# Mobile Money and Socioeconomic Development: A Cross-Country Investigation in Sub-Saharan Africa

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## ABSTRACT

*Over the past decade, mobile money, as a disruptive financial services innovation, has been widely adopted in Sub-Saharan Africa where the majority of population was financially excluded. Despite the transformative role of mobile money, the macro-level socioeconomic implications have been weakly examined so far. To fill the research gap, this paper explores the theoretical and empirical links between mobile money and socioeconomic development. Drawing on the theory of technology affordances and the emerging mobile money literature, this paper argues that mobile money, when adopted on a massive scale, has the potential to lead to socioeconomic development at the societal level. Results of Difference-in-Differences analysis show that mobile money, when widely adopted, has a positive effect on a country's economic growth. Additional analysis reveals that the positive effect is found to increase as mobile money spreads into a society over time. This paper contributes to the emerging mobile money literature by documenting the positive relationship between mobile money and socioeconomic development at the societal level.*

**KEYWORDS**: Mobile Money, Affordances, Socioeconomic Development, Economic Growth, Financial Inclusion, Developing Economies

## INTRODUCTION

In recent years, two industries that have seen phenomenal growth in developing economies are telecommunication and microfinance. Both industries have fuelled socioeconomic development by opening up new possibilities for communication and financial services to populations in both rural and urban areas (e.g., Aker & Mbiti, 2010; Majchrzak et al., 2016; Khandker, 2005; Andrianaivo & Kpodar, 2012). The uniquely flexible digital technologies make it possible to reconfigure and recombine sociotechnical elements of telecommunication and microfinance, giving birth to a widely applauded financial technology innovation: mobile money. Since its inception in the mid-2000s, mobile money has been believed to hold the

potential to transform the landscape of financial inclusion and generate significant socioeconomic benefits in developing economies (e.g., Plyler et al., 2010; Jack et al., 2013; GSMA, 2015; Aron, 2017).

Two billion people in the world remain unbanked, without access to safe, secure, and affordable financial services (GSMA, 2015). Financial exclusion leads to a variety of serious social problems such as social exclusion, poverty, and income inequality, which, in turn, further marginalizes the unbanked low-income population from formal economy and social activities (Radcliffe & Voorhies, 2012). Over the last decade, this situation has been alleviated with the introduction of mobile money (e.g., M-Pesa), with which individuals, households, and businesses have access to basic financial services (e.g., person-to-person money transfer, payments, saving) over mobile phones. With cash digitized into electronic money (e-money), mobile money overcomes a range of financial barriers, provides advantages over traditional banking services, and has been particularly attractive for low-income population who are excluded from traditional banking services (Mas, 2010; Jack & Suri, 2014; Aron, 2017).

As widely deployed in developing economies over time, mobile money has been increasingly argued to be a promising digital pathway to satisfy the unmet financial demands and therefore facilitate financial inclusion. With deepened degree of financial inclusion, time has witnessed the potentially disruptive socioeconomic implications of mobile money. However, research on this phenomenon is still in its infancy, and understanding of socioeconomic benefits of mobile money has so far been limited (Aron, 2017). In particular, the emerging literature dominantly focuses on socioeconomic impacts at the household (e.g., Mago & Chitokwindo, 2014; Jack & Suri, 2014) and the small business level (e.g., Bångens & Söderberg, 2011; Chale & Mbamba, 2015), with few studies at higher level of analysis (e.g., Plyler et al., 2010). Although the documented evidence suggests the potentially aggregate effects, the research at the societal level remains scant. More in this point, very few, if any, studies have provided cross-country empirical evidence. To fill the research gap, this paper asks and addresses the following research question:

***Research Question****: Does mobile money, when widely adopted, lead to a country's socioeconomic development?*

In providing the theoretical account of the link between mobile money and socioeconomic development, this paper draws on the theory of technology affordances (e.g., Markus & Silver, 2008). The unique perspective of the theory is that what mobile money brings about is essentially a set of new affordances to be exploited and actualized by users. This paper argues that the affordances of mobile

money, once actualized on a massive scale, generate not only immediate socioeconomic benefits, but the conditions for subsequent affordances that are likely to be triggered and actualized to produce far-reaching socioeconomic impacts at a higher level. As the affordances and the impacts realized at different levels build on and reinforce each other, socioeconomic development is precipitated at the societal level.

Using a number of empirical specifications based on Difference-in-Differences approach and Granger causality test, this paper notably finds that successful take-off of mobile money deployment in an developing economy leads to economic growth, and not *vice verse*. In addition, the results show that the positive effect grows over time as a greater population adopts mobile money. Robustness checks not only corroborate the main results, but reveal that the positive increasing effect of mobile money holds even when controlling for mobile phone usage. The findings contribute to the emerging literature by establishing the positive relationship between successful mobile money deployment and socioeconomic development, which is, to the best of the author's knowledge, the first cross-country evidence.

The remainder of this paper is structured as follows. Section 2 reviews the literature of mobile money in developing economies and discusses technology affordances of mobile money. In Section 3, research methodology is described. Main results are reported in Section 4 and a series of robustness checks are conducted in Section 5. Section 6 closes this paper with discussions of theoretical and practical implications.

# LITERATURE REVIEW

This section first discusses mobile money and its deployment and adoption in developing economies, especially in Sub-Saharan Africa. Then, the theory of technology affordances is applied to provide the theoretical account of the link between mobile money and socioeconomic development, followed by the review of the socioeconomic benefits of mobile money at micro-, meso-, and macro-level. Finally, based on the theoretical discussion and reviewed evidence, this section develops a testable hypothesis.

## Mobile Money in Developing Economies

Mobile money, also called mobile financial services, refers to the use of information and communication technologies (ICT) and non-bank retail channels to extend the delivery of basic financial services to users who would not be reached profitably with traditional branch-based financial services (GSMA, 2015). By definition, mobile money is primarily deployed in developing economies to facilitate financial

inclusion and socioeconomic development. Therefore, it is important to conceptually demarcate mobile money from other mobile technology-based financial services, i.e., mobile banking in developed economies. The distinguishing characteristics are that 1) users can sign up for the service *without* an existing bank account; 2) users can convert cash and e-money into each other by visiting an authorized transactional agent outside of bank branches; and 3) users initiate transactions using an interface that is available on basic mobile handsets. The fundamental differences are summarized in Table 1.

