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Law, mobile money drivers and mobile money innovations in developing countries

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Abstract

This study investigates how the rule of law (i.e. law) modulates demand- and supply-side drivers of mobile money to influence mobile money innovations (i.e. mobile money accounts, the mobile phone used to send money and the mobile phone used to receive money) in developing countries. The following findings from Tobit regressions are established. First, from the demand-side linkages, law modulates: (i) bank accounts and automated teller machine (ATM) penetration for negative interactive relationships with mobile money innovations and (ii) bank sector concentration for a positive interactive relationship with mobile money accounts. Second, from supply-side linkages, law interacts with: (i) mobile subscriptions for a negative relationship with the mobile phone used to send money; (ii) mobile connectivity coverage for a negative nexus on the mobile phone used to receive money and (iii) mobile connectivity performance for a negative influence on the mobile phone used to send/receive money. Policy implications are discussed in the light of enhancing the rule of law as well as improving mobile phone subscription, connectivity and performance dynamics.

1. Introduction

The study is premised on investigating the importance of the rule of law in modulating demand-side and supply-side mobile money drivers for financial inclusion in developing countries[1]. The premise of the study builds on three fundamental elements in the policy and scholarly literature, namely: (i) the relevance of mobile phones and attendant externalities in sustainable development goals (SDGs); (ii) the importance of mobile technologies in inclusive finance and (iii) omissions in the attendant literature that are worthwhile to address. The motivational factors are further clarified in the light of the same chronology in which they are highlighted.

First, the substance of mobile technologies in SDGs is informed by the importance of the technologies in enabling progress towards sustainable development on the one hand and on the other, their relevance as essential contributors towards the realization of the post-2015 sustainable development agenda of the United Nations (UN) which encompass 17 inequality and poverty oriented targets to be reached by the year 2030 (Granryd, 2018). It is equally imperative to disclose that in 2016 or in the immediate aftermath of the post-2015 millennium development agenda, among the multitude of industries, the mobile industry was the first to clearly make a commitment to the corresponding SDGs (Granryd, 2018). It did so by making a pledge that it would substantially leverage on the existing networks it had built in the mobile industry to boost the delivery of inclusive services in poor and developing nations. According to the narrative, it is apperant with the unfolding of time that mobile technologies are in the driver's seat in tailoring corresponding services to the realization of all 17 SDGs.

Second, the essence of mobile technologies in financial inclusion is visible from a multitude of perspectives and the attendant visibility is apparent in the way such technologies are improving livelihoods by, *inter alia*, mitigating income inequality and poverty (Gosavi, 201I8; Granryd, 2018; Tchamyou, Asongu & Odhiambo, 2019a; Morsy, 2020; Asongu, Nnanna & Acha-Anyi, 2020a, 2020b; Anarfo, Abor & Osei, 2020; Koomson, Bukari & Villano, 2021). A mechanism by which the underlying intuition is being manifested is through

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[1] In this study, the terms "mobile" and "mobile phones" are used interchangeably. Moreover, mobile money innovations are used interchangeably with three main dynamics, notably: mobile money accounts, the mobile used to send money and the mobile used to receive money. Modulation is understood in this study as the rule of law interacting with mobile money drivers to influence mobile money innovations. Modulating is therefore aimed at the rule of law hypothetically amplifying the nexus between mobile money drivers and mobile money innovations. In this context, both the rule of law and mobile money drivers are acknowledged as positive macroeconomic signals. Conservely, the term "moderation" refers to a context when one of the interacting variables is a negative macroeconomic signal such that, the rule of law moderates the effect of the negative signal on mobile money innovations. Examples of negative macroeconomic signals are inequality and poverty.

mobile money innovations because as documented by Granryd (2018), as of the end 2017, approximately 700 million mobile accounts were registered which reflected a rise of about 62% from the two previous years. In line with the discourse, mobile money increased as an indispensible medium of exchange and payment platform for many countries in the digitial economy. Connecting these insights to the present study, such mobile money innovations are largely traceably to the outcome variables employed in the present study, notably: mobile money accounts, the mobile phone used to send money and the mobile phone used to receive money. In summary, the narrative maintains that such mobile technologies are associated with favorable externalities within the framework of reducing poverty and inequality which are significant policy syndromes standing on the way to the achievement of most inclusive-related SDGs. The purpose of the present study is to provide more insights into the extant literature in respect to how the rule of law is relevant in modulating both demand- and supply-side mobile money drivers for financial inclusion in terms of mobile money innovations.

Third, the focus of the study within the framework highlighted in the last sentence of the previous paragraph is informed by an apparent gap in the scholarly literature on the importance of mobile technologies in financial inclusion. Accordingly, whereas a significant body of knowledge has been devoted to the importance of mobile phones in promoting financial inclusion (Ondiege, 2010; Asongu, 2013; Uduji & Okolo-Obasi, 2018a, 2018b; Tchamyou, Erregers & Cassimon, 2019; Lashitew, van Tulder & Liasse, 2019; Asongu, Biekpe & Cassimon, 2020, 2021), the attendant body of knowledge is sparse on the relevance of the rule of law in moderating how demand factors and supply features of mobile money innovations influence the mobile money innovation outcomes. Some of the contemporary studies from which this study departs have been concerned with: law as information in the data-driven era (Hildebrandt, 2016; Bayamlioğlu & Leenes, 2018) as well as the nexus between the rule of law and technological management (Brownsword, 2016); coherence in technology law (Guihot, 2019); the linkage between smart technology, law and the circular economy (Thomas, 2018); agricultural technology and inclusive governance (Beyleveld & Jianjun, 2017) and the incidence of mobile phones in grovernance-driven exports of technology commodities (Asongu & Asongu, 2019).

