald	1.435	1.435	1.435	1.435	1.435	1.435	1.435	1.435
Adjusted R²	0.213	-0.045	0.260	0.245	0.309	-0.051	0.322	0.309
Fisher	**6.096*****	0.961	**6.969*****	**6.591*****	**9.424*****	0.784	**9.957*****	**9.424*****
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							

Panel B: Regressions with HAC Standard errors

	Prop. 1	Prop.2	Prop.3	Prop.4	Prop.5	Prop.6	Prop.7	Prop.8
Constant	**1.460*****	-0.001	**-0.316***	**-0.318***	**2.184*****	-0.005	**-1.179*****	**-1.184*****
	(0.000)	(0.741)	**(0.072)**	**(0.070)**	**(0.000)**	(0.818)	**(0.002)**	**(0.002)**
Mobile Banking	**-0.72*****	-0.001	**0.227****	**0.226****	**-0.88*****	-0.006	**0.893*****	**0.886*****
	(0.001)	(0.737)	**(0.019)**	**(0.019)**	**(0.000)**	(0.629)	**(0.000)**	**(0.000)**
Inflation	-0.001	0.0006	-0.001	-0.0004	0.007	0.002	-0.010	-0.007
	(0.902)	(0.173)	(0.649)	(0.861)	(0.273)	(0.221)	(0.122)	(0.273)
Hausman	4.010	2.738	3.529	3.577	**7.779****	2.456	**8.525****	**7.779****
	(0.134)	(0.254)	(0.171)	(0.167)	**(0.020)**	(0.292)	**(0.014)**	**(0.020)**
Sargan -OIR	**5.930**	**4.160**	**0.543**	**0.554**	**2.130**	**3.988**	**2.239**	**2.130**
	(0.204)	**(0.384)**	**(0.969)**	**(0.967)**	**(0.711)**	**(0.407)**	**(0.691)**	**(0.711)**
Adjusted R²	0.213	-0.045	0.260	0.245	0.309	-0.051	0.322	0.309
Fisher	**5.489*****	0.927	**4.422****	**3.836****	**13.44*****	0.758	**15.060*****	**13.448*****
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. Prop: Proposition. HAC: Heteroscedasticity and Autocorrelation Consistent. FDI: Foreign Direct Investment. OIR: Overidentifying Restrictions. TSLS: Two Stage Least Squares. For the Cragg-Donald minimum eigenvalue, critical values (significance levels) for TSLS bias over OLS are: 15.72(5%), 9.48(10%), 6.08(20%), 4.78(30%). P-values in brackets.

Table 3 presents results based on OLS without (Panel A) and with (Panel B) HAC standard errors. We have already provided justification for the imperative of OLS estimation above. In comparison to Table 2, two differences are worth pointing-out. (1) More control variables are employed because there are no identification constraints (difference between

endogenous explaining variables and instruments) imperative for instrument validity test[16]. (2) The RAMSEY RESET[17] is used to specify the OLS model. Its null hypothesis is the position that nonlinear combinations in the explaining variables have no explanatory power in explaining the response variable. Hence a rejection of the null hypothesis points to misspecification of the model.

Only the first issue is addressed by Table 3. Based on the significance of estimated coefficients and findings of the RESET, the following could be established in comparison to results of Table 2. (1) Propositions 1 to 4 entail insignificant regressions. Only the mobile banking elasticity of Proposition 1 is valid, however our failure to take it into consideration hinges on equation misspecification; owing to rejection of the null hypothesis of the RESET. (2) The significance and signs of mobile banking elasticities of Propositions 5, 7 & 8 are compatible with those in Table 2. Hence we do not elucidate them further because the economic interpretations are similar. (3) Regressions pertaining to Propositions 2, 3, 4 & 6 do not merit any attention because their estimates do not jointly enter significantly at 1%, 5% or 10% significance levels (see critical values pertaining of the Fisher test for these propositions). (4)In terms of robust standard errors, findings of Panel A are HAC consistent in Panel B.