**Table 1. Comparison of Mobile Money and Mobile Banking**

|  | *Mobile Money* | *Mobile Banking* |
|---|---|---|
| **Primary focus** | To provide basic financial services via mobile phone to achieve financial inclusion | To deliver existing banking services via mobile phone to make them easily accessible |
| **Deployed mainly in** | Developing economies | Developed economies |
| **Target customer base** | Low-income population with limited access to financial services | Existing customers |
| **Banking business** | Little credit provision | Deposit-taking and credit services |
| **Example** | M-Pesa | Apple Pay |

Mobile money is made possible by digitally reconfiguring existing sociotechnical elements that were previously disconnected (Yoo et al., 2012). In particular, taking advantage of powerful affordances of digital technologies (Kallinikos et al., 2013), mobile money providers are able to orchestrate telecommunication infrastructure, a network of transactional agents, and mobile phones to establish an end-to-end digital financial services system. Whereas telecommunication infrastructure provides technical foundation, the agents play a key role by offering front-line customer service, including, but not limited to, registration for the service, cash-in, and cash-out. By visiting an authorized "brick-and-mortar" agent, users create mobile money account under instruction. Then, a user can start cash-in process—converting cash into e-money stored in mobile money account. With value stored, the user may initiate a range of financial transactions such as person-to-person money transfer, bill payment, airtime top-up. In the case of receiving e-money from individuals, merchants, or institutions, the recipient can exchange e-money for cash at an agent—the cash-out process.

Leveraging on high penetration of mobile phones and widely scattered transactional agents (Mas & Morawczynski, 2009; Kendall et al., 2012; GSMA 2015), mobile money is able to serve as an alternative to and/or substitute for traditional banking services. Mobile phone—"*a bank branch in the pocket*"—is empowered to carry a sizable function of banking services. Likewise, transactional agent—"*a bank branch in the neighbourhood*"—that would have otherwise little to do with banking services are empowered to function as bank branches. As penetration rate grows, mobile money is believed to broaden reach and coverage of basic financial services at affordable costs into populations who would otherwise be excluded from traditional banking services (e.g., GSMA, 2015; Evans & Pirchio, 2015; Beck et al., 2016; Aron, 2017).

Since its inception, mobile money has been widely deployed and adopted in developing economies, especially in Sub-Saharan Africa. As of 2015, mobile money was available in 93 countries via 271 deployments. In 2015, 37 economies had ten times more registered agents than bank branches, and registered customer accounts grew 31% to reach a total of 411 million globally. In terms of transaction volume, mobile money processed over a billion transactions in December 2015, which was more than double what PayPal processed globally (GSMA, 2015). Number of transactions (per 1,000 adults) and value of the transactions (% of GDP) in several Sub-Saharan African countries with successful mobile money deployments are depicted in the left and right panel of Figure 1[1]. This figure suggests the potential substantive socioeconomic effects of mobile money; that is, the disruptive financial innovation facilitates active participation of users in economic activities, and has gradually become a crucial financial tool in driving socioeconomic development.

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[1] The data were collected from International Monetary Fund Financial Access Survey: http://data. imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C/ (visited on December 13, 2018).

**Figure 1. Number of Mobile Money Transactions (per 1,000 adults) and Value of the Transactions (% of GDP) by Country**
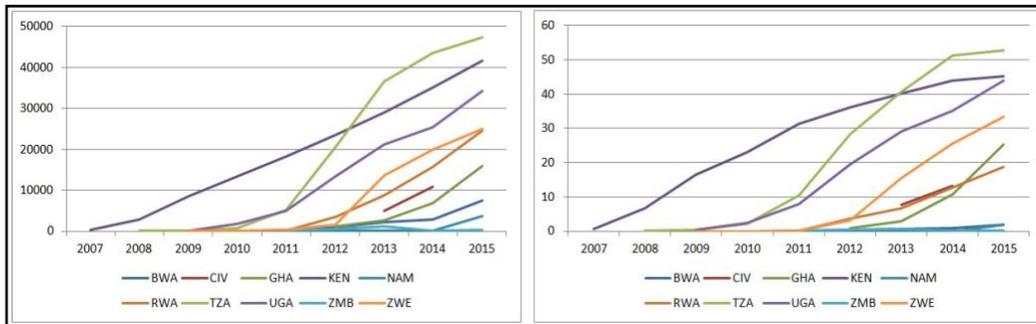


## Technology Affordances of Mobile Money

Technology affordance refers to "*an action potential, that is, to what an individual or organization with a particular purpose can do with a technology or information system*" (Majchrzak & Markus, 2012, pp. 832). By digitally orchestrating a new set of sociotechnical elements and relationships, an ICT innovation can bear multi-functionality (Yoo et al., 2012), which generates multiple affordances available to users. Users with different capabilities and purposes are able to achieve a variety of goals by exploiting and exploring multiple affordances of an innovation (Markus & Silver, 2008). For example, a smart phone can be used as a navigator, a music player, a digital camera, and a social media tool, which will lead to outcomes of different degrees and types. More in this point, as products and services are accessed, delivered, and consumed in a digital way, users are afforded the ability to circumvent traditional socioeconomic frictions (e.g., time-space constraints), and leverage data, knowledge and resources that were previously hardly accessed. For instance, crowdfunding affords entrepreneurs not only the ability to collect funds from the crowd, but the possibility to take advantage of non-financial value (e.g., knowledge of product development, marketing, human capital) provided by the crowd (e.g., Lehner et al., 2015).

Given its explanatory power, the technology affordances perspective has been increasingly applied to examine uses and consequences of an innovation (e.g., Leonardi, 2013), and received further theoretical development. Extending the previous theory that was focused on individual-level affordances as action potentials, Strong et al. (2014) shifted the focus from action potentials toward actualization of the potentials and theorized the process of actualizing affordances of an innovation in an organizational context, which explains organizational-level change. It is argued that when the primary affordances of an innovation (concerned

with key functions and capabilities) are perceived advantageous over existing practices and processes, the affordances are being simultaneously actualized by many individual actors. Such dynamic actualization not only generates immediate concrete outcomes, but may create enabling, stimulating, and releasing conditions under which a group of actors enact secondary and tertiary affordances (Strong et al., 2014). The newly enacted affordances are likely to be interrelated and interactive, and their actualization may contribute to achieving goals at group and/or organizational level. In the context of ICT innovations for development, it is therefore arguable that when affordances of an innovation are actualized by individual users on a large scale, a set of ripple affordances at collective level are likely to be unleashed, triggered, and actualized, the socioeconomic benefits of which build on, reinforce each other, and are aligned to produce socioeconomic development at societal level over time.

