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Mobile Money

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Abstract

The surge in access to mobile phones throughout the developing world has brought with it a wide range of benefits. One of the most noteworthy breakthroughs has been mobile money, enabling users to deposit, transfer, and withdraw funds from a digital account without owning a bank account Mobile money provides a dramatic reduction in transaction costs, as well as improvements in convenience, security, and time taken for the transaction. There is a growing literature that documents the benefits of mobile money, including improvements in the ability to smooth consumption better in the face of health and economic shocks, improving women's empowerment, and reducing poverty. More recently, there has been a growth in digital financial services that use mobile money as the rails to deliver other products (largely credit). However, such innovations are few and far between with more research needed on their deployment and impact.

Editors' note: This VoxDevLit draws and replicates parts from the *Annual Review of Economics'* chapter on Mobile Money by Tavneet Suri (2017) with permission of the Annual Review

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Summary

The proliferation of mobile phone markets and networks has been accompanied by innovations that add substantial value for, and provide beneficial services to, customers. A key domain is financial services, previously inhibited by poor infrastructure and high transaction costs. The advent of mobile money has enabled users to deposit, transfer, and withdraw funds in a digital account without owning a bank account. Today, the service is available in 96% of countries where less than a third of the population have an account at a formal financial institution.

Mobile money provides a dramatic reduction in transaction costs, as well as improvements in convenience, security, and the time taken for the transaction. In addition, the mobile money agents are much more easily accessible than other formal financial institutions, so the money sent via this system can be quickly deposited and withdrawn.

The most successful and well-known mobile money product, M-PESA, was launched in 2007 in Kenya. Its launch has been followed by other similar services across the developing world. There has been a lot of research on the role systems like M-PESA can play and the impacts they can have on economies. Evidence shows that households with M-PESA are better able to smooth risks, since their consumption is less sensitive to unexpected income and health shocks. In the longer run, this has had impacts on poverty in Kenya. The consumption smoothing effects of mobile money have also been documented in Mozambique, Bangladesh, Tanzania, and Uganda.

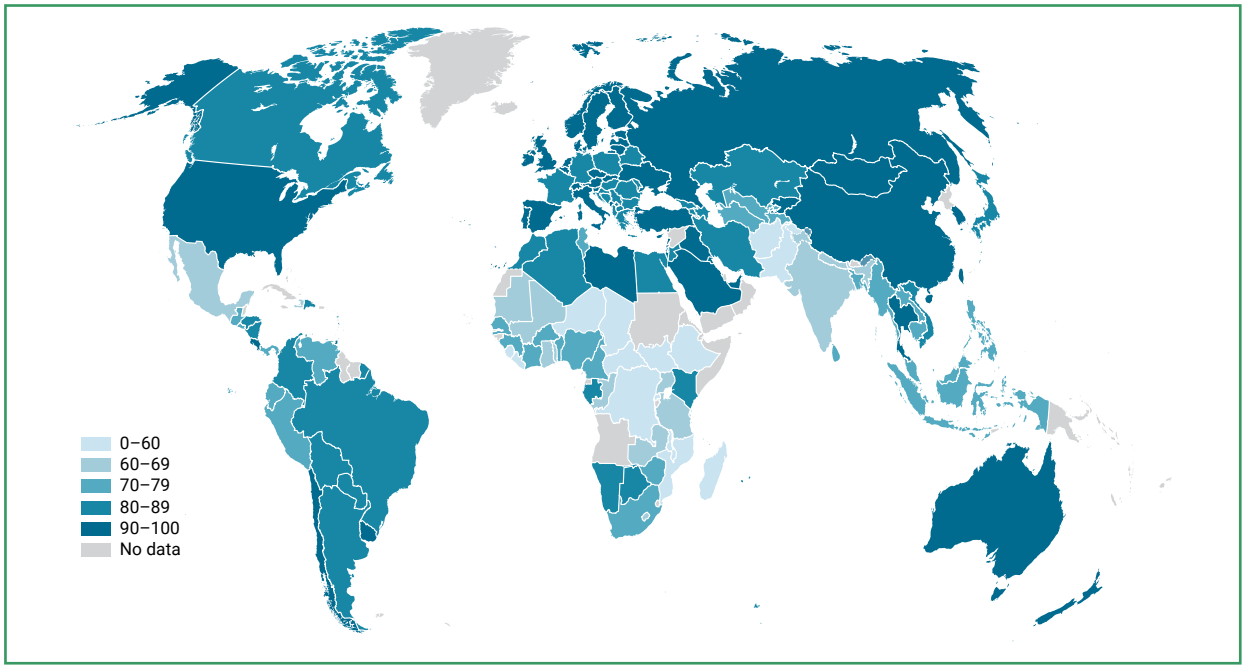
In addition to these basic effects, there has been a range of papers (largely randomised controlled trials) showing the benefits of mobile money in particular contexts (such as aid delivery, salary payments, high conflict areas, etc.). There is also a small but growing literature on the value-added products over mobile money, in particular, digital bank accounts which operate over the rails of mobile money. Given that mobile money and, more broadly, a digital payments system has been so widely adopted in the developing world, and seeing that there are so few value-added services layered over it, there is a lot left to do and learn.

I Introduction

The mobile phone has been amongst the most rapidly adopted innovations in the world, with SIM cards and airtime (prepaid phone minutes)[1] being ubiquitous now in many economies. This is particularly true in developing economies: as of 2019, there were 1.15 billion and 858.8 million subscribers in India and sub-Saharan Africa, respectively (International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database). A large body of literature shows the benefits of mobile phones (see Aker and Mbiti 2010 for a review), with specific studies showing that communication via text can affect credit repayment (e.g., Karlan et al. 2012), savings behaviours (Karlan et al. 2016), adherence to medicinal treatments (for one example, amongst many, see Lester et al. 2010), and voting behaviour (e.g., Marx et al. 2016). The expansion of mobile phone markets and networks has been accompanied by innovations that add substantial value for and provide beneficial services to customers; in particular, financial services that were previously inhibited by poor infrastructure and high transaction costs.

This review focuses on one of the most widespread technological innovations in the context of developing economies: mobile money. The most prominent and best-known innovations adding service over the mobile phone has been mobile money – which, in 2019, processed almost US$ 2 billion a day (GSMA 2019). Mobile money enables mobile phone owners to deposit, transfer, and withdraw funds into a digital account without owning a bank account. It is therefore distinct from mobile banking, which allows access to one's existing bank account via a mobile phone. As such, mobile money sits outside the formal banking system since the accounts are only linked to a phone number and not to any formal bank account or credit card. Mobile money operates via software that is installed on a SIM card, although it is typically run on regular phones rather than smartphones. Mobile money is especially important in developing economies and available in 96% of countries where less than a third of the population have an account at a formal financial institution (GSMA 2019a).

Figure 1 Mobile phone ownership across the world (adults with a mobile phone (%), 2017)