Among studies in the evolving strand of literature on mobile money innovations, the closest to this study is Lashitew et al. (2019) which has examined correlates of mobile money innovations in developing countries. In essence, the attendant study has used supply factors, demand features and macro level factors to assess drivers of mobile money innovations in the developing world. The corresponding proxies for mobile money innovations are mobile

money accounts, the mobile used to send money and the mobile used to receive money. The present research departs from Lashitew et al. (2019) on both aguemental and technical fronts. From the argumental perspective, it is argued that while understanding drivers of mobile money innovations is informative and relevant to policy makers, understanding how the attendant drivers interact with one another to influence mobile money innovations is even more relevant because it provides the opportunity to assess which drivers are complementary and which substituting. This understanding of complementarity is consistent with policy insights from studies based on interactive regressions (Efobi & Osabuohien, 2013; Asongu & Odhiambo, 2020a). On the technical front, understanding how the rule of law (which is a dimension of institutional governance) affects the importance of demand-side and supply-side factors in mobile money innovations is fundamental because the relevance of the attendant factors is largely contingent on the quality of institutions. This is consistent with contemporary literature on the importance of institutions in driving innovation and the knowledge economy in developing countries (Oluwatobi, Efobi & Olurinola, 2015; Alege Tchamyou, 2017; Asongu & Odhiambo, 2019b).

The discussed extension of Lashitew et al. (2019) leads to the following findings. First, from the demand-side nexuses: (i) the rule of law modulates bank accounts and automated teller machine (ATM) penetration to establish negative conditional relationships with mobile money innovations while (ii) the role of the rule of law in modulating bank sector concentration for mobile money accounts is positive. Second, from supply-side mobile money regressions: (i) there is a negative interactive nexus between the rule of law and mobile subscriptions for the mobile phone used to send money and (ii) mobile connectivity coverage is moderated by the rule of law for a negative nexus on the mobile phone used to receive money and the corresponding negative nexus is also apparent from interactions between mobile connectivity performance for the mobile phone used to send/receive money.

The rest of the paper is organized in the following way. The theoretical underpinnings and intuition for the study are covered in Section 2. Section 3 presents the data and corresponding methodology whereas the empirical results and attendant discussion are provided in Section 4. Section 5 concludes with suggestions for further research.

2. Theoretical underpinnings and intuition

The theoretical underpinnings motivating the adoption of mobile technologies for inclusive development by means of mobile money innovatons are fundamentally treacable to technology acceptance models (Asongu & Odhiambo, 2020b). Coleman (1998) submits that a

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critical perspective in information diffusion rests on the innovation ability of the person using the technology. Rosenberg (1972) is consistent with Coleman (1998) on the stance that human capital (i.e. knowledge, skill and expertise) and human interactions are essential for people to adopt information technologies. Moreover, within the framework of mobile phones, there is a growing body of literature supporting the perspective that people are continuously adopting the attendant technologies because of corresponding innovations that address societal concerns such as the need for financial inclusion (Uduji, Okolo-Obasi & Asongu, 2018, 2019a, 2019b, 2019c, 2020; Issahaku, Abu & Nkegbe, 2018; Abor, Amidu & Issahaku, 2018). In the light of the corresponding literature (Yousafzai, Foxall & Pallister, 2010; Asongu, Nwachukwu & Aziz, 2018), there are three main theories on technology acceptance, notably: the technology acceptance model (TAM), the theory of planned behavior (TPB) and the theory of reasoned action (TRA).

In the light of the above, the TPB, TAM and TRA which underpin this study posit that the decision to select, adopt and use a specific technology is contingent on the type of technology as well as on the anticipated innovative externalities associated with the underlying technology. According to the TRA, users of technological innovations (e.g. mobile money innovations as used in this study) are rational in their motivations and are also knowledgeable of their actions surrounding the adoption of such technologies (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980; Bagozzi, 1982). It is worthwhile to take on board the fact the TPB is an improved version of the TRA (Ajzen, 1991). The TPB is framed, when differences exist among individuals who show some conscious connections to their actions as opposed to those for which such conscious connections are not apparent. In respect of the TAM, the hypothesis underpinning an individual's desire to adopt and use a given technology is contingent on the voluntary consideration of such an individual to willingly accept to adopt and use the given innovation in technology (Davis, 1989). It is worth articulating that there are two essential common perspectives underlying the three theories, notably: (i) an individual's belief make-up and (ii) composite features surrounding psychological, behaviorial, personal and utilitarian characteristics (Asongu & Odhiambo, 2020b).

In the light of the above, the various traits that underline the adoption of mobile money innovations by an individual are worth engaging. (i) The utilitarian view is apparent when the user adopting a mobile money innovation is more concerned by the anticipated usefulness in the light of the corresponding potential externalities of imporving the individual's wellbeing. Accordingly, having acess to a mobile money account on the one hand, and on the other, using the mobile phone to send/receive money, have a plethora of benefits already highlighted

in the introduction of this study. (ii) From the behaviorable angle, even when personal motivations are not apparent, an individual can take the decision of adopting mobile money innovations because he/she intends to be take part in the social normality. (iii) Pyschological and personal features can be apparent when ucommon potential gains motivate individuals to adopt mobile money innovations. This is logical when such users are aware of some attendant benefits that other users are not yet aware of. For instance, the use of mobile phones to send/receive money may entail some hidden positive externalities that are exclusively known by a few users. (iv) The importance of belief formation in the user adopting the mobile phone in order to benefit from financial inclusion in terms of mobile money innovations is premised on the view that it has become an accepted societal norm that the use of mobile phones and mobile money innovations can potentially improve living standards, because they, *inter alia*, increase financial inclusion and reduce transaction costs.