To understand the affordances of mobile money, it is necessary to briefly survey the landscape of financial services in developing economies. Prior to the advent of mobile money, low-income population has limited access to traditional banking services, due to poor formal financial infrastructure (e.g. low penetration of bank branches and ATMs) (Triki & Faye, 2013), and a series of financial barriers including accessibility, affordability and eligibility (Beck et al., 2008). Thus, it is not surprising that the financially excluded group has to rely on informal financial services, i.e., hiding cash under the mattress, participating in saving groups with, sending money via bus driver, etc. However, none of them can sufficiently satisfy financial needs because of costs and risks associated with cash, i.e., theft, loss, limited liquidity, etc. (Mas, 2010; Mbiti & Weil, 2011). The fundamental problem of insufficient formal and informal financial services is attributable to excessive immersion in cash (Radcliffe & Voorhies, 2012). Cash needs to be kept, transported, and circulated in physical way, and hence creates considerable frictions in developing economies where financial as well as basic public infrastructures remain underdeveloped. Consequently, in such economies, the access and use level of quality financial services meeting basic financial needs is rather limited.

Against this backdrop, mobile money is developed to cater to the basic financial needs of individuals, households, and businesses, especially those who are marginalized from traditional banking services (Radcliffe & Voorhies, 2012; Evans & Pirchio, 2015; Aron, 2017). The fundamental novelty of mobile money lies on the digitization of cash into e-money and the use of mobile phones as the media for financial transactions. With e-money, mobile money can relax time-space constraints and helps users stay out of costs and risks associated with cash (Mas, 2010; Mbiti & Weil, 2011). As such, mobile money reduces a variety of transactions costs including costs of sending and receiving money over distances,

transport costs of travel to a bank or government office, coordination costs between consumers and goods/services providers, and opportunity costs such as loss of money (Ramada-Sarasola, 2012; Aron, 2017). Therefore, *the primary affordances of mobile money are that users are afforded the ability to have access to a number of basic financial services, and conduct effective financial transactions with reduced costs than ever before*.

As will be discussed shortly, actualization of the primary affordances on a massive scale not only generates the immediate socioeconomic benefits, but creates enabling, stimulating, and releasing conditions under which additional affordances are likely to be triggered and actualized. The actualized affordances include, but are not limited to, improved household income, enhanced consumption and output of goods and services, capital accumulation, optimized capital and human resource allocation within households and businesses, and increased volume and velocity of financial transactions (Jack et al., 2010; Ramada-Sarasola, 2012; Aron, 2017), which, together, are believed to contribute to broader socioeconomic development. In the spirit of the transformational mechanism (from micro- to macro-level) (Hedström et al., 1998), we expect to observe socioeconomic benefits afforded by mobile money at varied levels, ranging from the individual/household through business to community level.

**Mobile Money and Socioeconomic Development**
Based on the theoretical discussion of technology affordances of mobile money, this sub-section reviews empirical evidence on socioeconomic benefits at micro-, meso-, and macro-level.

*Mobile Money and Household Welfare*
A growing body of studies shows that actualization of the primary affordances of mobile money, especially the instant e-money transfer, produces the immediate socioeconomic benefits concerning household welfare improvement. First, household income and consumption are enhanced due to frictionless e-money transfer among friends and family members via mobile money. For example, low-income households in rural areas in Kenya reported that income increased by up to 30% through transfers from their social networks (Morawczynski & Pickens, 2009). With disposable income, household consumption is improved. Jack and Suri (2011) observed that annual individual expenditure of M-Pesa users was, on average, 67% higher than that of non-users. Second, through instant e-money transfer, households are afforded the ability to smooth negative shock arising from events such as drought, disease, school dropout, to which households would otherwise have been susceptible (Jack & Suri, 2014; Aker et al., 2016). Third, mobile money also affords household users the ability to facilitate financial transactions that benefit family

businesses. Sekabira and Qaim (2017) found that mobile money enables smallholder coffee farm households in Uganda to accumulate capital and assets by improving agricultural marketing (e.g., transactions with buyers from distant regions) and facilitating off-farm economic activities (e.g., small businesses in trade, handcrafts), which would have been difficult to achieve.

Improved household welfare, afforded by mobile money, creates enabling conditions under which households can enact and actualize additional affordances. In cases when income and consumption effect of mobile money helps bring households out of poverty and negative shock, the beneficiaries are afforded the opportunity to invest more in human capital, compared with the case where mobile money is absent. Such households may support family members to acquire skills, and stretch the spectrum of labor decisions by engaging in higher-risk but higher-return occupations or migrating to higher-return labor markets (Jack & Suri, 2011). Mobile money, therefore, may contribute indirectly to quality of workforce and a high level of labor force participation in economic activities. In addition to human capital, the above evidence implies that mobile money may facilitate greater capital accumulation, more efficient family businesses investment, and a higher level of self-employment. It is arguable that affordances of mobile money, once realized on a massive scale, can not only produce the immediate socioeconomic impacts on household welfare, but contribute to socioeconomic development through improved human and financial capital.

### *Mobile Money and Small Businesses Growth/Creation of New Businesses*
Small businesses in developing economies often suffer several financial constraints such as lack of access to funds, debt collection, liquidity, cash-flow management and low sales (Bångens & Söderberg, 2011). Since use of e-money can substantively reduce transactions costs and facilitate financial trade (Simiyu & Oloko, 2015; Nyaga & Okonga, 2014), mobile money affords small businesses the ability to circumvent those financial bottlenecks and improve business operation and growth. Chale and Mbamba (2015) agreed with Bångens and Söderberg (2011) that small businesses in Tanzania benefit from mobile money in various aspects including sales transactions, purchase of stock, receiving payment, and payment of goods and services, which is translated into improved financial performance. More evidence has been documented in Kenya. Small businesses experience growth in sales revenue by saving and receiving money, and making payments through mobile money (Kirui & Onyuma, 2015; Ngaruiya et al., 2014; Wanyonyi & Bwisa, 2013), which, in turn, speeds up the cycle from capital to inventory to receivables and back to capital for future investment (Higgins et al., 2012).

Not only this, since mobile money serves as a foundational electronic payment infrastructure, it also affords entrepreneurs the opportunity to adopt new business models that contribute to socioeconomic development. For example, anecdotal evidence is that the new venture, M-Kopa in Kenya, was created to enable off-the-grid households in remote locations to access to electricity by taking a solar system home, and paying a daily amount through mobile money (M-Pesa) (Klapper et al., 2016). Also, mobile money is being integrated into healthcare systems to help marginalized community access healthcare services through mobile phones[2]. The use case of mobile money in supporting venture creation can also be found in micro-insurance industry (Gencer, 2011).