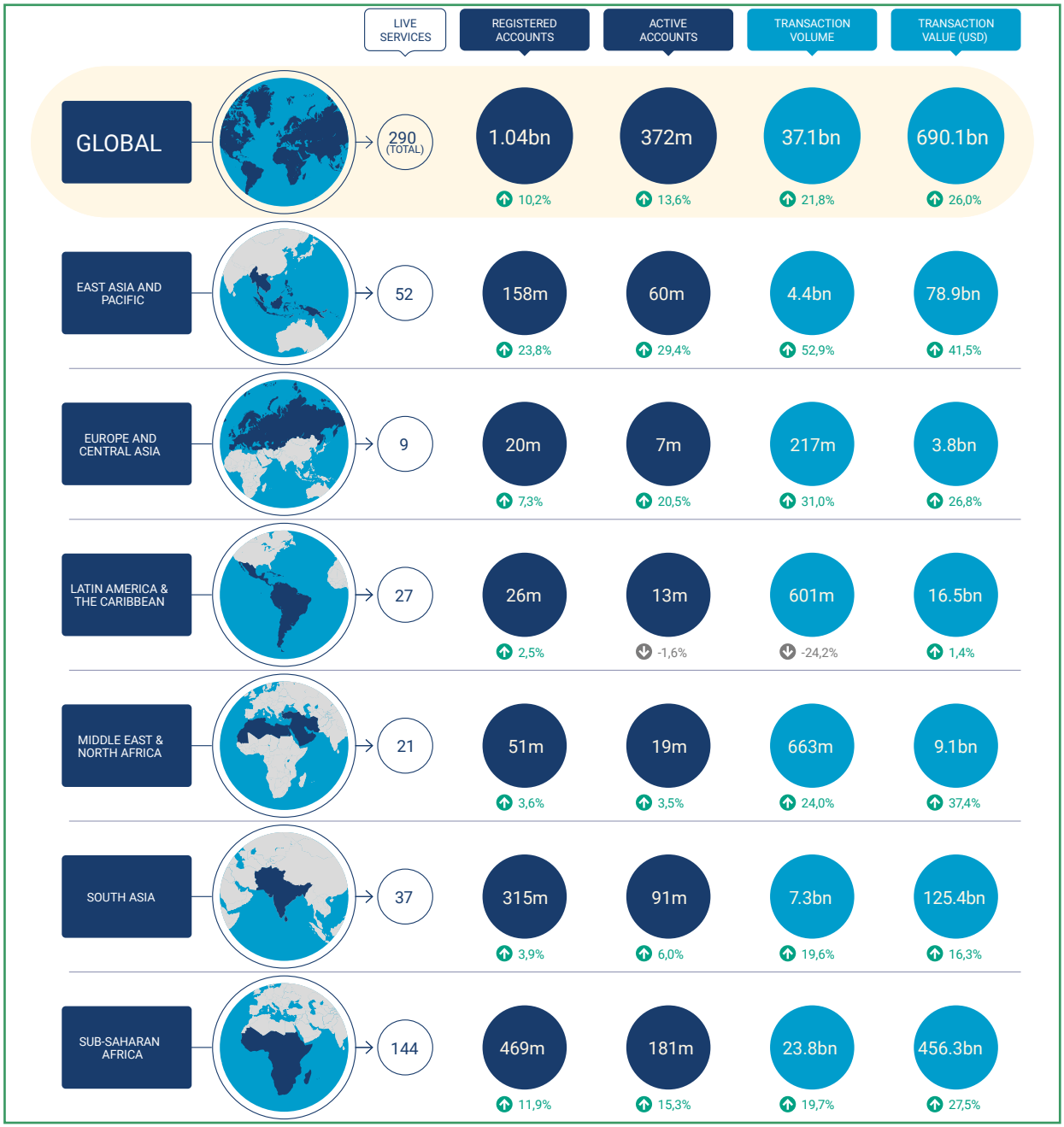
Source: Global Findex (Gallup World Poll 2017)

Mobile money has been adopted widely and quickly across the developing world. Figure 1 shows the

1 About 95% of connections in India are prepaid, as are 97% in Kenya, 98% in Tanzania, and 74% in Brazil (Davidson & Leishman 2016).

adoption of mobile phones worldwide in 2017, while Figure 2 shows the adoption of mobile money as of 2019, highlighting the number of accounts across regions of the world and the volume of transactions. Early deployments of mobile money systems started in the mid-2000s, with the Philippines, Kenya, and Tanzania being amongst the first countries to use the service. Since then, this innovation has spread quickly across the developing world. By the end of 2019, a total of 290 mobile money services were being offered in 95 countries; there were more than 1 billion mobile money accounts globally, including 372 million actively used for a transaction in the previous 90 days. Though nearly half of all accounts are registered in sub-Saharan Africa, there were almost half a billion registered accounts in Asia in 2019, including 150 million active accounts (GSMA 2019a). The most successful and well-known mobile money product was launched in 2007 in Kenya by one of the main telecommunications companies in the country, Safaricom. The product is called M-PESA, M referring to mobile and PESA being the word for money in Swahili. M-PESA has reached almost universal coverage in Kenya.

Figure 2 Mobile payment account penetration, 2019



Source: GSMA 2019b

The aim of this overview is not to provide a comprehensive review of all aspects of mobile money,[2] but rather, to highlight the economics behind the product: what may have driven its adoption and what are its impacts. Given the success of M-PESA, a lot of the research discussed in this review focuses on Kenya, although there are more recent studies of mobile money systems in other countries that are now catching up as well as studies that focus on specific interventions that promote the use of mobile money in a specific context. Towards the end of the review, we also discuss the more recent innovations that build on mobile money systems to deliver additional financial services and value. Although these innovations exist, they have not given rise to a thriving fintech[3] sector, but this area may be where the most exciting opportunities for research exist.

II How mobile money works

Mobile money is not mobile banking – it is a distinct product. It is most often provided by telecommunications companies, henceforth telcos (examples of exceptions are B-Cash in Bangladesh and Splash in Sierra Leone[4]). Mobile money systems, therefore, lie outside the formal banking system and have often been referred to as shadow banking systems (for a definition of a shadow banking system, see Bernanke 2012). From the point of view of the consumer or user, the mobile money system is a payment account that sits on their mobile phone. It operates through a menu on their SIM card and allows them to engage in a variety of financial transactions.

Initially, the focus of mobile money systems was on allowing consumers to make person-to-person (P2P) payments digitally without needing a bank account or a wire transfer. As mobile money expanded its purview, consumers were able to use it to pay their bills (including utilities), to store and hold money (i.e., save), to make person-to-business (P2B) payments, to receive payments from businesses (such as wages), and to receive government-to-person (G2P) payments. More recently, banks and other entrepreneurs have started to build digital bank accounts and digital lending systems that operate over the rails of mobile money.

Mobile money works very simply. On the consumer side, the consumer registers an account with a mobile money agent, providing information that is equivalent to the Know Your Customer (KYC) banking rules. They register for the service with a government-issued ID (in some countries, this is the ID used for voting).[5] This process takes a few minutes (as opposed to opening a bank account, which could take days or weeks).

To be able to make any payments from their account, a consumer must deposit cash into it. They do this at any mobile money agent in the country. They give the agent cash and immediately get a notification that the cash has been deposited in their account. From there, they can use the menu on their mobile phone to transfer that money to anyone else in the country with a cell phone via their phone number. To get their cash back, they have to return to the agent. Each of these transactions incurs transaction fees (depositing is often an exception); of course, the transaction fee schedule varies across countries. Figure 3 shows the transaction fees for transfers across a selection of different countries.[6] There is often no interest paid on

2 Aron (2017) provides an excellent review that is more detailed, including on the macroeconomic impacts of mobile money and its regulation.

3 Fintech refers to financial technology, encompassing all technologies that are related to the finance sector.

4 These two implementations of mobile money are by private entrepreneurs that negotiated with all of the telcos in each country.

5 In many countries, one needs to show an ID to get a SIM card. In 2017, the most common reported use of an ID in sub-Saharan Africa was to get a SIM card or mobile phone service. (ID4D data, available at https://globalfindex.worldbank.org)

6 We chose these countries because they have the most successful deployments of mobile money for which tariff charts were publicly available.

deposits, and the deposits and withdrawals are done through an agent for the mobile money service and not a bank branch.[7]

Additionally, other standard banking services, such as loans or standing order payments, are usually not available through the telco or the mobile money platform itself.[8] However, some banks have partnered with telcos to provide digital bank accounts that operate over the rails of mobile money. These accounts operate by making the movement of money between a mobile money wallet and the digital bank account free of cost, and then the digital bank account can use M-PESA agents to be the cash-in and cash-out points for the bank account. For example, to withdraw money from the digital bank account, one moves it from the digital bank account to their mobile money account (at no cost) and then withdraws from a regular mobile money agent.

In 2011, Safaricom partnered with the Commercial Bank of Africa (CBA), to create a digital banking product called M-Shwari. Since then, CBA has launched similar products in Tanzania (called M-Pawa), as well as in Uganda, Rwanda, and Cote d'Ivoire (called MoKash). Similar accounts are provided by Equity Bank Kenya (called Equitel) and Kenya Commercial Bank (called KCB M-PESA). With these accounts, consumers can use their mobile phone to open a bank account, deposit money in it by transferring balances from mobile money, withdraw from it via mobile money, and request a loan. Underlying the loan decision is a credit scoring rule or algorithm based on administrative data on airtime purchases and mobile money transactions (not often a machine learning credit-scoring algorithm).[9] In the case of Kenya, M-Shwari has been enormously popular. As of late 2016, over 80% of Kenyan mobile phone owners had an M-Shwari account (Bharadwaj and Suri 2020). Finally, it is worth mentioning two digital lending companies called Branch and Tala. They are not banks, and so their product offers no savings capabilities, just a digital loan. To make a lending decision, their product asks for permission to scrape the applicant's phone for data on handset details, GPS info, call and SMS logs (hence information on mobile money transactions), social network data from Facebook, and contact lists. A machine learning algorithm then uses these data to create a credit score and make a lending decision. Increased usage of the product results in larger loans. The loans are all disbursed and repaid through mobile money. Similarly, M-KOPA also provides a digital lending product, just of a very specific nature: they offer asset-based financing for solar panels where payments on the loan are made from mobile money. As mentioned above, this review focuses only on mobile money and not mobile banking. However, we do include research on digital bank accounts and digital lending products as they rely entirely on mobile money for their operations.