The anticipated benefits from mobile money innovations can be consolidated when institutional governance in the perspective of the rule of law is apparent. Accordingly, to the OECD (2019), the rule of law is fundamental in promoting economic development, because it, *inter alia*: (i) is an essential value and the basis of good governance; (ii) represents one of the core pillars of the wellbeing of people; (iii) reduces inequalities by granting equal access to justice; (iv) provides an enabling environment and favorable business climate; (v) boosts empowerment, literacy and awareness and (vi) promotes responsive justice and legality in people-centred systems. Given the assocated inclusive benefits of the rule of law, it is natural to posit that the rule of law would modulate the demand- and supply-side mobile money drivers. Some perspectives of this intuition are substantiated in what follows.

It is logical to anticipate that the degree by which demand-side and supply-side mobile money drivers influence mobile money innovations is contingent on the rule of law because in the light of the preceding paragraph, an environment with a better rule of law improves consumption and investment opportunities that can be linked to mobile money innovations associated with such consumption and investment avenues. It follows that a country with comparatively higher levels of rule of law can benefit more from mobile money innovations compared to a country with poor levels of the rule of law. The arguments surrounding the importance of the rule of law in modulating mobile money drivers for mobile money innovations are broadly consistent with the importance of strengthening the rule of law (OECD, 2019) as well as the nexus between the rule of law and technology management (Brownsword, 2016).

3. Data and methodology

3.1 Data

Following the motivation of this research which is an extension of Lashitew et al. (2019), the research builds on the data used by the underlying study which consist of 2010 to 2014 averages from developing countries for which data were available at the time of the study. The data are obtained from a plethora of authoritative sources, notably: (i) the Global System for Mobile Communications Association (GSMA); (ii) Waveman and Koutroumpis (2011); (iii) the Global Financial Structure Database (GFSD); (iv) the Financial Inclusion Indices (Findex) database and (v) World Governance Indicators (WGI) and World Development Indicators (WDI) of the World Bank.

Three main mobile money innovation variables are used, namely: mobile money accounts, the mobile used to send money and the mobile used to receive money. The source of these dependent variables is the 2014 Findex database. Moreover, while Lashitew et al. (2019) has assessed drivers of mobile money innovations using supply, demand and macro-level factors, the present study uses one macro level factor (i.e. the rule of law) to modulate the incidences of both demand and supply factors in order to assess how such moderations affect mobile money innovations. Another worthwhile consideration is that, owing to concerns of mulitcollinearity that have been identified and corrected by extensions of Lashitew et al. (2019) in the empirical literature (Asongu et al., 2020, 2021), not all covariates employed by the underlying study are used in the present study. Therefore, while all variables used by Lashitew et al. (2019) are clarified in this study in order to articulate how the presented study steers clear of Lashitew et al. (2019), only variables relevant to the problem statement of this study are employed in the empirical exercise. The attendant variables are discussed in what follows.

First, the supply-oriented mobile money drivers are: (i) mobile connectivity performance, mobile connectivity coverage and the "gross and unique subscription" rates from the GSMA; (ii) mobile penetration rate from the WDI of the World Bank and (iii) telecommunications sector regulation (hence telecom) obtained from Waverman and Koutroumpis (2011). Second, the corresponding demand oriented factors which are sourced from the GFSD entail: the number of automated teller machines (ATMs); bank sector concentration and "perecentage of adults with a bank account in a formal banking institution". Third, macro-level factors are both from the WDI (i.e. GDP growth, GDP per capita and urbanization rate) and WGI (i.e. the rule of law) of the World Bank. The choice of the control variables is motivated by both contemporary and non-contemporary literature on financial

inclusion (Muwanguzi & Musambira, 2009; Mas & Morawczynski, 2009; Waverman & Koutroumpis, 2011; Demirguc-Kunt & Klapper, 2012; Demirgüç-Kunt & Klapper, 2013; Gruber & Koutroumpis, 2013; Van der Boor, Oliveira & Veloso, 2014; Demirgüç-Kunt, Klapper & Van Oudheusden, 2015; World Bank, 2016; Asongu & Odhiambo, 2018a; Murendo, Wollni, De Brauw & Mugabi, 2018; GSMA, 2018; Asongu & Asongu, 2018).

There are two main sets of specifications in this study, (i) the role of the rule of law in the incidence of demand-side mobile money drivers on mobile money innovations for which supply-side mobile money drivers are partly used as control variables and (ii) the role of the rule of law in the incidence of supply-side mobile money drivers on mobile money innovations for which demand-side mobile money drivers are used as part of the control variables. It follows that when the main independent variables of interest are demand factors, supply factors are part of the control variables and vice versa. On the expected signs of the control variables, with the exception of bank sector concentration which is anticipated to negatively affect mobile money innovations, the adopted control variables in both sets of regressions are largely expected to positively influence mobile money innovations. This is consistent with the attendant literature which has documented that bank sector concentration or market power can limit financial access because banks use such market power to set the prices of loans above marginal costs in order to increase their profits margins and enjoy a quiet life (Asongu, Nwachukwu & Tchamyou, 2016; Tchamyou & Asongu, 2017; Kusi, Agbloyor, Ansah-Adu & Gyeke-Dako, 2017; Asongu & Biekpe, 2018; Boateng, Asongu, Akamavi & Tchamyou, 2018; Kusi & Opoku-Mensah, 2018; Asongu & Odhiambo, 2018b; Tchamyou, 2019).