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[16] A Sargan OIR test for instrument validity is only applicable in the presence of over-identification (instruments greater than endogenous explaining variables by at least one degree of freedom). In the cases of exact-identification (instruments equal to endogenous explaining variables) and under-identification (instruments less than endogenous explaining variables) the test is not applicable.

[17] Regression Equation Specification Error Test.

Table 3: Effect of Mobile Banking on Propositions (OLS)

Panel A: Regressions without HAC Standard errors

	Prop. 1	Prop.2	Prop.3	Prop.4	Prop.5	Prop.6	Prop.7	Prop.8
Constant	**1.641***	-0.005	-0.062	-0.067	**1.651***	-0.024	**-0.626***	**-0.651***
	(0.000)	(0.598)	(0.575)	(0.549)	**(0.000)**	(0.386)	**(0.006)**	**(0.003)**
Mobile Banking	**-0.868***	0.002	0.078	0.080	**-0.565***	0.014	**0.551***	**0.565***
	(0.000)	(0.671)	(0.218)	(0.212)	**(0.000)**	(0.365)	**(0.000)**	**(0.000)**
Inflation	-0.0006	**-0.0003***	-0.002	-0.002	**0.008***	**-0.001****	-0.007	**-0.008***
	(0.931)	**(0.083)**	(0.318)	(0.255)	**(0.066)**	**(0.042)**	(0.126)	**(0.066)**
Growth	0.026	0.0009	0.002	0.003	0.006	0.002	-0.008	-0.006
	(0.210)	(0.121)	(0.751)	(0.650)	(0.613)	(0.153)	(0.497)	(0.613)
Trade	-0.0003	0.000	0.000	0.000	0.000	0.0001	-0.0001	-0.000
	(0.736)	(0.184)	(0.947)	(0.852)	(0.952)	(0.221)	(0.825)	(0.952)
Democracy	0.001	0.000	-0.003	-0.003	0.004	0.0002	-0.004	-0.004
	(0.897)	(0.970)	(0.205)	(0.214)	(0.351)	(0.725)	(0.342)	(0.351)
FDI	-0.006	**-0.0006****	0.003	0.002	-0.010	**-0.002****	**0.013***	0.010
	(0.541)	**(0.040)**	(0.344)	(0.457)	(0.104)	**(0.012)**	**(0.057)**	(0.104)
Adjusted R²	0.3489	0.036	0.045	0.044	0.489	0.143	0.463	0.489
Fisher	**3.947***	1.207	1.263	1.254	**6.277***	1.920	**5.750***	**6.277***
RAMSEY RESET	2.611*	3.080*	**0.769**	**0.923**	0.248	8.710***	0.259	0.248
	(0.093)	(0.063)	**(0.474)**	**(0.41)**	(0.782)	(0.001)	(0.774)	(0.782)
Observations	51	51	51	51	51	51	51	51

Panel B: Regressions with HAC Standard errors

	Prop. 1	Prop.2	Prop.3	Prop.4	Prop.5	Prop.6	Prop.7	Prop.8
Constant	**1.641***	-0.005	-0.062	-0.067	**1.651***	-0.024	**-0.626***	**-0.651***
	(0.000)	(0.544)	(0.747)	(0.726)	**(0.000)**	(0.418)	**(0.085)**	**(0.068)**
Mobile Banking	**-0.868***	0.002	0.078	0.080	**-0.56***	0.014	**0.551***	**0.565***
	(0.000)	(0.630)	(0.475)	(0.461)	**(0.006)**	(0.360)	**(0.009)**	**(0.006)**
Inflation	-0.0006	-0.0003	-0.002	-0.002	**0.008****	-0.001	-0.007	**-0.008****
	(0.914)	(0.208)	(0.207)	(0.141)	**(0.034)**	(0.187)	(0.112)	**(0.034)**
Growth	0.026	0.0009	0.002	0.003	0.006	0.002	-0.008	-0.006
	(0.124)	(0.203)	(0.727)	(0.614)	(0.545)	(0.258)	(0.444)	(0.545)
Trade	-0.0003	0.000	0.000	0.000	0.000	0.0001	-0.0001	-0.000
	(0.704)	(0.230)	(0.945)	(0.846)	(0.957)	(0.346)	(0.847)	(0.957)
Democracy	0.001	0.000	-0.003	-0.003	0.004	0.0002	-0.004	-0.004
	(0.878)	(0.961)	(0.150)	(0.153)	(0.299)	(0.656)	(0.297)	(0.299)
FDI	-0.006	**-0.0006****	0.003	0.002	-0.010	**-0.002****	**0.013***	0.010
	(0.570)	**(0.017)**	(0.358)	(0.470)	(0.118)	**(0.029)**	**(0.082)**	(0.118)
Adjusted R²	0.348	0.036	0.045	0.044	0.489	0.143	0.463	0.489
Fisher	**4.399***	1.627	0.912	0.936	**4.998***	1.310	**3.586***	**4.998***
RAMSEY RESET	2.611*	3.080*	**0.769**	**0.923**	0.248	8.710***	0.259	0.248
	(0.093)	(0.063)	**(0.474)**	**(0.41)**	(0.782)	(0.001)	(0.774)	(0.782)
Observations	51	51	51	51	51	51	51	51