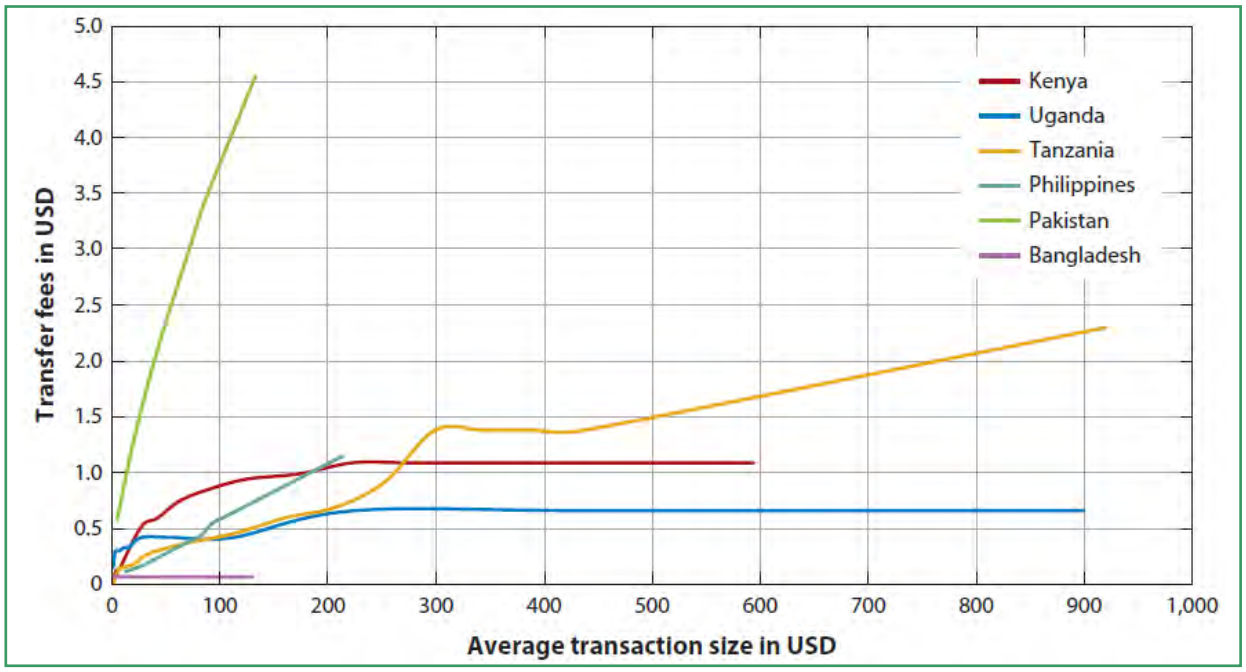
Although the consumer side of mobile money feels similar to a bank account, the back-end of the system and how it operates are quite different. The money in a mobile money account is called e-money (or electronic money) and always trades one-for-one with cash (minus the transaction costs for the particular transaction being conducted). When a consumer deposits money in their mobile money account, they are in fact, purchasing the equivalent value in e-money from the agent. This means that the agent must hold a stock of e-money that they can then trade with the consumer. Similarly, if the consumer wants to withdraw money from their mobile money account, they are selling e-money to the agent for cash of the equivalent value (minus the transaction cost).

7 In Kenya, withdrawals can also be made from an ATM, though this is not always the case. In addition, more recently, banks have provided digital bank accounts essentially overlaid on mobile money. .

8 In 2019, Safaricom launched a mobile money overdraft product called Fuliza through its mobile money system. This allows people to overdraw on their accounts for a fee (it acts like a loan). However, Safaricom still cannot hold the mobile money float themselves. This is unusual – most telcos do not offer loans through their mobile money systems.

9 Although there is little research on the value of mobile money transaction data itself, the transaction data are being used in practice to create credit scores in Kenya. However, recent literature uses mobile phone call data records (CDRs), which are beyond the scope of this review. As an example, Blumenstock (2015a) uses call records from Rwanda to predict wealth, and Blumenstock et al. (2015b) show that predictions from records match the Demographic and Health Survey in Rwanda fairly accurately.

Figure 3 Transaction fees for Kenya, Uganda, Tanzania, the Philippines, Pakistan, and Bangladesh



Source: Suri (2017)

The agent's primary role is, therefore, to manage their float or inventory of e-money just as they would manage their inventory of any other commodity they stock. Most of these agents are either existing businesses that sell airtime and phones or small retailers such as basic grocery stores, petrol stations, chemists, or tailors. As of December 2019, the number of agent outlets tripled over the preceding five years to 7.7 million (GSMA 2019). Agents always have an existing business and provide mobile money services in addition to it. The requirements to become an agent vary across countries. In Kenya, for example, potential agents need to apply to the mobile money operator to become an agent (see Jack et al. 2010 for more details on the evolution of the agent system in Kenya). These applicants need to have a bank account and an internet connection to be considered; if they are approved as agents, they have to purchase an initial quantity of e-money valued at US$ 1,000.[10] They can then trade this e-money as they would any other commodity of which they hold inventories. If they run out of e-money, they go back to the operator to purchase more, and if they run out of cash, they can sell e-money back to the operator. Since 2009, in Kenya, banks have been allowed to be agents to the agents, so that agents can trade cash and e-money back and forth with bank branches rather than solely with the operator. Agents are a core part of the mobile money model, as they provide consumer cash-in and cash-out services, i.e., they serve as the ATM equivalents. Therefore, the extent of the network of these agents is crucial.

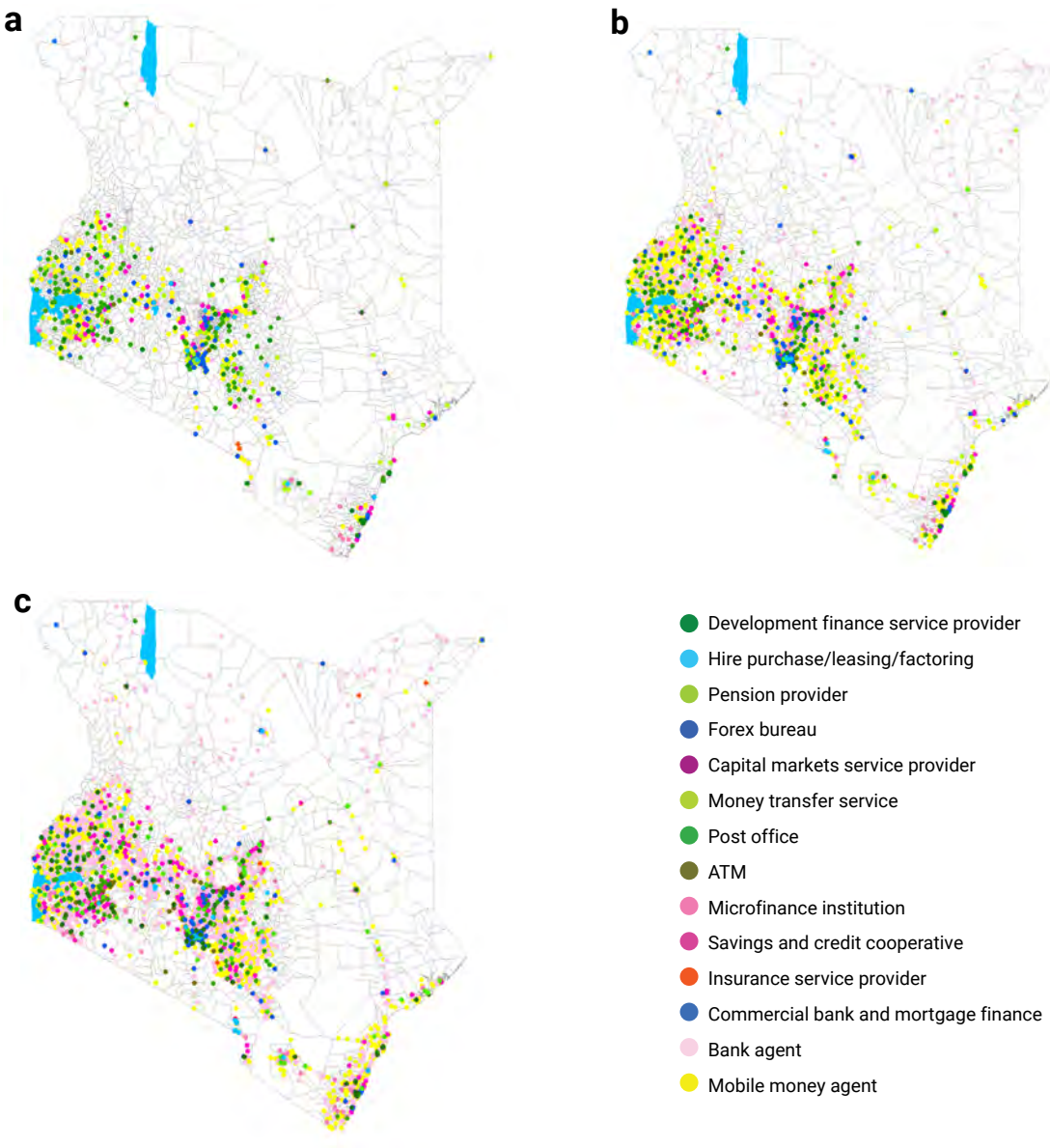
Figure 4 shows the initial distribution of M-PESA (the only mobile money service at the time) agents in Kenya in 2007, when the service was launched, as well as the subsequent agent expansion through 2015. Note that in 2011 Kenya passed regulation that allowed for bank agents, i.e. non-bank entrepreneurs to take deposits on behalf of banks so a lot of mobile money agents were also able to be agents for banks, hence the prevalence of bank agents in 2015.