The appendices provide more information on the definitions of variables and their corresponding sources (see Appendix 1), the summary statistics (see Appendix 2) and the correlation matrix (see Appendix 3). The correlation matrix guides the study on the concern of multicollinearity discussed in the subsequent paragraphs. A discourse on the corresponding threshold of multicollinearity which is 0.600 is provided in the methodology section.

4.2 Methodology

A threshold of 0.600 is used to identify concerns of multicollinearity because it the average of two opposing tendencies in the mainstream scholarship. As apparent in Appendix 3, the highlighted correlation values in bold, are combinations of independent variables of interest which should be avoided in a specification. In essence, the threshold is an average of two

contending strands from Kennedy (2008) who has advocated a 0.700 threshold and Obrien (2007) and Wichers (1975) who have posited for a 0.500 threshold.

The adopted methodology which is the Tobit empirical strategy is consistent with that adopted by Lashitew et al. (2019). The choice of the empirical strategy is informed by both contemporary and non-contemporary literature on the essence of adopting the Tobit regression strategy when the dependent variable is specified within a determined range (Kumbhakar & Lovell, 2000; Koetter & Vins, 2008; Coccorese & Pellecchia, 2010; Ariss, 2010; Asongu & Nwachukwu, 2016; Ajide, Raheem & Asongu, 2019). Put in other words, minimum and maximum values of the attendant outcome variable should be clearly articulated.

In the light of information on the outcome variables provided in the summary statistics (see Appendix 2), the mobile money innovations variables are: (i) theoretically defined within a range of 0% to 100% adoption rates and (ii) practically defined by ranges of 0.00% to 58.39%, 0.00% to 60.48% and 0.00% to 66.65%, adoption rates for "mobile money accounts", "the mobile used to send money" and "the mobile used to receive money", respectively. The direct understanding of the statistics above is that the outcome variables are censored on both sides of the conditional distribution of the mobile money innovation dynamics. Moreover, the Ordinary Least Squares (OLS) approach is not tailored to account for the censored nature of the outcome variables because the corresponding estimation technique is not adapted to account for variations in the conditional probabilities of restricted observations which are evident when minimum and maximum adoption rates are typical of the dependent variable (Amemiya, 1984).

It follows from the underlying that the Tobit regression model is appropriate for this study because it takes on board the extreme points of the conditional distribution of the adopted mobile money accounts, the mobile phone used to send money and the mobile phone used to receive money. In the light of Tobit (1958) and Carson and Sun (2007), Equations (1) and (2) below reflect the standard estimation Tobit process.

$$y_{i,t}^{*} = \alpha_0 + \beta X_{i,t} + \varepsilon_{i,t} \ , \hspace{3cm} (1)$$

where $y_{i,t}^{*}$ is a latent response variable, $X_{i,t}$ is an observed $1 \times k$ vector of explanatory variables and $\varepsilon_{i,t} \approx$ i.i.d. N(0, σ²) and is independent of $X_{i,t}$. As opposed to observing $y_{i,t}^{*}$, we observe $y_{i,t}$:

$$y_{i,t} = \begin{cases} y_{i,t}^{*}, & if \ y_{i,t}^{*} > \gamma \\ 0, & if \ y_{i,t}^{*} \leq \gamma, \end{cases} \hspace{2cm} (2)$$

where γ is a non-stochastic constant. It follows that, the value of $y_{i,t}^*$ is missing when it is less than or equal to γ.

There are two main assumptions linked to the adopted empirical approach. On the one hand, it is assumed that the residuals are distributed normally. On the other hand, the dependent mobile money innovation outcomes are linked to an unbounded and linear function of the independent variables (Amemiya, 1984). It is also worthwhile to emphasize that two main marginal nexuses are apparent when relating the principal predictors (i.e. demand- and supply-side mobile money drivers). The first puts into perspective the marginal nexuses of the principal predictors of the unobserved latent rate of mobile money adoption rates whereas the second corresponds to the censored and observed mobile money adoption rates. The reported findings or empirical results are consistent with contemporary literature (Lashitew et al., 2019; Asongu et al., 2020, 2021) in which, marginal nexuses underlying the relationship between observed and censored rates of mobile money innovations are exclusively provided in the light of the fact that according to the attendant literature, such disclosure is in line with more obvious interpretations from an analytical point of view.

4. Empirical results
4.1 Presentation of results

The empirical findings are disclosed in this section in two main tables. While Table 1 shows results on linkages between the rule of law, demand-side mobile money drivers and financial inclusion in terms of mobile money innovations, Table 2 discloses the corresponding findings on nexuses between the rule of law, supply-side mobile money drivers and financial inclusion. Three main demand- and supply-side channels are adopted for each table and for each of these mechanisms, three main specifications are apparent that are relevant respectively to the three mobile money adoption outcome variables.

In order to assess the overall incidence of the rule of law in modulating the adopted demand- and supply-side mobile money driving channels on the mobile money innovations, net relationships cannot be computed in the light of contemporary interactive regression studies (Agoba, Abor, Osei & Sa-Aadu, 2019; Asongu & Odhiambo, 2020c, 2020d) because at least one estimated coefficient needed for the computation of such net relationships is not significant in the corresponding specifications. Hence, interpretations of the findings are restricted exclusively to the conditional or interactive relationships in accordance with another strand of interactive regressions literature (Osabuohien & Efobi, 2013; Asongu & Odhiambo, 2020e).