*,**,***: significance levels of 10%, 5% and 1% respectively. Prop: Proposition. OLS: Ordinary Least Squares. HAC: Heteroscedasticity and Autocorrelation Consistent. FDI: Foreign Direct Investment. P-values in brackets.

5.2 Retrospect to tested hypotheses

Hypothesis 1: The informal financial sector (a previously missing component in the definition

of money supply: M2) is significantly affected by mobile-penetration (banking). *True*

We have observed from the findings that the informal financial intermediary sector is positively affected by the mobile banking phenomenon.

Hypothesis 2: Disentangling different components of the existing measurement (financial system) into formal (banking sector) and semi-formal (other financial institutions) sector indicators could improve understanding of the mobile-finance nexus. *True*

Based on the weight of available empirical evidence, mobile banking has a negative incidence on the depth(deposits) of formal and semi-formal financial sectors, with the effect on the former more detrimental than that on the later.

Hypothesis 3: Introducing measures of sector importance could ameliorate the capacity to understand how improvements of shares in different sectors of the financial system are affected by the mobile-finance nexus. To put this in other terms, the need to evaluate how one financial sector develops at the expense of another (and vice-versa) and the incidence of mobile banking on these changes could be crucial in orienting policy-making. *True*

By introducing measures of financial sector importance, we have been able observe that improvements in M2 resulting from mobile finance are captured exclusively by the informal banking sector. It is a substantial 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 related activities.

5.3 Further discussion of results, policy implications and future directions

Before we dive into further discussion of the results, it is imperative to outline the intuition motivating this paper. (1) The growing relevance of mobile banking in developing countries needs a macroeconomic financial development context. However, this aspect has been fundamentally sidelined in the conception, definition and application of financial depth.

(2) Some voices have expressed sentiments on the instrumentality of mobile banking 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. (3) *"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). (4)As postulated by Maurer (2008) and sustained 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 scares. From a broad spectrum, most studies on mobile banking have been theoretical and qualitative in nature (Maurer, 2008; Jonathan & Camilo, 2008; Merritt, 2010; Thacker & Wright, 2012). The slim existing empirical studies hinge on country-specific and micro-level data (collected from surveys) for the most part (Demombynes & Thegeya ,2012).

The purpose of this study has been to give a macroeconomic financial context to the growing phenomenon of 'mobile-banking/transfer/payments'. This paper has contributed at the same time to the macroeconomic literature on measuring financial development and has responded to the growing field of economic development by means of informal sector promotion and micro finance. It has suggested a practicable way to disentangle the effects of mobile banking on various financial sectors. Its contribution to the literature has been fourfold. Firstly, it has corrected one of the deepest empirical hollows in the financial development literature which has been the equation of financial depth in the view of money supply to liquid liabilities: this equation has sidelined a burgeoning phenomenon whose time has come (mobile banking). This first contribution has hinged on the thesis that financial