Aside from consumers and agents, there is a third component underlying the operation of mobile money: what happens to the money itself. The cash deposited in mobile money accounts is usually held in trust accounts, which are administered by a small number of commercial banks in the country. The trust accounts are owned by the mobile money account holders – think of each mobile money account holder as having

10 More specifically, agents must be registered as a limited company and have traded for at least 6 months. The investment required is approximately US$ 1,000 per outlet for float and US$ 1,000 worth of SIM card replacements.

rights over a small sliver of one of these trust accounts. However, the account holder cannot deposit or withdraw money from their mobile money account at the commercial bank that holds a trust account (unless the bank branches are themselves agents). The account holder can only deposit and withdraw money from a mobile money agent. Similarly, an individual's mobile money account is not considered to be a bank account – it does not earn interest and loans are not available to users.11 However, the trust accounts often earn interest, as they are accounts in the commercial banking system. Given this structure, the mobile operator with which the mobile money account is held is itself not subject to the same regulations under which commercial banks or other deposit-taking institutions conduct business since they do not hold the cash, i.e. they are not deposit takers.

Figure 4 Agent density in Kenya in (a) 2007, (b) 2011, (c) 2015



Source: Finaccess Geospatial Mapping 2016

11 As we discuss in Section V, more recently, telcos have created partnerships with banks such that loans are available but the loan capital comes from the partner bank and not from the telco.

IIA Regulation of mobile money

On the regulatory side, mobile money has required some innovation to build the necessary governance and institutions. Aron (2017) provides an excellent review of the regulatory side of mobile money systems, including how the regulation for mobile money may need to be unbundled at the level of the component systems and how regulation should be built around each of the components (such as customer registration, exchange and storage of e-money, foreign transfers, and interoperability).

In this section, we touch on only the main innovations in the regulatory system that have emerged from the advent of mobile money. Most countries have created their own regulatory frameworks around mobile money, but there are many common elements. The first is the requirement to report on aggregate transactions (and sometimes high-value individual transactions) to the regulator in-charge (this is often the Central Bank, but may also include the Communications Commission). Often, there are limits on transaction sizes and the amount that can be held in a mobile money account; for example, in Kenya, these limits are US$ 700 and US$ 1,000 respectively, and in Uganda, US$ 1,500 and US$ 1,200, respectively. Similarly, there is often direct regulation around the trust or bank accounts that hold the float and rules on whether these can earn interest (as in Kenya, Malawi, Afghanistan, Sri Lanka, and several Pacific Island countries; see Greenacre and Buckley 2014) or must be 100% cash reserve accounts deposited at the Central Bank (as in the Philippines). When these accounts earn interest, rules regulate whether interest is to be disbursed to consumers and, if not, what happens to it. In Kenya, for example, the interest from the trust account has to go to charity; in Tanzania and Liberia, it can be disbursed back to consumers. Although there are variations in the exact regulatory framework across countries, these regulations are far less stringent than those for commercial banks.

A final regulatory issue that has been debated heavily in the policy sphere (see Camner 2013, Davidson and Leishman 2012) is the issue of interoperability – the ability to transact with mobile money across service providers. Interoperability can be at the platform level or the agent level (allowing customers or agents of different services to send mobile money to each other, respectively) or at the customer level (allowing customers to access their mobile money account through any SIM) (Davidson and Leishman 2012). As mobile money systems come closer to becoming payment systems, the issue of whether transactions can cross different telcos has become relevant. In some countries, like Bangladesh and Sierra Leone, this is not an issue because, in both countries, at least one mobile money operator is an entrepreneur independent of a telco, but with agreements with a number of different telcos. However, in most countries where a given product is launched by a single telco, policymakers are debating their role in requiring interoperability, given how important network externalities are in this industry. To date, Tanzania is the only country where this is operational. It was enabled by the industry leading the discussions and adopting common business standards to ease switching, working closely with the Bank of Tanzania, which oversaw the regulatory process. Afghanistan has a “switch” that would allow interoperability; however, no telco has signed up to use it as the subscription fees are too high.

III The success (or lack thereof) of mobile money

One of the most successful deployments of mobile money has been M-PESA in Kenya. M-PESA has been widely adopted, with 97% of households having an account as of 2014 (see Jack and Suri 2016). Although other countries are now catching up [for example, in Uganda, 51% of individuals older than 15 years have an account, while 39% in Tanzania do (Demirguc-Kunt et al. 2018)], there are still many unsuccessful deployments of mobile money. Although it is hard to causally identify the reasons for the success (or lack thereof) of mobile money deployments, it is worth discussing some of the hypotheses for why mobile money has been a success in some economies but not others. It is important to understand how the business models and implementations of the various services may differ across countries and what has correlated with success.

As a summary example, Vaughan et al. (2013), some of the actual implementers of M-PESA in Kenya,[12] describe their pilot, which started in October 2005 with a grant from the UK Department for International Development's innovation fund and with microfinance clients. The product was then changed and rebranded based on consumer feedback as an internal remittance product to send money to friends and family – this experimentation was important to the success of the product. Vaughan et al. (2013) also highlight some additional key factors that allowed mobile money to reach scale in Kenya; in particular, developing a strong network of agents, removing entry barriers for customers, investing in the infrastructure for scale at the very outset, and regulating the system after the innovation. Of course, the fact that Safaricom had a large market share also likely played a role.

The success of mobile money systems is certainly underpinned by the rapid deployment and growth of the agent network, i.e., the end distributors of the service. This growth and reliability are associated with a network that is trustworthy, efficient, liquid, and profitable for the agents. As an example, Figure 4 shows the rollout of mobile money agents in Kenya during the success of M-PESA, displaying the growth in access to agents in 2007 (just as M-PESA launched), in 2011, and 2015. Note that there were fewer than 1,000 bank branches, just over 1,000 ATMs, and 3,000 M-PESA agents across Kenya in early 2008 (Camner et al. 2009). At the time of writing, there are over 180,000 agents serving both M-PESA and other mobile money customers. Table 1 shows data on the number of agents in some of the countries with mobile money deployments.[13] It is striking that the number of agents is at least triple the number of bank branches in Kenya, Uganda, Tanzania, and Bangladesh.[14] This is not the case in Nigeria because mobile money is both poorly deployed and poorly adopted there, with adoption rates of 6% in 2017 (Demirguc-Kunt et al. 2018).

Table 1 Number of agents in selected markets

Country	Number of agents by provider[a]		Number of Agents[b]	Number of bank branches[b]
	Provider	Number of agents		
Pakistan	EasyPaisa	10,500	NA	NA
Philippines	GCash	18,000	NA	NA
Kenya	M-PESA	20,500	65,569	10,619
Uganda	NA	NA	41,794	477
Tanzania	NA	NA	45,429	579
Nigeria	NA	NA	3,567	4,989
Bangladesh	NA	NA	31,755	8,641

a Data taken from Groupe Speciale Mobile Association data from the Agent Management toolkit, 2012

b Data taken from the Financial Services for the Poor maps data for Kenya from 2015, Nigeria from 2015, Tanzania from 2014, Bangladesh from 2013, and Uganda (date unknown). Data available at http://fspmaps.org

Abbreviation: NA, not applicable

As these agent networks grew and became denser, the distance between a household and an agent shrank. For example, Table 2 shows how the average distance to a mobile money agent changed in Kenya between 2007 and 2015, and how it compares to the average distance to a bank branch. These averages mask a lot of heterogeneity: in 2007, 32% of households lived more than 10 km away from a bank branch,

12 Pauline Vaughan ran M-PESA from 2007 to 2009, and Michael Joseph was the CEO of Safaricom from 2000 to 2010.

13 The year of the data varies across countries because of the difficulty in finding recent data on the number of agents in each country.