Whereas immediate economic benefits, afforded by mobile money, are concerned with improved business operation/performance and creation of new businesses, a set of subsequent ripple affordances are believed to generate far-reaching socioeconomic implications at the societal level. First, small businesses constitute a vast majority of business community in developing economies, especially in Sub-Saharan Africa (Mead & Liedholm, 1998). Second, small businesses play a pivotal role because they serve as a major source of producing goods and services; generating income to facilitate consumption; creating employment to develop a group of skilled workers; and reducing poverty, among other observed and unobserved socioeconomic effects (Beck et al., 2005). Finally, technological innovations and new ventures enabled by mobile money add new jobs and income within those markets and provide socioeconomic benefits to marginalized community who would otherwise continue to be sidelined.

### *Mobile Money and Community Development*
Given socioeconomic benefits, directly and indirectly afforded by mobile money, at the household and business level, the aggregate effects seem plausible at the community level, where mobile money is widely adopted. A few studies suggest that mobile money can serve as an engine for community development and local economy. Ramada-Sarasola (2012) maintained that affordances of mobile money, once widely actualized in a community, produces impacts on increasing efficiency of local financial market, boosting local infrastructure, increasing labor demand, and increasing the need for local innovations. Likewise, Plyler et al. (2010) empirically examined the spillover and ripple effects of M-Pesa in Kibera (urban slum), Muranga and Kitui (two rural districts), Kenya. The study showed that both users and non-users benefit from the actualized affordances of M-Pesa through the four overarching socioeconomic effects, along with 11 sub-effects, at the

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[2] https://www.gsma.com/mobilefordevelopment/programme/mhealth/mobile-money-transforming-healthcare-in-emerging-markets/ (visited on December 13, 2018).

community level: local economic expansion (money circulation, expansion of businesses, and employment opportunities), security (money, food, and physical), capital accumulation (human, social, and financial capital) and business environment (transactions ease and quality control). In the similar vein, Yokossi (2017) recently found that ubiquitous access to mobile money services in communities of Kenya contributes to local economic activity and performance.

### *Mobile Money and Financial Inclusion/Financial Sector Development*
Once adopted on a massive scale, mobile money affords the improved financial inclusion and financial sector development. On the one hand, given the lack of access to quality financial services in developing economies, the rural poor households are willing to adopt and use mobile money for it provides an accessible, convenient, cheap, and secure way of transferring money, saving money, and making payments (e.g., Mbiti & Weil, 2011; Mago & Chitokwindo, 2014). Mas and Ng'weno (2012) showed that mobile money is regarded as an efficient alternative to and complement with cash in business transactions for informal small businesses. At macro level, Evans and Pirchio (2015) theorized that mobile money is more likely to take off and expand financial inclusion in poorer counties that lack formal financial infrastructure (e.g., low penetration of bank branches and ATMs). On the other hand, a growing body of studies shows the impact of mobile money on financial sector development. For example, Gencer (2011) argued that as mobile money reaches the previous financially excluded segments, it can afford the capture of new deposits from the informal sector and reallocation of financial capital to boost investment, production, and consumption. Also, Adam and Walker (2015) showed that mobile money helps to reduce the incompleteness of financial markets and increase the macroeconomic stability of the countries where mobile money is widespread, with benefits going mainly to rural, low-income households.

The socioeconomic implications of financial inclusion and financial sector development are well established. Deepened financial inclusion and efficient financial sector can enhance the quality and efficiency of financial intermediation, reduce the cost of capital, facilitate the efficient allocation of productive resources, and boost entrepreneurial activities, ultimately resulting in socioeconomic development (e.g., Asharf et al., 2006; Sarma & Pais, 2011; Sahay et al., 2015). Although the socioeconomic impacts have been predominantly considered with respect to formal financial services like bank accounts, given that mobile money has been found to contribute to greater financial inclusion and financial sector development in developing economies (e.g., Aron, 2017; Adam & Walker, 2015), this paper argues that a financial innovation like mobile money achieved outside the sphere of traditional financial institutions can also drive socioeconomic development.

## Recap: A Testable Hypothesis

It is worth noting that the socioeconomic benefits afforded by mobile money at each level may interact, build on, and reinforce each other, igniting a spiral of socioeconomic development, as the theory of technology affordances suggests. Mobile money, as efficient and effective financial services, is found to promote household welfare. As a greater number of users integrate mobile money in their daily lives, mobile money turns into a fundamental payment infrastructure, which facilitates financial transactions for small businesses and spurs creation of new ventures. The output of those businesses produces more jobs and promotes household income that can be consumed, saved, and invested into human/financial capital. Also, the widespread use of mobile money deepens financial inclusion and financial sector development, which eliminates financial frictions and costs for both business and public sector to push the frontier of socioeconomic development that will ultimately benefit households.

The evidence reviewed at the household, business, community, and nation level (from micro to macro) suggests that mobile money holds the potential to lead to socioeconomic development. However, the research on mobile money impacts at the societal level remains scant. In the context of Kenya, Beck et al. (2016) found that the introduction of M-Pesa in 2007 explained 14% of the total factor productivity growth between 2006 and 2013. Yet, generalizability of the finding may be limited as the study only investigated a single country. In their cross-country study, Andrianaivo and Kpodar (2012) showed that the positive relation between financial inclusion (measured by number of deposits/loans accounts per head) and economic growth was stronger in countries where mobile money has been deployed. This finding, however, deserves further investigation because only three countries (Zambia, South Africa, and Kenya) were considered. Despite the limited evidence, the two studies point to the potential socioeconomic impacts of mobile money at the societal level.

To summarize the literature, it is arguable that mobile money, when adopted on a massive scale, can be considered as a driving force of socioeconomic development. To make it testable, this paper considers a particular aspect—economic growth—of socioeconomic development, and formulates the following hypothesis:

*Hypothesis: Mobile money, when widely adopted, has a positive effect on a country's economic growth.*

# METHODOLOGY

Since mobile money has not been around for long, the macro level research is mainly constrained by limited data availability (Triki & Faye, 2013). One potential way to overcome this limitation and examine the link is to use Difference-in-Differences (DD) approach. The underlying logic of DD is to determine the effect of a treatment (e.g., policy, medication, training program, etc.) by measuring the differences of the mean changes in outcomes of treatment and control group in pre-versus post-period (Card & Krueger, 1993; Autor, 2003; Angrist & Pischke, 2008). For example, in their seminal study, Card and Krueger (1993) treated minimum wage law as a treatment, and investigated the impact of the law on employment growth by comparing fast food stores in New Jersey and Pennsylvania, one of which was affected by the law, while the other not.