The following findings are apparent from Tables 1-2. First, from the demand-side nexuses: (i) the rule of law modulates bank accounts and ATM penetration to establish negative conditional relationships with mobile money innovations while (ii) the role of the rule of law in modulating bank sector concentration for mobile money accounts is positive. Second, from supply-side mobile money regressions: (i) there is a negative interactive nexus between the rule of law and mobile subscriptions for the mobile phone used to send money and (ii) mobile connectivity converage is moderated by the rule of law for a negative nexus on the mobile phone used to receive money whereas the corresponding negative nexus is apparent from interactions between mobile connectivity performance for the mobile phone used to send/receive money. Third, most of the significant control variables have the expected signs.

Table 1: Law, demand-side mobile phone innovations and financial inclusion

	Dependent variables: Mobile money accounts, Mobile used to send money & Mobile used to receive money								
	Law and Bank accounts			Law and ATM penetration			Law and Banking Sector Concentration		
	Mobile money accounts	Mobile used to send money	Mobile used to receive money	Mobile money accounts	Mobile used to send money	Mobile used to receive money	Mobile money accounts	Mobile used to send money	Mobile used to receive money
Rule of Law (Law)	**2.955****	-0.236	-1.218	0.669	-0.529	-1.503	**-5.553*****	-4.232	**-5.517***
	(0.020)	(0.853)	(0.478)	(0.512)	(0.658)	(0.333)	**(0.009)**	(0.124)	**(0.092)**
Bank Accounts (BA)	-0.024	0.009	0.008	---	---	---	---	---	---
	(0.296)	(0.755)	(0.806)						
ATM Penetration (ATM)	---	---	---	0.003	-0.018	-0.015	---	---	---
				(0.822)	(0.453)	(0.564)			
Banking Sec. Con. (BSC)	---	---	---	---	---	---	-0.022	0.001	-0.004
							(0.219)	(0.924)	(0.855)
Law × BA	**-0.096*****	**-0.058****	**-0.065***	---	---	---	---	---	---
	(0.002)	**(0.049)**	**(0.062)**						
Law × ATM	---	---	---	**-0.061****	**-0.052****	**-0.055****	---	---	---
				(0.018)	**(0.027)**	**(0.039)**			
Law × BSC	---	---	---	---	---	---	**0.057****	0.020	0.023
							(0.024)	(0.469)	(0.501)
Mobile Subscription rate	-0.009	0.025	0.016	-0.003	0.023	0.014	0.017	0.036	0.029
	(0.706)	(0.324)	(0.589)	(0.875)	(0.389)	(0.676)	(0.446)	(0.161)	(0.341)
Mobile Connectivity Perf.	**0.150****	-0.118	-0.127	0.087	-0.087	-0.095	0.036	-0.122	-0.134
	(0.046)	(0.125)	(0.163)	(0.138)	(0.289)	(0.315)	(0.406)	(0.182)	(0.199)
Telecom sector regulation	**5.429***	2.111	4.171	**8.130*****	5.542	**8.069****	**6.792****	4.533	6.291
	(0.059)	(0.459)	(0.213)	**(0.008)**	(0.100)	**(0.041)**	**(0.012)**	(0.196)	(0.119)
GDP growth	**0.619*****	0.054	-0.048	**0.745*****	0.207	0.163	**0.702*****	0.209	0.109
	(0.001)	(0.817)	(0.876)	**(0.000)**	(0.398)	(0.596)	**(0.000)**	(0.373)	(0.706)
Urbanization	-0.044	0.020	0.043	-0.045	0.009	0.023	**-0.054***	-0.001	0.013
	(0.141)	(0.634)	(0.389)	(0.136)	(0.823)	(0.661)	**(0.063)**	(0.976)	(0.795)
Africa	**7.610*****	**3.109***	**5.019****	**8.110*****	2.336	**3.997***	**7.363*****	2.085	**3.675***
	(0.000)	**(0.098)**	**(0.030)**	**(0.000)**	(0.212)	**(0.078)**	**(0.000)**	(0.234)	**(0.094)**
Asia	**3.489****	-0.179	0.479	**3.607****	-0.654	-0.151	2.582*	-0.932	-0.350
	(0.035)	(0.906)	(0.797)	**(0.023)**	(0.658)	(0.931)	(0.089)	(0.527)	(0.843)
Americas	**4.877****	**-2.347***	-2.429	**4.889*****	-2.446	-2.437	**4.751*****	**-2.367***	-2.296
	(0.010)	**(0.087)**	(0.117)	**(0.007)**	(0.107)	(0.147)	**(0.005)**	**(0.088)**	(0.140)
Middle East	**3.693***	**-3.364***	-2.792	**5.719****	-2.235	-1.014	**5.019****	-2.860	-1.791
	(0.069)	**(0.091)**	(0.194)	**(0.010)**	(0.288)	(0.658)	**(0.019)**	(0.162)	(0.413)
Observations	111	117	117	115	119	119	116	120	120

GDP: Gross Domestic Product. PPP: Purchasing Power Parity. *,**,***: significance levels of 10%, 5% and 1% respectively.