depth in the perspective of liquid liabilities as applied to developing countries is very misleading because a great chunk of the monetary base does not transit through the banking system but via informal networks like the growing phenomenon of mobile-transfers(payments/banking). Secondly, the study has been in response to a growing call for more scholarly research on the mobile-finance nexus; a phenomenon that is gaining momentum around the world. Various initiatives on the use of the mobile phone to provide financial services to those without access to traditional banks have been developed, yet relatively little scholarly research explores the incidence of these m-banking/m-payment systems on financial development(Jonathan & Camilo,2008,1; Maurer, 2008; Aker & Mbiti,2010,225; Thacker & Wright,2012,1). Thirdly, since empirical research on the phenomenon has been hampered owing to lack of data, this paper has made available financial macroeconomic financial indicators to the research community that could practically be used to assess the mobile-finance nexus. These indicators can easily be computed from existing World Development Indicators (WDIs) and Financial Development and Structure Database (FDSD). Fourthly, we will provide relevant policy recommendations that could guide future search and macroeconomic policy on the growing phenomenon

In this seminal 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. Eight propositions have resulted from cross examination of these definitions, upon which three hypotheses have been tested. 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 the financial system (formal and semi-formal sectors). (2) However, when a previously missing informal-financial sector component is added to the

conception and definition of the financial system (Asongu, 2011a), mobile banking has a positive incidence on informal financial intermediary development.

Ultimately mobile banking is 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 edges over traditional banking methods as it breaks down geographical constraints; it also offers other advantages such as immediacy, efficiency and security. This could partly elucidate the reason the incidence of the phenomenon has been positive to the informal financial sector to the detriment of the formal banking system.

Three practical implications have resulted from the findings. (1) There is a burgeoning role of informal finance in developing countries. (2) The incidence of the growing 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 guide monetary policy; since a great chunk of the monetary base (M0) in less developed countries is now captured by mobile-banking.

Apart from 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 penetration in the financial sector; (4) last but not the least, monetary policy tools that could combat inflation resulting from mobile banking activities.

6. Conclusion

Nothing is more powerful than a phenomenon whose time has come. What is the macroeconomic empirical context of growing 'mobile-banking/transfer/payments'? Perhaps

one of the deepest empirical hollows in the financial development literature has been the equation of financial depth in the perspective of monetary supply to liquid liabilities. This equation has put on the margin, a burgeoning phenomenon whose time has come: mobile banking. The purpose of this paper has been to propose new financial indicators in the light of mobile banking. To assess our propositions, we have decomposed money supply into formal, semi-formal and informal sectors and then assessed the incidence of mobile banking on each constituent. Thus the IFS (2008) definition of the financial system has been extended to incorporate an informal financial sector in line with Asongu(2011a). Three hypotheses based on eight propositions have been tested using a plethora of endogeneity-robust and HAC standard errors estimation techniques.

Based on the findings, the informal financial sector (a previously missing component in the definition of money supply: M2) is significantly positively impacted by mobile-penetration (banking), while the incidence of mobile banking is negative on formal and semi-formal financial intermediary development. Three broad implications have been established from the results. (1) There is a burgeoning role of informal finance in developing countries. (2) The incidence of the growing 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 guide monetary policy; since a great chunk of the monetary base (M0) in less developed countries is now captured by mobile-banking.

Since empirical research on the phenomenon has been hampered by lack of data, we have made available macroeconomic financial indicators to the research community. The present paper has been in response to the numerous calls on the research gap in the literature that emphasize the need for research on m-banking/m-payments. The mobile-finance nexus is gaining momentum, yet relatively little scholarly research explores the incidence of these m-

banking/m-payment (systems) on financial development. The paper has contributed at the same time to the macroeconomic literature on measuring financial development and has responded to the growing field of economic development by means of informal financial sector promotion, microfinance and mobile banking. It has suggested a practicable way to disentangle the effects of mobile banking on various financial sectors. The missing-link in the literature on which the paper is motivated is that liquid liabilities as applied to developing countries is misleading because a great chunk of the monetary base does not transit through the banking system but via informal networks like the growing phenomenon of mobile-banking(finance).