In this spirit, this paper considers the *widespread adoption of mobile money* (or successful mobile money deployment) as a treatment, and attempts to examine the impact on economic growth by comparing countries, in which mobile money has been widely adopted, with countries where mobile money was not available (as of 2015) or identified as a failed deployment. In order to further explore the potential *causal* link, this study also implements the Granger causality test along with DD approach. The Granger test is a popular method to determine whether causes precede consequences and not *vice versa* (Granger, 1969). In what follows, the basic elements—treatment and control group, and time period—are constructed. Then, data and variables are described, and a set of models with respect to DD approach and Granger test are specified.

## Treatment, Control Group, and Time Period
In using DD approach, the impact of a treatment would be more convincing if members in treatment and control group share similar characteristics i.e., patients with the same disease. In this logic, this paper decided to consider countries from the same region—Sub-Saharan Africa, instead of sampling from the population. The motive of choosing this area is threefold. First, the countries are closer to each other in socioeconomic sense relative to the case in which a Sub-Saharan African country is compared with a Latin American country; second, a majority of those countries are developing economies, and 75% of the population in this area do not have access to traditional banking services (Alexandre et al., 2011); and third, mobile money has been intensively deployed and rapidly adopted in this area (GSMA, 2015; Evans & Pirchio, 2015).

The criterion distinguishing treatment and control group is *whether mobile money has been widely adopted*. As an emerging phenomenon, there is no hard, universal rule, and the decision has to be made in an exploratory fashion. However, in investigating adoption pattern of successful versus failed mobile money in developing economies, Evans and Pirchio (2015) concluded that mobile money either ignites and takes off quickly or does not at all. Based on that conclusion, this study determines countries in treatment group. Using number of mobile money accounts per 1,000 adults collected from International Monetary Fund Financial Access Survey[3], this paper examines adoption patterns in Sub-Saharan African countries. Among those, the left panel of Figure 1 includes 6 countries that Evans and Pirchio (2015) identified as those with successful mobile money deployments. In the similar vein, this paper determines additional 4 countries that show successful mobile money adoption patterns (See right panel of Figure 2). This exploratory approach makes sense because penetration approaches toward 800 out of 1,000 adults in a few years since deployment. Taken together, treatment group consists of 10 countries (See Table 2).

**Figure 2. Mobile Money Adoption in Countries with Successful Mobile Money Deployment (Treatment Group)**
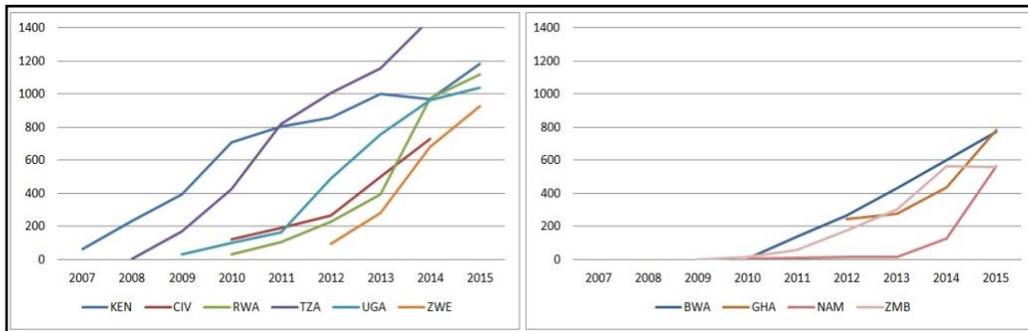


As for the control group, there are two sub-sets. The first set includes 6 countries where mobile money had not been carried out as of 2015, according to GSMA Mobile Money Development Tracker[4]. This Tracker documents deployments of mobile money initiatives in developing economies around the world. The second set encompasses 5 countries with failed mobile money deployment as per Evans

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[3] International Monetary Fund Financial Access Survey. URL: http://data.imf.org/?sk=E5DCA B7E-A5CA-4892-A6EA-598B5463A34C/ (visited on December 13, 2018).

[4] GSMA Mobile Money Development Tracker. URL: https://www.gsma.com/mobilefordevelo pment/m4d-tracker/mobile-money-deployment-tracker/ (visited on December 13, 2018).

and Pirchio (2015). In short, treatment and control group comprises 10 and 11 countries, respectively (See Table 2).

**Table 2. Countries in Treatment and Control Group**

| *Treatment Group* | *Control Group* |
|---|---|
| Botswana (*BWA*) | Angola (*AGO*) |
| Côte d'Ivoire (*CIV*) | Burkina Faso (*BFA*) |
| Ghana (*GHA*) | Cape Verde (*CPV*) |
| Kenya (*KEN*) | Central African Republic (*CAF*) |
| Namibia (*NAM*) | Chad (*TCD*) |
| Rwanda (*RWA*) | Comoros (*COM*) |
| Tanzania (*TZA*) | Equatorial Guinea (*GNQ*) |
| Uganda (*UGA*) | Madagascar (*MDG*) |
| Zambia (*ZMB*) | Nigeria (*NGA*) |
| Zimbabwe (*ZWE*) | South Africa (*ZAF*) |
| | Sudan (*SDN*) |
| **Total: 10** | **Total: 11** |

In addition to the treatment and control group, the other key element of DD approach is time period. According to GSMA Mobile Money Development Tracker, mobile money had been intensively launched in Sub-Saharan Africa between 2008 and 2010. Given this observation, this study decides to consider 5 years prior to and post this intensive launch period. It should be noted that there is no universal pre and post period in the dataset because the timing of mobile money deployment varies across countries. As a result, a balanced panel dataset is created, consisting of 273 country-year observations, with 21 countries ranging from 2003 to 2015.