14 These numbers come from the FSP Maps data, which was collected in Kenya in 2015, in Nigeria in 2015, in Tanzania in 2014, in Bangladesh in 2013, and in Uganda (date unknown). The FSP maps data is available at http://fspmaps.org.

and 19% lived more than 20 km away, whereas 46% of households lived within 1 km of an agent, a number that rose to 68% by 2015. In addition to a dense network of agents, successful deployments of mobile money had a network of agents that were efficient at managing their e-money and cash inventories, helped by consistent monitoring and liquidity management by the service operator. Eijkman et al. (2010) show that agents rebalanced their accounts almost daily, more frequently in urban areas. In addition, agents faced a lot of competition, as consumers favoured agents with better service and trading volumes.

Table 2 Average distance to the closest financial institution, Kenya

Year	Bank branches	Bank agents	Mobile money agents
2007	9.2 km	NA	4.9 km
2011	7.0 km	5.2 km	1.9 km
2015	6.0 km	1.9 km	1.4 km

Data taken fromFinaccess Geospatial Mapping 2016

(https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/SG589T)

Similarly, in a later study, Balasubramanian and Drake (2015) look at how the demand for mobile money in Kenya and Uganda is affected by agent quality (measured in terms of pricing transparency and expertise) and agent competition. They combine a survey of 3,000 mobile money agents with location data on 68,000 financial access and transportation points, spatial census data, and population and poverty estimates. They find that greater agent competition is associated with a higher inventory of both cash and e-money, that more transparency in pricing and greater agent expertise are associated with higher demand, and that the return to expertise increases with competition.

Aside from the agent network, there are a number of other factors that may have driven the successful adoption of M-PESA and that have been described qualitatively. Mas and Morawczynski (2009) attribute some of the success of M-PESA to strong branding, an easy-to-use product, simple and transparent retail pricing, free deposit and no minimum balance feature, ability to send money to nonusers, and ability to perform ATM withdrawals. Heyer and Mas (2009) highlight the importance of volume, momentum, and coverage, as well as the regulatory environment, the quality of the retail infrastructure, and the high telecom penetration. Mas and Ng'weno (2010) highlight brand management, channel management, and pricing as the major contributing factors behind M-PESA's massive success. Similarly, Mas and Radcliffe (2010) discuss the clever and easy-to-use design and Safaricom's business model. The authors suggest that the differentially wide spread of mobile money across countries could be partially attributed to differential regulations. M-PESA, in particular, benefited from a good working relationship between Safaricom and the Central Bank. Mas and Radcliffe (2011) also highlight how important network effects and trust are in scaling up a retail payment system. More recently, Lal and Sachdev (2015) compare five successful mobile money deployments[15] to five less successful ones.[16] In addition to the relationship with regulators and the agent networks mentioned above, they suggest that adoption is also driven by an underlying reliable mobile network with a successful and trusted brand and business.

One of the earliest quantitative studies of mobile money started in 2008 in Kenya around M-PESA. Jack and Suri (2011), in this and later work, document the patterns of adoption of M-PESA over 2008–2014[17]

15 These are Telesom ZAAD in Somaliland, Dialog eZ Cash in Sri Lanka, Econet EcoCash in Zimbabwe, SMART Communications SMART Money in the Philippines, and Globe Telecom GCASH in the Philippines.

16 These are Vodacom M-PESA in South Africa, MTN money in Uganda, Eko Financial Services in India, and the broader situations in Nigeria and Brazil, although MTN money in Uganda is now growing rapidly.

17 The surveys were conducted in 2008, 2009, 2010, 2011, and 2014. The sample was not national—it excluded sections of the North of the country, where households are semi-nomadic and therefore hard to track over time. The part of the country excluded from the sample covered about 8% of the Kenyan population at the time. The sample was also weighted toward urban areas, as the initial sample drawn in 2008 was weighted by the number of agents in the administrative location (there were about 2,500 locations in Kenya at the time). The reader is

using household surveys conducted across a large part of the country. As expected, the initial users were richer and more educated; however, adoption of the product did reach down the income spectrum in the country, with over 90% of households in their sample having an account by the time of their last survey in 2014.[18] Khan and Blumenstock (2016) study the adoption of mobile money more carefully in Ghana, Zambia, and Pakistan. They build a supervised machine learning model of adoption using call record data and find this model does not distinguish very effectively between active and registered mobile money users, contrary to expectations that active users should be quite distinct in their patterns of phone use. Across countries, it is unlikely that any single set of characteristics will consistently predict mobile money adoption and use.

As we describe in Section IV, one of the most important uses of mobile money has been P2P remittances. Therefore, having a widespread agent network whose cash and e-money inventories are well managed is crucial to the success of the product. Of course, once adoption starts, there will be strong network effects, even stronger than for mobile phones themselves given that there is little interoperability in these markets. There has been surprisingly little work documenting network effects in the adoption of mobile money. An exception is Batista and Vicente (2020), who conducted a randomised controlled trial (RCT) with 200 primary farmer subjects in the Manica province of Mozambique, and 400 of their farming network members. All primary subjects were newly given access to mobile money accounts. In the treatment group, the two closest farming friends of the primary subjects were provided with a mobile money account. The results suggest that the network intervention increased the general use of mobile money by primary subjects and their network members, and reduced household expenditures and lending to social networks. These patterns are consistent with lower social pressure to share resources induced by the network treatment, although the mechanisms underlying this effect cannot be precisely distinguished in the context of this experiment. Further work examining this and related issues is required.[19]

IV Impacts of mobile money

IVA Impacts of the basic services

Since the launch and success of M-PESA, and the launch of mobile money services across many countries in the developing world, there has been a lot of research around the type of role systems like M-PESA can play and the kinds of impacts they can have on economies. What are the possible mechanisms through which mobile money systems can affect developing economies?[20] All mobile money systems have transaction fees and therefore do not really encourage cashless retail transactions in the way credit cards or debit cards have in the United States, though that is starting to change, especially during the COVID-19 pandemic when some mobile money services removed some of the transaction fees. Instead, in a lot of countries, they are largely used to make two types of transactions: (a) geographically disparate transactions, i.e., transactions across space, and (b) transactions where the opportunity cost of holding cash may be high, as in high-crime cities (see Economides and Jeziorski 2015). For these types of transactions, mobile money provides a dramatic reduction in transaction costs, as well as improvements

referred to Jack and Suri (2011, 2014) for more information on the sample.

18 Mbiti and Weil (2011) also document the characteristics of the users.

19 An early exception is Fafchamps et al. (2016), who study a precursor to mobile money, the P2P transfer of prepaid airtime credit in Rwanda. More recently, Batista et al. (2018) describe sharing behaviour of information about P2P mobile money transfers within exogenously created networks of mobile money users in rural Mozambique. The results from their lab-in-the-field experiment show that simpler interventions within these networks are likely to produce strongest information sharing: anonymous communication, for example, yields higher sharing than homophily within networks.

20 Maurer (2012a,b) and Donovan (2012) provide descriptions of similar mechanisms through which mobile money could affect economies.

in convenience, security, and time taken for the transaction. For example, in Kenya, the average transaction traveled 200 km in 2008 (Jack and Suri 2011), which would be an approximately US$ 5 bus ride – instead, consumers paid a US$ 0.35 fee (given the average transaction size). In addition, the mobile money agents are much more easily accessible (see Table 2) than any other financial institution, so the money sent via this system can be easily deposited and withdrawn.

Given these reductions in transaction costs and improvements in safety, mobile money could simply facilitate trade both on the intensive margin (making existing transactions more efficient) and on the extensive margin (enabling transactions that would not have happened without mobile money). Such facilitation of trade could result in better allocation of capital and, thus, increase savings. Similarly, there could be an improvement in the allocation of human capital as the returns to migration improve. In addition, mobile money accounts may provide safe storage of savings and potentially reduce precautionary savings (through improving the efficiency of person-to-person transfers), thereby potentially increasing total savings, as well as improving the allocation of savings and risk (via increased and more efficient remittances) across households and firms. In Kenya, researchers found that mobile money boosted entrepreneurship by reducing theft (and therefore output losses) while speeding up entrepreneur-supplier transactions and raising the valuation of trade credit (Beck et al. 2018). Mobile money may also have effects on intra-family dynamics, as these accounts are individually held. Finally, on the macroeconomic side, mobile money systems could increase the velocity of money and inflation (though the evidence is mixed on this, as discussed below). In economies with dual currencies, like that of Somaliland (see Iazzolino 2015), mobile money could facilitate trade, remittances, and transactions in US dollars.