Table 2: Law, supply-side mobile phone innovations and financial inclusion

	Dependent variables: Mobile money accounts, Mobile used to send money & Mobile used to receive money								
	Law and Mobile Subscription (MS)			Law and Mobile Connectivity Performance (MCP)			Law and Mobile Connectivity Coverage (MCC)		
	Mobile money accounts	**Mobile used to send money**	**Mobile used to receive money**	**Mobile money accounts**	**Mobile used to send money**	**Mobile used to receive money**	**Mobile money accounts**	**Mobile used to send money**	**Mobile used to receive money**
Rule of Law (Law)	0.310 (0.831)	-0.308 (0.859)	-1.056 (0.653)	0.004 (0.996)	-1.306 (0.237)	-2.087 (0.134)	1.320 (0.345)	2.017 (0.274)	1.557 (0.518)
Mobile Subscription (MS)	0.015 (0.498)	0.026 (0.203)	0.027 (0.273)	---	---	---	---	---	---
MCP	---	---	---	0.021 (0.963)	-0.145 (0.039)	**-0.162** (0.046)	---	---	---
MCC	---	---	---	---	---	---	-0.008 (0.769)	-0.047 (0.161)	-0.040 (0.318)
Law × MS	-0.011 (0.621)	**-0.051*** (0.067)	-0.057 (0.120)	---	---	---	---	---	---
Law × MCP	---	---	---	-0.025 (0.584)	-0.135 (0.010)	**-0.159** (0.010)	---	---	---
Law × MCC	---	---	---	---	---	---	-0.024 (0.180)	**-0.081*** (0.003)	**-0.093*** (0.006)
Bank accounts	0.009 (0.738)	0.019 (0.577)	0.016 (0.702)	0.005 (0.864)	0.034 (0.329)	0.031 (0.448)	0.010 (0.704)	0.026 (0.430)	0.020 (0.608)
Banking Sector Conc.	-0.040 (0.077)	-0.003 (0.877)	-0.006 (0.815)	-0.038 (0.103)	-0.006 (0.796)	-0.007 (0.794)	**-0.038*** (0.096)	-0.003 (0.886)	-0.002 (0.922)
GDP growth	**0.552*** (0.002)	0.131 (0.522)	0.043 (0.870)	**0.528*** (0.006)	-0.007 (0.972)	-0.115 (0.669)	**0.507*** (0.005)	0.016 (0.932)	-0.092 (0.726)
Urbanization	**-0.046*** (0.095)	0.001 (0.961)	0.017 (0.594)	-0.037 (0.167)	0.022 (0.615)	0.043 (0.420)	-0.035 (0.201)	0.023 (0.635)	0.039 (0.491)
Africa	**8.227*** (0.001)	**4.476** (0.012)	**6.184*** (0.006)	**8.254*** (0.000)	**3.457** (0.044)	**5.126** (0.016)	**8.175*** (0.001)	**3.610** (0.037)	**5.571** (0.013)
Asia	**2.941*** (0.078)	-0.746 (0.575)	-0.204 (0.900)	**3.264** (0.040)	-0.095 (0.947)	0.611 (0.734)	**3.155*** (0.055)	-0.372 (0.780)	0.364 (0.828)
Americas	**5.781*** (0.002)	-1.074 (0.392)	-1.017 (0.480)	**5.825*** (0.001)	-1.675 (0.223)	-1.743 (0.256)	**5.530*** (0.003)	-1.826 (0.213)	-1.812 (0.272)
Middle East	**5.226** (0.016)	-2.070 (0.202)	-1.865 (0.277)	**4.714** (0.033)	-2.795 (0.121)	-2.812 (0.140)	**4.792** (0.025)	-2.900 (0.115)	-2.869 (0.127)
Observations	123	129	129	122	128	128	122	128	128

GDP: Gross Domestic Product. PPP: Purchasing Power Parity. *,**,***: significance levels of 10%, 5% and 1% respectively.

4.2 Further discussion of results

The finding are further discussed in this section in three strands, notably: (i) the negative conditional linkages between the rule of law and attendant demand- and supply-side mobile money drivers on mobile money innovations; (ii) the economic relevance of insignificant unconditional findings and (iii) clarifying the concern of bank accounts and associated dynamics not having the anticipated effect on financial inclusion in developing countries. These points are expanded in the same chronology as highlighted.

First, the rule of law broadly interacts with both demand-side and supply-side mobile money drivers to negatively influence mobile money innovations fundamentally because it is negatively skewed. It is important to note that while the rule of law is conceived as a positive governance signal, it measured as both a positive and a negative signal in the perspective that

it takes both positive and negative values. Hence, while the rule of law is thereotically conceived as an indicator of good governance, in practical terms however, a positively skewed rule of law can be understood as favorable rule of law while a negatively skewed rule of law is correspondingly understood as an unfavorable rule of law. As apparent in the summary statistics, the rule of law is negatively skewed because: (i) it has a negative mean value and (ii) its maximum positive value is lower in magnitude compared to its corresponding minimum negative value. It follows that in order to have the anticipated positive interactions, the rule of law should be enhanced so that it should be positively skewed. Suggestions on how the rule of law can be improved are discussed in the concluding section.

Second, the largely insignificant unconditional nexuses of the mobile money drivers is also an indication that the attendant mobile money drivers have to be further consolidated and improved within the framework of influencing mobile money innovations. Hence, considering the intuitive and established relevance of the adopted mobile money drivers on mobile money innovations, the insignificant unconditional estimates are reported nonetheless in order to articulate the importance of policy makers to formulate and implement policies that improve the nexus between mobile money drivers and mobile money innovations. Suggestions on how these mobile money drivers can be improved are discussed in the concluding section.