**Variables**
Following the prior research (e.g., Datta & Agarwal, 2004), this paper uses GDP per capita growth rate (*GDPPCGR*) as dependent variable, measuring economic growth. This data was extracted from World Development Indicators. The key explanatory variable is Mobile Money (*MM)*, a dummy variable. It is assigned the value of 1 for treatment country in the year when mobile money is available; otherwise 0. In doing so, this variable can capture the effects of successful mobile money deployments on the treatment countries in post periods. This data was derived from GSMA Mobile Money Development Tracker. Following the prior studies (e.g., Sassi & Goaied, 2013), this paper considers three control variables:

government consumption (% of GDP) (*Lgc*); inflation rate (annual %) (*Linf*); and trade openness (% of GDP) (*Ltrade*). All control variables are transformed to logarithmic form and the data was collected from World Development Indicators. Due to the limited data availability (and missing values), this paper has to drop some frequently used control variables such as interest rate and education level.

## Model Specifications
When we examine the antecedents of economic growth, one typical concern is that one can hardly consider all factors that relate to economic growth. To overcome this concern, this paper adopts a three-pronged approach. First, country-fixed effects are used to control for country-specific, time-invariant characteristics. Second, year-fixed effects are deployed to control for year-specific variables that might vary over time but not across countries. Third, multiple control variables are introduced as aforementioned. In consistent with the economic growth literature (e.g., Sassi & Goaied, 2013; Andrianaivo & Kpodar, 2012), this paper estimates a standard growth model as below.

$$y_{it} = \beta_0 + \beta_1 MM_{it} + \beta_2 X_{it} + \gamma_i + \lambda_t + \varepsilon_{it}$$

In this model, $y_{it}$ represents economic growth, measured by GDP per capita growth rate (*GDPPCGR*) of a country $i$ in year $t$. $MM_{it}$, as dummy variable, captures the treatment effect of successful mobile money deployment in a country $i$ in year $t$. $X_{it}$ represents control variables of a country $i$ in year $t$. $\gamma_i$ and $\lambda_t$ represent country- and year-fixed effects, respectively. $\varepsilon_{it}$ is error term.

In order to detect the potential causal link, this study also creates *Lead* (anticipatory effects) and *Lag* (post-treatment effects) variables in the spirit of Granger (1969). The Granger idea is to see whether causes happen before consequences, and not *vice versa*. If mobile money causes economic growth, *Lead* variables should be *insignificant* and the coefficients are close to *zero*, whereas *Lag* variables are *significant* (Autor, 2003; Angrist & Pischke, 2008). In addition to causality detection, using *Lead* and *Lag* variables offers two additional advantages. First, it enables us to test parallel trend assumption of DD approach (Angrist & Pischke, 2008). Second, as *Lag* variables essentially *decompose* the dummy variable, $MM_{it}$, into a series of dummy variables, we are able to observe the pattern of mobile money impact over time (e.g., either increasing or decreasing or flattening), which is of substantive interest. Accordingly, the model is formulated as follows.

$$y_{it} = \beta_0 + \beta_1 Lead_i + \beta_2 Lag_i + \beta_3 X_{it} + \gamma_i + \lambda_t + \varepsilon_{it}$$

Due to small sample size, the number of variables that could be considered in the above model is limited.  As such, this paper constructs 2 *Lead* variables and 3 *Lag* variables for each country. *Lead 2* and *Lead 1* are indicator variables for 3 year and 2 year prior, respectively. Since it is observed that a pilot study was often conducted prior to the commercial launch of mobile money[5], this study intentionally omits 1 year prior as an effort to mimic deployment of mobile money in a country as an intervention (or treatment) as per DD design. As for *Lag* variables, this paper creates three indicators that reflect three phases rather than individual post-treatment year. *Lag 1*, *Lag 2* and *Lag 3* represent three phases, corresponding to 1) launch year (of the first mobile money deployment) and one year after; 2) two years and three years after; and 3) four or more years after, respectively.

STATA package was used to estimate the country-/year-fixed effects models. Also, this study implements *vce (cluster)* option to cluster standard errors on country, which returns more robust standard errors of point estimates (Bertrand et al., 2004). Summary statistics of variables are reported in Table 3.

## Table 3. Summary Statistics

| *Variable* | *Obs* | *Mean* | *SD* | *Min* | *Max* |
|---|---|---|---|---|---|
| *GDPPCGR* | 273 | 2.806 | 5.918 | -36.830 | 32.248 |
| *MM* | 273 | 0.249 | 0.433 | 0 | 1 |
| *Lead 2* | 273 | 0.037 | 0.188 | 0 | 1 |
| *Lead 1* | 273 | 0.037 | 0.188 | 0 | 1 |
| *Lag 1* | 273 | 0.073 | 0.261 | 0 | 1 |
| *Lag 2* | 273 | 0.073 | 0.261 | 0 | 1 |
| *Lag 3* | 273 | 0.103 | 0.304 | 0 | 1 |
| *Lgc* | 273 | 2.573 | 0.459 | 0.716 | 4.158 |
| *Linf* | 273 | 2.316 | 1.118 | -0.509 | 10.103 |
| *Ltrade* | 273 | 4.194 | 0.426 | 2.950 | 5.727 |

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[5] For example, M-Pesa pilot in Kenya:https://www.scribd.com/document/195926126/M-Money-Channel-Distribution-Case-Kenya-SAFARICOM-M-PESA/ (visited on December 13, 2018); Zoona pilot in Zambia: https://www.sbs.ox.ac.uk/sites/default/files/Skoll_Centre/Docs/Zoona-Case-A.pdf/ (visited on December 13, 2018); MTN pilot in Ghana and Côte d'Ivoire: https://techbaron.com/mtns-mobile-money-transfer-launch-in-uganda-to-pave-way-for-rollout-in-other-countries/ (visited on December 13, 2018).

# RESULTS

The results are reported in Table 4[6]. In consistent with the previous research (e.g., Sassi & Goaied, 2013; Andrianaivo & Kpodar, 2012), government consumption (*Lgc*) and inflation rate (*Linf*) are negatively associated with economic growth, whereas trade openness (*Ltrade*) is positively related to economic growth. These results verify the validity of the models specified in the current setting.