Economides and Jeziorski (2015) study the demand for mobile money, exploiting a natural experiment created by an exogenous and unanticipated increase in the transaction fees in Tanzania. They identify the slope of the demand curve and compute consumers' willingness to pay for risk amelioration using transportation and storage transactions. They find that consumers who execute large transactions are usually more price inelastic than consumers who execute smaller transactions, and that demand for long-distance transfers is less elastic than that for short-distance transfers. Consumers use the mobile money network extensively for extremely short-term storage (less than 2 hours), probably due to high levels of street crime and burglaries, and are willing to pay up to 1% of the transaction amount to avoid carrying money in the form of cash for each extra kilometre, and up to 1.1% to avoid keeping money at home for an extra day.

Looking at the impacts of mobile money in Kenya, Jack and Suri (2014) use the survey data described above to understand how M-PESA has improved the ability of households to share risk. Informal risk-sharing networks are used extensively to pool risk in developing economies,[21] including in Kenya (see Suri 2014). Given the prevalence of such relationships, which involve transfers of money between households, and given the large transaction cost reductions afforded by M-PESA,[22] M-PESA could have important impacts on the efficiency with which individuals spread risk. As Jack and Suri (2014) show, these effects are sizeable (Figure 5a illustrates their findings). Households with M-PESA are better able to smooth risks, and their consumption is less sensitive to shocks. When subject to a shock, households that have mobile money are more likely to receive a remittance from friends and family, receive more money in total, and receive it from a more diverse set of people in their network, all resulting in efficiency gains in risk-sharing. This also explains why a large share of transactions on M-PESA are P2P remittances across long distances.

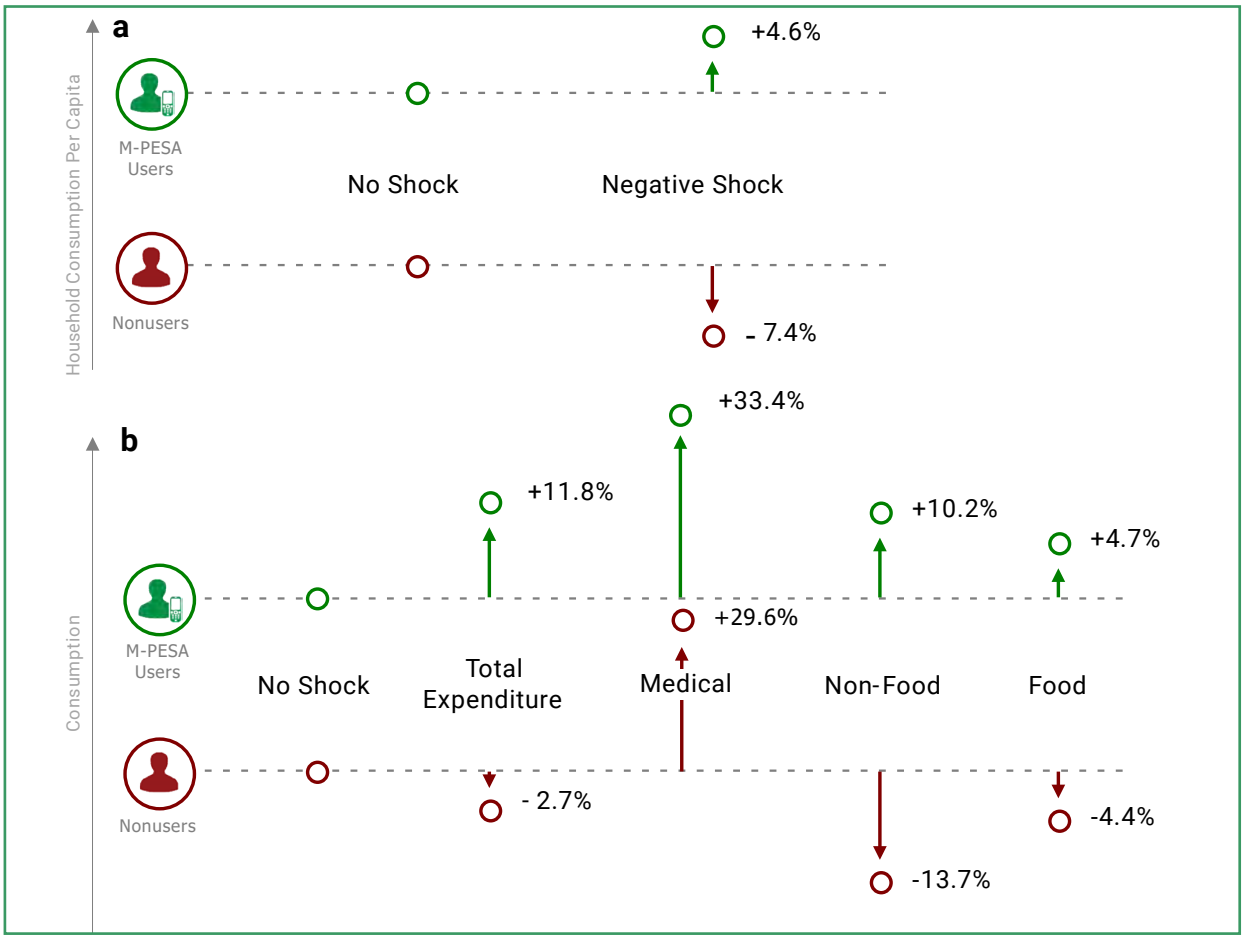
In complementary work, Suri et al. (2012) look specifically at how M-PESA affects people's response to health shocks. They find that M-PESA users are able to spend more on medical expenses in the event of a health shock, while also increasing expenses on food and maintaining their education expenditure.

21 Kinnan (2014) provides an excellent review of the literature on informal risk-sharing.

22 The cost of sending money via M-PESA was almost 30% of that of sending it via a postal bank or via bus delivery through a driver, and 46% of the cost of sending it via Western Union (these percentages do not include transportation or time costs).

Nonuser households or households far from agents are unable to increase expenditure on food after the shock, decrease their non-food subsistence expenditure, and might pull children out of school to finance healthcare costs. When hit by an illness shock, nonusers substitute away from non-medical expenses, such as nonfood subsistence, to finance the needed medical care expenditure. The authors find no evidence that nonusers suffer significant food reductions, suggesting that both users and nonusers do not cut back on necessary consumption. Non-users seem mostly to substitute away from their children's education to fund their health shocks. These results are illustrated in Figure 5b.

Figure 5 Resilience of M-PESA users and nonusers to economic shocks. Panel a is based on data from Jack and Suri (2014); panel b is based on data from Suri et al. (2012).



Finally, using the last round of their panel survey conducted in 2014, Suri and Jack (2016) measure the longer-term impacts of M-PESA. They find that better access to mobile money services have increased household consumption and savings and, thus, reduced poverty rates. They find that poverty rates declined by 2 percentage points as a result (196,000 households move out of extreme poverty); reductions that were larger amongst female-headed households. They also find significant changes in occupation choice, largely amongst women, who moved away from agriculture as their main occupation to business and retail. As a result of M-PESA, 186,000 women made this transition.

Gürbüz (2017), again in Kenya, using self-collected survey data and an instrumental variable strategy, finds that mobile money use leads to households being 16-22% more likely to save, and increases average household savings by 15-21% of average household income (US$ 2.74-3.72).

Blumenstock et al. (2016) also study the response to shocks (in the context of an earthquake in Rwanda) using administrative data on mobile phone records, airtime purchases, and transfers of airtime. They find, as a result of the earthquake, a modest increase of US$ 84 in airtime transferred and an increase of US$ 16,959 in value of calls made, potentially indicative of indirect transfers as the caller bears the cost of the call in Rwanda. They also find that transfers were more likely to be sent to wealthier individuals and to individuals with a history of reciprocity with the sender.

In Tanzania, Riley (2016) uses a panel difference-in-difference specification to examine village spillovers from the use of mobile money services. She finds that mobile money improves risk-sharing for households that use it, but does not have spillovers to non-user households within the same village. Mobile money use makes it more likely that a household receives remittances and increases the value of remittances received after a village-level rainfall shock, such as a drought or flood. Also in Tanzania, and using the same data source, Abiona and Foureaux Koppensteiner (2018) find that use of mobile money services protects households from sliding into poverty after a rainfall shock, and enables households to maintain investment in human capital.

For Uganda, Munyegera and Matsumoto (2014) use panel survey data to show that using mobile money is associated with a 69% increase in household per capita consumption, mobile money subscribers are 20 percentage points more likely to receive remittances from their family members in town, and the total annual value of remittances received is 33% higher compared to non-user households.