Appendices

Appendix 1: Summary statistics and presentation of countries

		Mean	S.D	Min.	Max.	Obser.
	Panel A: Summary Statistics					
GDP-based financial development indicators	Proposition 1	0.271	0.225	0.042	0.892	52
	Proposition 2	0.002	0.007	-0.005	0.041	52
	Proposition 3	0.066	0.054	-0.145	0.217	52
	Proposition 4	0.068	0.055	-0.145	0.216	52
Measures of financial sector importance	Proposition 5	0.753	0.173	0.272	1.336	52
	Proposition 6	0.006	0.031	-0.027	0.192	52
	Proposition 7	0.239	0.173	-0.336	0.727	52
	Proposition 8	0.246	0.173	-0.336	0.727	52
	Mobile Phone Penetration	1.674	0.217	1.043	2.242	52
	Inflation	117.95	764.60	1.953	5304.8	52
	GDP growth	4.760	3.087	-6.959	12.894	52
	Trade	82.221	37.303	34.609	211.28	52
	Foreign Direct Investment	4.675	4.731	0.062	23.203	52
	Democracy	2.906	3.709	-7.428	10.000	52
	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
Instrumental Variables	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

	Propositions								Mobile P.	Control Variables					
Prop.1	Prop.2	Prop.3	Prop.4	Prop.5	Prop.6	Prop.7	Prop.8	P.	Inflation	GDPg	Trade	FDI	Demo		
1.000	0.040	0.186	0.190	0.538	-0.041	-0.532	-0.538	-0.593	-0.055	-0.210	0.290	0.338	0.210	Prop.1
	1.000	-0.009	0.126	-0.055	0.966	-0.118	0.055	0.048	0.018	0.061	-0.031	-0.179	0.094	Prop.2
		1.000	0.990	-0.596	-0.050	0.605	0.596	0.238	-0.185	-0.177	0.004	0.187	-0.239	Prop.3
			1.000	-0.598	0.080	0.584	0.598	0.243	-0.181	-0.167	-0.000	0.171	-0.224	Prop.4
				1.000	-0.095	-0.983	-1.000	-0.492	0.208	0.039	0.242	0.050	0.270	Prop.5
					1.000	-0.085	0.095	0.081	0.023	0.051	-0.078	-0.304	0.120	Prop.6
						1.000	0.983	0.477	-0.213	-0.048	-0.227	-0.023	-0.292	Prop.7
							1.000	0.492	-0.208	-0.039	-0.242	-0.050	-0.270	Prop.8
								1.000	-0.031	0.255	-0.444	-0.231	0.030	Mobile P.
									1.000	-0.569	0.026	0.042	-0.077	Inflation
										1.000	-0.107	-0.217	-0.008	GDPg
											1.000	0.541	-0.100	Trade
												1.000	-0.167	FDI
													1.000	Demo

Prop: Proposition. P:Penetration. GDPg: GDP growth rate. FDI: Foreign Direct Investment. Demo: Democracy.

Appendix 3: Variable definitions

Variables	Signs	Variable definitions	Sources
Trade Openness	Trade	Exports plus Imports(% of GDP)	World Bank(WDI)
Capital Openness	FDI	Foreign Direct Investment(% of GDP)	World Bank(WDI)
Democracy	Demo	Institutionalized Democracy	World Bank(WDI)
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.

Appendix 4: Segments of the financial system by degree of formality in Paper's context

Paper's context		Tiers	Definitions	Institutions	Principal Clients
Formal financial system	Formal Financial sector (Deposit Banks)	Formal banks	Licensed by central bank	Commercial and development banks	Large businesses, Government
Semi-formal and informal financial systems	IMF Definition of Financial System from International Financial Statistics (IFS)	Semi-formal financial sector (Other Financial Institutions)	Specialized non-bank financial institutions		Rural banks, Post banks, Saving and Loan Companies, Deposit taking Micro Finance banks	Large rural enterprises, Salaried Workers, Small and medium enterprises
			Other non-bank financial institutions	Legally registered but not licensed as financial institution by central bank and government	Credit Unions, Micro Finance NGOs	Microenterprises, Entrepreneurial poor
	Missing component in IFS definition	Informal financial sector	Informal banks	Not legally registered at national level(though may be linked to a registered association)	Savings collectors, Savings and credit associations, Money lenders	Self-employed poor

Source (Asongu,2011a)

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