**Table 4. Impact of Mobile Money on Economic Growth (DV: GDP per capita growth)**

|  | *(1)* | *(2)* | *(3)* | *(4)* |
|---|---|---|---|---|
| *MM* | ---- | 3.120*** [1.103] | ---- | ---- |
| *Lead 2* | ---- | ---- | ---- | -1.154 [1.781] |
| *Lead 1* | ---- | ---- | ---- | 0.328 [2.662] |
| *Lag 1* | ---- | ---- | 2.792*** [0.932] | 2.683** [1.071] |
| *Lag 2* | ---- | ---- | 2.887* [1.410] | 2.763** [1.316] |
| *Lag 3* | ---- | ---- | 3.748** [1.691] | 3.612** [1.683] |
| *Lgc* | -4.871* [2.796] | -4.538* [2.680] | -4.585* [2.701] | -4.644* [2.646] |
| *Linf* | -2.245*** [0.521] | -1.992*** [0.518] | -2.011*** [0.523] | -2.015*** [0.532] |
| *Ltrade* | 5.854** [2.366] | 4.866** [2.258] | 4.787** [2.284] | 4.808** [2.297] |
| Constant | -4.419 [7.905] | -1.775 [7.852] | -1.280 [8.326] | -1.207 [8.206] |
| Observations | 273 | 273 | 273 | 273 |
| # of Countries | 21 | 21 | 21 | 21 |
| F test (F) | 9.61 | 13.19 | 38.44 | 258.77 |
| Prob > F | 0.000 | 0.000 | 0.000 | 0.000 |
| $R^2$ overall | 0.109 | 0.148 | 0.150 | 0.150 |

[6] For the sake of space, all results of Year dummies are not reported. They are available upon request.

*Notes: Standards errors in brackets; \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.*

Column (2) shows that mobile money, when widely adopted, is positively associated with a country's economic growth. The coefficient means that when comparing the treatment and control group, the countries with successful mobile money deployments experience, on average, 3.12% higher economic growth than those in control group, other things being equal. The explanatory power of mobile money is also illustrated by the increase in overall $R^2$ from 0.109 to 0.148. When we decompose the dummy variable, *MM*, into three phases, *Lag 1* through *Lag 3*, the results (Column (3)) reveal that the effect of mobile money remains significantly positive throughout the three phases. More in this point, the coefficient increases over time, showing greater impact on economic growth as mobile money service penetrates into the greater population.

As expected, even if *Lead* variables are introduced in the model (Column (4)), the positive increasing effect of mobile money holds with negligible change in size. The inclusion of *Lead* variables does not result in any change in overall $R^2$. Furthermore, the coefficients of *Lead* variables are found close to zero and insignificant, whereas the impacts of *Lag* variables remain positive. It is also worth noting that a sharply increasing effect on economic growth in the first few years after successful deployment of mobile money is observed (See Figure 3). These observations, together, reveal that in Granger's spirit mobile money leads to economic growth, and not *vice versa*. Put differently, successful mobile money deployments serves as an engine for economic growth, rather than a consequence of it. In addition, the coefficients of *Lead* and *Lag* variables show that current specification of DD models does not violate the parallel trend assumption (Angrist & Pischke, 2008), which lends further support to these results.

**Figure 3. Point Estimates and 95% Confidence Interval of Coefficients of Lead and Lag Variables (DV: GDP per capita growth)**
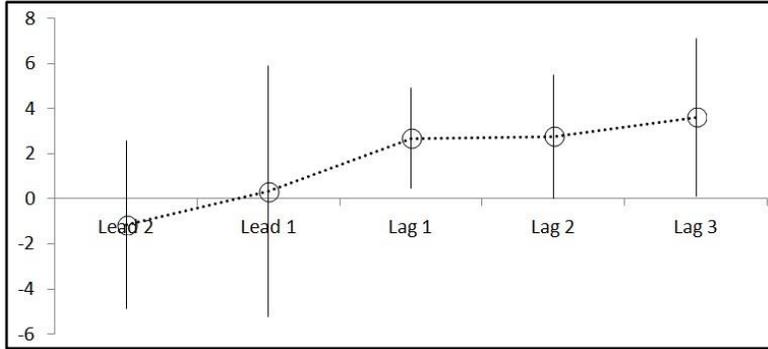


# ROBUSTNESS CHECKS

To test robustness of the results, this paper performs two extra analyses. First, an alternative dependent variable, GDP growth rate, is considered. Second, another control variable, *mobile phone per head*, is included in the model. The rationale of introducing mobile phone penetration is to disentangle the effect of mobile money from that of mobile phone usage. The results are reported in Table 5.

**Table 5. Robustness Checks**

|  | DV: GDP per capita growth (annual %) | | | DV: GDP growth (annual %) | | |
|---|---|---|---|---|---|---|
|  | *(5)* | *(6)* | *(7)* | *(8)* | *(9)* | *(10)* |
| *MM* | ---- | 2.636** [1.198] | ---- | ---- | 3.369** [1.201] | ---- |
| *Mobile phone per head* | 5.283* [2.725] | 3.442 [2.906] | 3.589 [2.949] | 5.324* [2.624] | 2.964 [2.692] | 3.063 [2.746] |
| *Lag 1* | ---- | ---- | 2.265** [1.029] | ---- | ---- | 2.908*** [1.036] |
| *Lag 2* | ---- | ---- | 2.312 [1.583] | ---- | ---- | 3.332** [1.572] |
| *Lag 3* | ---- | ---- | 3.332* | ---- | ---- | 3.959** |

| | | | [1.672] | | | [1.765] |
|---|---|---|---|---|---|---|
| *Lgc* | -4.823* [2.689] | -4.559* [2.622] | -4.613* [2.634] | -4.962* [2.730] | -4.624* [2.647] | -4.673* [2.663] |
| *Linf* | -2.079*** [0.510] | -1.923*** [0.510] | -1.942*** [0.515] | -2.332*** [0.507] | -2.133*** [0.499] | -2.148*** [0.504] |
| *Ltrade* | 5.565** [2.280] | 4.831** [2.224] | 4.743** [2.253] | 6.583*** [2.208] | 5.645** [2.153] | 5.548** [2.180] |
| Constant | -4.069 [7.643] | -1.957 [7.733] | -1.418 [8.211] | -4.777 [7.495] | -2.078 [7.587] | -1.517 [8.079] |
| Observations | 273 | 273 | 273 | 273 | 273 | 273 |
| # of Countries | 21 | 21 | 21 | 21 | 21 | 21 |
| F test (F) | 14.31 | 14.18 | 37.10 | 18.68 | 30.09 | 59.65 |
| Prob > F | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| $R^2$ overall | 0.119 | 0.152 | 0.154 | 0.133 | 0.180 | 0.183 |

*Notes: Standards errors in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.*

Column (6) and (7) show that due to inclusion of mobile phone usage, there is a slight decrease in the effect of *MM* as well as *Lag* variables, compared with the previous results. Although *Lag 2* becomes insignificant, the effect of successful mobile money development turns out to be significantly positive in the later phase, *Lag 3*, which in general concurs with the prior results. Even if we use GDP growth rate as dependent variable (Column (9) and (10)), the results hold consistent. In short, the robustness checks corroborate the major results that successful mobile money deployment contributes to economic growth and the effect grows over time. In addition, the results further reveal that the pattern of positive, increasing impact persists even when controlling for the effect of mobile phone usage.