Using survey and administrative data on M-PESA in Kenya, Jack et al. (2013) study the impact of mobile money on the volume, reach, direction, and type of internal remittances. They find that M-PESA users are more likely to receive and send remittances (by 37.4 and 34.3 percentage points, respectively). This includes an increase in the frequency (two more transactions per round) and amount of remittances. The reach of transactions is, on average, 100 km greater, and reciprocity is also greater for M-PESA users (they are 13.2 percentage points more likely to engage in at least one reciprocal transfer). Finally, M-PESA users are more likely to transact for regular support, credit, and insurance purposes, and they change the composition of remittances by shifting from regular support purposes to credit arrangements.

Using qualitative methods, Morawczynski (2009) finds that M-PESA usage increased during periods of violence, like the post-election violence in Kenya in 2007, and resulted in reduced vulnerability to consumption shocks. Morawczynski and Pickens (2009) find that M-PESA increases savings for both the banked and unbanked, improves women's empowerment, and facilitates transfers within networks during bad events. Plyler et al. (2010) find community-level effects of M-PESA in terms of money circulation and local employment; physical, financial, and food security; greater financial, human, and social capital accumulation; and an improvement in the business environment, as transactions are easier.

Aside from these initial studies on mobile money, there are a number of recent field experiments studying the impact of mobile money. Batista and Vicente (2013) study the initial rollout of a mobile money product, mKesh, in Mozambique. In the treatment areas, there was intense mobilisation of agents and information dissemination. In addition, randomly chosen households in treatment areas were provided with individual information and support in self-registering for a mobile money account. Using survey, behavioural and administrative data, the authors find that, in terms of take-up, 76% of individually targeted individuals conducted at least one transaction on the system. In terms of impact, financial literacy, trust in local agents, and the usage of mCel (the accompanying telco), financial services were higher in treatment areas. In addition, the overall willingness to remit (independently of the money transfer mechanism) increased, though the overall willingness to save did not increase significantly. As with the studies on M-PESA, the remittance aspect of mobile money seems to be the most salient.

Using a field experiment in rural Mozambique, Batista and Vicente (2018) confirm the findings of Jack and Suri (2014) when following households in both treated and control locations over three years: after major floods affected some of the experimental areas in 2013, households in treated locations were better able to smooth their consumption and reported being less vulnerable to episodes of hunger. This same response occurred in response to household idiosyncratic shocks. This consumption-smoothing behaviour happened as a result of increased migrant remittances to households affected by shocks, as shown by both mobile money administrative records and remittance reports from household surveys. Households affected by shocks and who lived in areas where mobile money was available were, in this way, provided with extra resources to attend to shock-related expenditures without the need to cut on food expenditure. This can presumably explain the observed increase in the perceived well-being and decreased vulnerability of treated households.

Batista and Vicente (2018) find that households in villages where mobile money was available were less likely to keep actively farming their land, similar to Suri and Jack (2016). This agricultural disinvestment effect is strengthened over time, as treated household members emigrate out of rural areas – a treatment effect that also strengthens over time. This migration treatment effect of mobile money is consistent with the hypothesis that the introduction of mobile money reduced the transaction costs associated with long-distance transfers and, in this way, improved household-level insurance possibilities, which incentivised migration. While the explanation for agricultural disinvestment in Suri and Jack (2016) was occupational change, the result in Batista and Vicente (2018) points to the introduction of mobile money creating a different type of occupational change that involves geographic mobility.

In Bangladesh, Lee et al. (2019) used an information treatment to encourage use of mobile banking accounts by rural households with a household member who had migrated to the city to facilitate urban to rural remittance flows. They find large increases in remittances, an increase in the consumption of the rural households by 7.5%, and an accompanying fall in their rates of extreme poverty. For these households, they also find increased consumption in the lean season and additional migration out of these households. The authors also study what happens to the urban migrants themselves – these individuals save more, see reductions in their poverty levels but they also have worse health (and the women work longer hours). So, although the mobile money technology brings important benefits, it can also bring costs to some parts of the family, in particular the migrants.

Recent work has also explored the potential of mobile money to promote the development of microenterprises. Batista et al. (2020) worked with 1270 microentrepreneurs operating in a relatively homogenous setting in Maputo, the capital city of Mozambique. Using an RCT, the authors study whether mobile money and/or financial management training (in a cross treatment design of the two interventions) help microentrepreneurs. They find that removing financial and management constraints had a positive impact on female-owned business performance, but had no detectable effect on male-owned businesses – with a treatment effect equivalent to approximately US$ 120/month (35% of the average monthly profits in the control group). In terms of mechanisms, the evidence shows that financial management training increased understanding of financial management skills in the short and long-run; although there was limited impact on savings, confidence in the ability to save more in the future increased. Administrative mobile money records show that microentrepreneurs in the experimental groups provided with these interest-bearing mobile money accounts, were more likely to conduct all types of mobile money transactions, with some evidence of increased effects of the combined intervention.

Riley (2020), in Uganda, examines the impact of disbursing microfinance loans through a mobile money account instead of the usual method of cash. She finds disbursement of loans through the mobile money account leads to an 11% increase in the value of business capital and a 15% increase in business profits. She also finds that the mechanism behind these effects is an improvement in the ability to resist sharing pressure from the woman's spouse. She sees that the mobile money account is used for the safe storage of the loan, rather than for transactions, and so the initial deposit of the loan into the mobile money account is crucial for it to have a positive impact on the business. The household as a whole is also better off when the woman receives the microfinance loan on a mobile money account, suggesting wider benefits from improving women's control of resources.

Another RCT explored the potential of mobile money as a secure saving device. In Kenya, Dizon et al. (2020) randomly assigned a mobile money account, labeled for saving, to women. They found that the treatment increased savings while reducing risk-sharing. However, the reduced risk-sharing was more than compensated for by the increased savings improving women's ability to manage risk, resulting in an overall improvement in women's ability to manage shocks.

To evaluate the impact of promoting mobile savings on agricultural modernisation, Batista and Vicente (2020) implemented an RCT with farmers in the Manica province of Mozambique. The randomised intervention incentivised savings in the period that mediated between harvest and planting seasons. All

farmers participating in the experiment had no prior access to mobile money and were offered identical mobile money accounts, except that the treated farmers were paid interest on balances held in their mobile money accounts over a three-month period between harvest and planting. As a result, treated farmers exhibited significantly higher savings, and were more likely to use fertiliser on their land (by 31-36 percentage points), as well as to use other agricultural inputs.

There has also been a growing body of literature that tries to understand the applications of mobile money, i.e., in particular contexts where mobile money could play a role. For example, Aker et al. (2018) conducted the first RCT involving mobile money in the specific context of cash transfers. To reduce malnutrition during the drought and the 2009–2010 food crisis, households in Niger were given monthly unconditional cash transfers, with women as the primary beneficiaries. The authors compared: (a) a cash arm, where households received the transfer manually; (b) a Zap arm (Zap is a mobile money service), where transfers were received via mobile money and households were also given a service-enabled mobile phone; and (c) a mobile arm, where the transfers were received manually but households were also given a mobile phone. There was no pure control group. Recipients of mobile money transfers had better nutrition, with a 10–16% more diversified diet, including greater proportions of protein and energy-rich food, and their children ate 33% more of a meal per day. The authors argue that these effects came from reduced time costs for the recipients, with mobile money transfer recipients saving, on average, two days over a five-month period. Despite the small magnitude of this effect, it could have had a significant opportunity cost because it occurred during the planting season. Another potential mechanism increasing bargaining power for women is the increase in privacy, given that the transfer was less observable to other household members. The electronic nature of the cash transfer did not, however, lead to significant use of mobile money beyond the programme. Finally, the authors also show that, although total costs were higher in mobile money villages (due to the distribution of phones), per-transaction costs were 20% lower. With appropriate infrastructure, mobile money could, therefore, significantly reduce costs of cash transfers to disbursing agencies.

Blumenstock et al. (2015b) designed an experiment to study mobile salary payments in seven provinces across Afghanistan between August 2012 and March 2013. The intervention provided employees in a firm with a mobile phone and training on using M-Paisa, a mobile money service, and randomly assigned half of them to receive their salary through M-Paisa as opposed to cash. Analysing survey and administrative data, the authors found significant cost reductions for the operating agency, but no significant impacts of mobile money use on the recipients.

Blumenstock et al. (2018) conducted a field experiment with automatic payroll deductions toward savings through M-Paisa via a new salary platform called M-Pasandaz. Employees were randomised into the following groups: (a) different default contribution rates from salary to a savings account (0% or 5%, which they could choose to change) and (b) different matching contribution rates from the firm (0%, 25%, or 50%). These were cross-randomisations, creating a 2×3 design with a total of six treatment groups. The authors find that employees enrolled in the 5% deduction rate were 40 percentage points more likely to save and that a 50% matching rate had comparable results to the 5% deduction for saving. The main explanation for this striking result seems to be present-bias preferences, where the employee procrastinates when making a non-default contribution.