In the light of the above, estimated coefficients that are statistically insignificant also have as much economic meaning and policy relevance as, estimated coefficients that are statistically significant. Hence, by reporting the corresponding findings and not relegating them to the "file drawer", this study also contributes to the literature of combating publication bias in which insignificant, weak and unexpected results are shelved in preference for significant, strong and expected results, respectively (Rosenberg, 2005; Franco, Malhotra & Simonovits, 2014; Asongu, 2015).

Third, the findings of the study also clarify some concerns in the literature as to why bank accounts and corresponding externalities may not be having the desired outcomes in terms of financial inclusion in developing countries (Klapper, El-Zoghbi & Hess, 2016). This study has shown that the concern may be traceable to low levels of the rule of law (and by extension, low levels in other dimensions of governance) that are relevant in adequately modulating mobile money drivers for mobile money innovations. The importance of the rule of law in driving financial inclusion by means of mobile money innovations has been discussed in Section 2.

5. Concluding implications and future research directions

This study investigates how the rule of law modulates demand- and supply-side drivers of mobile money to influence mobile money innovations (i.e. mobile money accounts, the mobile used to send money and the mobile used to receive money) in developing countries. The following findings from Tobit regressions are established. First, from the demand-side nexuses: (i) the rule of law modulates bank accounts and ATM penetration to establish negative conditional relationships with mobile money innovations while (ii) the role of the rule of law in modulating bank sector concentration for mobile money accounts is positive. Second, from supply-side mobile money regressions: (i) there is a negative interactive nexus between the rule of law and mobile subscriptions for the mobile phone used to send money and (ii) mobile connectivity converage is moderated by the rule of law for a negative nexus on the mobile phone used to receive money and the corresponding negative nexus is also apparent from interactions between mobile connectivity performance for the mobile phone used to send/receive money. Two main policy implications can be extracted from the study, notably: (i) the importance of improving the rule of law to generate indicators with positive skewness and (ii) the need to enhance mobile subscription, connectivity and performance dynamics in order to contribute towards reversing the signs of the established negative conditional nexuses.

First, the rule of law can be consolidated by improving some aspects discussed in the theoretical underpinnings section or Section 2 of this study (i.e. OECD, 2019). (i) The mobile money innovation case for the rule of law and responsive justice for social inclusion can be consolidated by *inter alia*: building a sound mechanism for consistent investments in projects of the rule of law that are specifically aligned to financial inclusion by means of mobile money innovations and adopting more people-centred mobile innovation leglislations. (ii) Legal literacy, awareness and empowerment programs should be designed to publicize the importance of mobile money innovations in financial inclusion. (iii) Enhancing people-centred as well as responsive justice and legal systems are worthwhile because such would, *amongst others*; address concerns that are preventing mobile money drivers from having the expected outcomes on mobile money innovations.

Second, mobile subscription, connectivity and performance dynamics can be enhanced by: (i) boosting value chains pertaining to mobile financial services in order to allow for more savings and mobile accounts to be opened and enable better financial access to the previously unbanked population, *inter alia*. (ii) More dimensions of digital innovation and inclusion should be considered, given that doing so facilitates the much essential move of financial

technologies (i.e. fintechs) to the digital economy which is indispensible in the fourth industrial revoluation. (iii) Taking into account the importance of fintechs beyond the perspective of financial services is also worthwhile because it enables an economy to use previously untapped human and economic resources for financial inclusion and productivity. (iv) Boosting mobile phone owernership through universal access policies as well as the attendant infrastructure relevant to the improvement of connectivity coverage and performance such as the speed at which data is uploaded and downloaded via mobile networks.

The study can be improved by investigating if the findings withstand empirical scrutiny when other dimensions of governance (e.g. political stability, "voice & accountability", government effectiveness, regulatory quality and corruption-control) are taken on board. In addition, owing to constraints in data availability at the time of study, only relationships are apparent from this study and hence, it would be worthwhile to examine (as time unfolds) if the established relationships can be extended to causality when the relevant panel data estimation techniques are used on data with more data points.

Appendices

Appendix 1: Definitions and sources of variables

Variables	Descriptions	Sources
Dependent variables		
Mobile Accounts	Percentage of adults who have personally used mobile phone to pay bills, send or receive money in the past 12 months using a GSMA recognized mobile money service	Financial Inclusion Indices (Findex) database
Sending Money	Percentage of adults who used a mobile phone to send money in the past 12 months	
Receiving Money	Percentage of adults who used a mobile phone to receive money in the past 12 months	
Demand factors		
Account at formal financial institution	Percentage of adults who have an account at a formal financial institution	Global Financial Structure Database (GFSD)
ATM access	Number of ATMs per 100,000 people	
Banking sector concentration	The percentage share of the three largest commercial banks in total banking assets	
Supply factors		
Mobile phone penetration - Gross & unique subscription rates	Gross mobile subscription rates refer to the percentage of adults in a country with subscriptions to mobile phones based on data from WDI. We used additional data from GSMA (2014) to calculate unique mobile subscription rates by correcting for double SIM-card ownership, which differs between rural and urban areas. This correction is based on survey evidence that urban and rural users own 2.03 & 1.18 active SIM-cards respectively.	World Development Indicators (WDI), GSMA
Mobile connectivity quality	Measures the average speed of uploading and downloading data through mobile network in 2014 & 2015.	GSMA
Mobile connectivity coverage	Measures the weighted average of share of populations covered by 2 G, 3 G and 4 G mobile data networks (normalized to range between 0 and 100).	GSMA
Telecom regulation	Measures the regulatory quality of the telecom sector in terms of four major criteria: transparency, independence, resource availability, and enforcement capability of the regulator. The index is based on dozens of indicators taken from the International Telecommunication Union's regulatory database.	Waverman and Koutroumpis (2011)
Macro-level factors		
Rule of Law	A measure of the extent to which agents have confidence in and abide by the rules of society	WDI
GDP per capita	GDP per capita in purchasing power parity	WDI
GDP growth	The rate of total GDP growth	WDI
Urbanization rate	Percentage of population living in urban areas	WDI