What is of great interest is the change in coefficient of *mobile phone per head*. In line with previous studies (e.g., Lee et al., 2012), *mobile phone per head*, as a proxy for mobile phone usage, is positively correlated to economic growth. However, when we introduce mobile money in the model, the effect becomes statistically insignificant. Given the small sample size, the number of variables that can be considered is limited. Further research could examine in depth the dynamics between mobile money and mobile phone usage by expanding the sample size as additional data on mobile money becomes available.

# DISCUSION AND CONCLUSION

This paper investigates whether successful mobile money deployment, or the widespread adoption of mobile money, leads to socioeconomic development at the societal level. In exploring the theoretical link, this paper builds on the technology affordances perspective. Essentially, what mobile money brings to users are a set of new affordances, or action potentials, which, once actualized, could help circumvent or overcome traditional socioeconomic frictions. By digitizing cash into e-money, mobile money affords users the ability to have access to and use a number of basic financial services in a more efficient and effective way than ever before.

As a greater number of users actualize the affordances, resulting socioeconomic benefits have been observed at varied levels. In particular, mobile money affords households the ability to improve household welfare, small business owners the possibility to thrive their businesses, and entrepreneurs the ability to develop digital business model, which are found to unleash additional interrelated and reinforcing affordances that, once actualized, contribute to higher-order socioeconomic development including community development, local economy, financial inclusion and financial sector development. Along these lines, it is hypothesized that mobile money, when widely adopted, can have a positive effect on economic growth, the economic aspect of socioeconomic development. Based on Difference-in-Differences approach and Granger causality test, this paper notably finds that mobile money, when adopted on a massive scale, has an *increasingly positive* effect on economic growth over time, and not *vice versa*; and that this pattern persists even when controlling for mobile phone usage.

The findings of this paper contribute to the literature in two ways. First, although a majority of studies has shown socioeconomic impacts of mobile money for households and small businesses, the literature still owes us the broader societal and economic implications. In this vein, the findings add knowledge to the emerging literature by documenting the societal level socioeconomic impacts of mobile money. This paper, to the author's best knowledge, is the first cross-country study that explores the potential causal link and shows the positive relationship between successful mobile money deployment and economic growth.

Additionally, the cross-country evidence established in this study sets the foundation for future theoretical and empirical research. To advance our understanding of the role mobile money plays in socioeconomic development, it is of extreme importance to develop an integrative theoretical framework addressing

the following aspects: 1) *whether* the relationship exists; 2) *how* the relationship operates; and 3) *why* the relationship occurs. As the findings provide empirical support regarding the *whether* inquiry, this paper constructs the fundamental building block for future inquiries. Yet, it should be noted that since this paper focuses on the economic dimension of socioeconomic development, future research is needed to examine the link between mobile money and social benefits such as well-being and poverty reduction of a country.

So far, the questions as to *how* and *why* remain underexplored at macro level. In particular, the mechanisms through which mobile money generates far-reaching socioeconomic benefits are under-theorized. Although the major focus of this paper is *not* to examine the mechanisms, this paper, based on the technology affordances perspective, provides at least two important theoretical implications in this regard. On the one hand, while existing studies implicitly agree with the mechanism of deepening financial inclusion (e.g., Aron, 2017), this paper suggests other potential mechanisms. For instance, serving as an efficient payment infrastructure, mobile money can fuel a wave of mobile-based digital entrepreneurship, technological innovations, and business model innovations, which will ultimately contribute to socioeconomic development (e.g., M-Kopa). Second, this paper also highlights the necessity and importance of acknowledging co-existence and potential interaction of multiple mechanisms across different levels. As discussed above, it is arguable that mechanisms at household (e.g., improving income and consumption), business (e.g., growing small businesses; spurring new venture creation), and community level (e.g., expanding local economy) may reinforce each other. Still, in-depth research is needed to further our understanding of the emerging phenomenon.

In practice, this paper provides several lessons for a number of stakeholders. First, the findings underline the importance of mobile money rollout in developing economies where a majority of population has limited access to basic financial services. Mobile money has been shown to be able to drive socioeconomic development, rather than a consequence of it. Second, because the findings suggest increasingly positive effect of mobile money, the stakeholders may expect wider societal and economic outcomes as mobile money spreads into the society over time. To achieve that, policymakers and authorities should devise policies that facilitate integration of mobile money into business and public sectors. For example, digital entrepreneurs as well as the governments can benefit from mobile money through the efficient management, organization, and distribution of social resources in the society, i.e., healthcare, insurance, and government subsidy. Finally and most fundamentally, the stakeholders should work in concert to create enabling environment (e.g. deregulation) and develop programs (e.g., financial literacy,

training program) to boost adoption and use of mobile money, especially among the financially excluded group.

Like others, this study has some limitations. The major one is concerned with limited data availability and the resulting small sample size. This issue, however, is unavoidable because mobile money comes alive not long enough, and because data collection efforts remain sporadic and insufficient (e.g., IMF Financial Access Survey is one of very few, if any, sources that provide panel data). Due to limited data availability, only a limited number of control variables are considered in the current setting. Similarly, because of small sample size, this paper fails to consider additional variables (e.g., interaction term of mobile money and mobile phone penetration), which would otherwise provide more insights into the phenomenon. The other limitation concerns the approach used to distinguish treatment and control group, which has to be exploratory and judgmental and therefore admittedly open to debate.

In conclusion, a growing number of ICT innovations have been transforming the way people live, work, and do business in developing economies. This paper examines the digitally-enabled socioeconomic development in the context of mobile money. In developing economies, mobile money, as disruptive digital financial services, can circumvent traditional financial barriers and frictions, and provide a set of basic financial services in a convenient, cheap, and secure way to the whole population, especially the financially excluded group. Mobile money, therefore, has been argued to hold the potential to drive socioeconomic development. As one of the pioneering efforts, this paper concludes that widespread adoption of mobile money leads to economic growth; and that the positive effect increases over time as a growing population adopt the services in their daily lives and businesses. The findings not only demonstrate socioeconomic benefits of mobile money at the societal level, but establish empirical and theoretical foundation for future efforts in theorizing the associated mechanisms, which will help organize and manage mobile money to become a blessing to developing economies.

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