Notes: Mobile Accounts is based on the second wave of the survey (2014) and Sending Money and Receiving Money are based on the first wave (2011). The variables telecom regulation is based on data for 2011. The two variables measuring mobile connectivity are based on average values for the years 2014 & 2015. For the remaining variables, averages are taken over the years 2010–2014 to smooth out potential year-to-year variations.

Appendix 2: Summary Statistics

Variables	Mean	S.D	Min	Max	Obs
Dependent variables					
Mobile accounts (%)	3.30	7.90	0.00	58.39	145
Sending money (%)	3.10	7.58	0.00	60.48	146
Receiving money (%)	4.47	9.58	0.00	66.65	146
Demand factors					
Account at formal fin. Institution (%)	45.72	31.73	0.40	99.74	147
ATM penetration	43.28	45.03	0.33	279.71	148
Banking sector concentration	71.94	20.70	9.49	100.00	143
Supply factors					
Unique mobile subscription rate	61.73	23.29	4.23	133.64	199
Mobile connectivity (performance)	11.92	14.69	0.04	67.19	147
Mobile connectivity (coverage)	62.18	27.29	8.88	99.60	147
Telecom regulation	0.41	0.17	0.00	0.74	128
Macro-level factors					
GDP per capita (PPP)	17,874	19,677	648	132,468	152
GDP growth	3.90	2.82	-4.92	11.10	153
Rule of Law	-0.09	1.01	-2.42	1.98	157
Urbanization (%)	58.22	22.85	8.81	100	155

Notes: The average values for the dependent variables are calculated across all countries, including those in which mobile money services are not available.

Appendix 3: Correlation matrix

	Mobile inclusion variables			Demand Factors				Supply Factors			Macro-level Factors				Region dummies			
	MMA	Send M	Receiv.M	BankAc	ATM Pen	BankSC	UMSr	MCP	MCC	TSR	GDPpc	GDPg	RL	Urban	Africa	Asia	Americas	Middle East
MMA	1.000																	
Send M	0.640	1.000																
Receiv.M	0.597	0.980	1.000															
Bank Ac	-0.292	-0.227	-0.266	1.000														
ATM Pen	-0.319	-0.248	-0.279	**0.708**	1.000													
BankSC	-0.079	-0.028	-0.026	0.051	-0.171	1.000												
UMSr	-0.237	-0.116	-0.142	0.411	0.305	-0.045	1.000											
MCP	-0.320	-0.272	-0.300	**0.821**	**0.779**	-0.053	0.270	1.000										
MCC	-0.385	-0.300	-0.323	**0.815**	**0.701**	-0.091	0.525	**0.780**	1.000									
TSR	-0.088	-0.070	-0.067	0.549	0.363	-0.008	0.237	0.466	0.473	1.000								
GDPpc	-0.420	-0.209	-0.228	**0.825**	**0.690**	-0.078	**0.644**	**0.729**	**0.872**	0.535	1.000							
GDPg	0.376	0.189	0.176	-0.532	-0.481	-0.058	-0.300	-0.477	-0.527	-0.433	-0.553	1.000						
RL	-0.271	-0.273	-0.308	**0.850**	**0.623**	0.040	0.374	**0.838**	**0.772**	**0.605**	**0.772**	-0.457	1.000					
Urban	-0.396	-0.212	-0.220	0.566	0.567	-0.051	0.364	0.598	0.731	0.349	**0.788**	-0.381	0.583	1.000				
Africa	0.533	0.415	0.444	-0.558	-0.519	0.123	-0.462	-0.487	**-0.681**	-0.288	**-0.683**	0.407	-0.418	-0.560	1.000			
Asia	-0.101	-0.076	-0.088	0.087	0.077	-0.009	-0.013	0.153	-0.006	-0.129	0.007	0.244	0.014	-0.075	-0.199	1.000		
Americas	-0.098	-0.116	-0.095	-0.176	-0.016	-0.004	0.092	-0.198	-0.029	0.001	0.045	0.025	-0.221	0.158	-0.268	-0.278	1.000	
Middle East	-0.086	-0.072	-0.082	-0.0001	0.047	0.019	-0.010	0.035	0.124	-0.131	0.140	0.040	0.017	0.237	-0.101	-0.105	-0.141	1.000

MMA: Mobile Money Accounts. Send M: Sending Money. Receiv M: Receiving Money. Bank Ac: Bank Accounts. ATM Pen: ATM Penetration. BankSC: Bank Sector Concentration. UMSr: Unique Mobile Subscription rate. MCP: Mobile Connectivity Performance. MCC: Mobile Connectivity Coverage. TSR: Telecom Sector Regulation. GDPpc: Gross Domestic Product per capita in PPP (in logs). GDPg: GDP growth. RL: Rule of Law. Urban: Urbanization.

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