Blumenstock et al. (2020) study the relationship between violence and financial decisions in Afghanistan. Using data from an RCT administered to increase mobile money take-up and combining this with administrative data, a nationally representative household survey, and behavioural field experiments, the authors find that people increase their cash holdings when exposed to violence and that people experiencing violence are less likely to transact in mobile money and hold less funds in their mobile money accounts. They argue that the mechanism underlying these effects is a demand for liquidity that arises from the fear of future violence. In particular, a one standard deviation increase in individual forecasts of violence is

associated with holding 20% less mobile money and 20% more cash. This suggests that violence may play an important role in preventing the development of formal and digital financial networks.[23]

IVB Impacts of digital bank accounts and digital lending products

As mentioned earlier, this review focuses on mobile money (accounts that lie outside the traditional banking system). This review does not include work on mobile banking which connects a bank account to a mobile phone app that allows easier transactions (e.g. the Bank of America app) or an app that relies on credit cards for a payment infrastructure (e.g. Apple Pay or Venmo). Mobile money is a payment system in of itself unlike things like Apple Pay which are just wrappers over an existing payments system (credit cards or bank accounts). However, we do include in this review the impacts of digital bank accounts and digital lending products that rely on mobile money for their payments infrastructure as these products would not exist without mobile money. In this section, we review what we know on these products. There is still little research on these products given how recently these products have been developed and built, but this leaves open many research questions.

Bastian et al. (2018) in Tanzania, examine the effects of providing digital bank accounts called M-Pawa from the Commercial Bank of Africa (mentioned above). They provided these accounts to female entrepreneurs with and without a business training. They find that, after six months, treated women are saving more in the mobile bank account, saving less in other forms of saving, and obtain more micro-loans through the mobile bank account. The saving accounts also increase women's reported control over how their business money is spent.

Breza et al. (2020) conduct a field experiment in Bangladesh to measure the impact of moving garment factory workers from cash to digital wage payments. The workers, most of them women, were randomised into the following groups: (a) workers who received a bank or mobile money account as well as direct wage payments; (b) workers who got an account but were not enrolled in digital payroll; and (c) workers who continued to receive wage payments in cash. They find evidence that financial capability comes from experience and 'learning-by-doing'. Workers enrolled in digital wage payments conduct fewer transactions with the help of bank agents, and carry out more transactions on their own. Compared to workers in the mobile money account-only group, these workers are 24 percentage points more likely to make a send-money transaction and 60 percentage points more likely to make a withdrawal from their account without receiving assistance. They added an audit study where actors posing as factory workers were sent to conduct mobile money transactions with local agents, and find that agents operating around factories that pay wages electronically are less likely to take advantage of women customers, such as adding on extra fees.

In an ongoing field experiment, Habyarimana and Jack (2016) study the Kenyan digital bank account, M-Shwari in a set of schools in Kenya using a field experiment with two treatment arms: a commitment (locked) savings arm and a regular savings arm (with a cross-randomisation of text message reminders to save for education). The intervention was targeted at the transition between primary and secondary school. The authors find an increase in savings and in secondary school enrollments for both groups relative to the control (though the effects are not significantly different across the two groups).

Bharadwaj et al. (2019) look at the impacts of M-Shwari loans using a regression discontinuity design around the M-Shwari credit score. They use administrative and survey data (collected in a narrow bandwidth around the credit score cutoff) to study the impacts of these short-term loans. They find large take up rates of these loans (34% of those eligible take-out loans) and that these loans do not substitute for other forms of credit and instead expand the credit available to these households. They also find that

23 In an accompanying policy white paper, Blumenstock et al. (2013) suggest that, when transactions are conducted in an unsafe or unstable environment, firms might benefit from shifting the costs of managing salary payments to mobile operators through mobile money.

these short-term loans improve resilience of the households to unexpected negative shocks. However, there is no evidence that these loans spur entrepreneurship or increases in wealth so they probably do not correct broader failures in the credit market though they do expand financial access.

Carlson (2017) studies the use of dynamic incentives by a digital lender (not a digital bank account) in Kenya that uses a smartphone application to screen (using a machine learning algorithm) and disburse credit to approved borrowers. The loans are disbursed and repaid through mobile money. The lender uses dynamic incentives to improve repayment rates, mostly increasing the credit limit over time as borrowers repay their loans. Using a set of natural experiments from policy changes made by the lender around their screening methods and their dynamic incentives, she shows that: (i) a larger initial (first) loan leads to increased probabilities of loan default, and (ii) repeat borrowers who get larger loans over time are less likely to default. She shows that borrowers have a strategic motive to repay their loans as this allows them to get larger loans in the future.

Finally, looking more broadly at credit market regulations, Bharadwaj and Suri (2020) use administrative data on M-Shwari accounts to study the impacts of interest rate cap regulations in Kenya that were imposed in September 2016. The interest rate caps affected all banking products, including all digital banking products except M-Shwari (i.e. the interest rate caps affected most of the competitors to M-Shwari but not them). The interest rate caps implied a lowering of the lending rates in digital banking products by a factor of about six and raised deposit rates by a factor of at least three. Bharadwaj and Suri find evidence of strategic behaviour on the part of the borrowers. The regulations increased borrowing on M-Shwari (which was more expensive as it was not subject to the caps), but a lot of this expanded borrowing comes from high-risk borrowers (those with worse credit scores who could no longer access other credit platforms), while low-risk borrowers left as they were able to access to credit on other cheaper platforms. Additionally, these same high-risk borrowers increase their savings on M-Shwari to grow their credit limits. In response, M-Shwari increases credit limits but far more for the low-risk borrowers to draw them back to M-Shwari.

IVC Macroeconomic impacts of mobile money

There has also been some work on the macroeconomic impact of mobile money systems. Weil et al. (2012) use survey data from Kenya, Tanzania, and Uganda to document the rapid adoption of mobile money between 2006 and 2009, and aggregate data from the Central Bank to look for structural breaks in monetary aggregates that would suggest macroeconomic effects of mobile money. They find evidence of these effects in Kenya, though the velocity of M-PESA, computed based on aggregate data provided by Safaricom, was no higher than that of cash or other monetary aggregates. Similarly, Mbiti and Weil (2011) start by showing that the transaction velocity of M-PESA was four transactions per month in 2008, not much higher than the velocity of cash. The calculated value of outstanding e-float was 3.3 billion shillings in August 2008, also a modest value in comparison to the 85.2 billion shillings of currency (M0) on average between January and June, 2008. Analysing transactions, they conclude that M-PESA is not used as a store of value, with the average account balance of users valued at less than US$ 10 at any point in time. More importantly, they show an effect on the prices of competitors to M-PESA (such as Moneygram and Western Union), with competitors reducing prices on transaction sizes below M-PESA's thresholds.

Contrary to this, Mas and Klein (2012) find that the velocity of money increases considerably; however, it does not affect the money supply base when e-money is based on a safe-deposit-box model. Aron et al. (2015) find little evidence of a link between mobile money and inflation using inflation forecasting models for Uganda. Simpasa et al. (2011) study the same question in Ethiopia, Kenya, Tanzania, and Uganda, highlighting the fact that mobile money could cause an increase in the velocity of money. They therefore suggest the need for regulation to make sure such products do not undermine the effectiveness of monetary policy in these economies.

In a different vein, Jack et al. (2010) show how existing models of monetary theory can be used to

think about the impact of mobile money on the operations of the financial system, and the subsequent implications for monetary and regulatory policy decisions. Discussing results from household and agent surveys in late 2008, the authors show that the most common problems are agents' lack of cash and e-money, which would give rise to price discrimination if the price of cash to e-money was not fixed. However, they argue that there may be informal credit or debit relationships between the agents and their coordinating bodies, which can be welfare-improving according to the theoretical models.

V Conclusion: Is mobile money the payments infrastructure of the future?

Although mobile money has been very successful in some countries (for example, by the end of 2014 in Kenya, 96% of households outside Nairobi used M-PESA) and is expanding in a number of other economies, its use remains mostly limited to very specific P2P transactions: those that take place over long distances and those that are in places where holding cash is risky. Outside these applications, there has been less success, and the innovation ecosystem around mobile money is still in its early stages.[24] Even in Kenya, less than a third of households use the system for paying bills,[25] for receiving payments or wages from an organisation, or for paying for other goods or services. As a result, few P2B, B2B, or G2P interactions take place over mobile money.[26] Similarly, although digital bank accounts that build over mobile money are very successful in Kenya and Tanzania, they have yet to make inroads in other countries. In addition, every single one of these digital bank accounts and digital lenders offer extremely small loans (on average US$ 5-20) to be repaid in a month (Bharadwaj et al. 2019). There is little product diversity and these lending efforts are still aimed at extremely short term needs rather than longer term investments. Although often referred to as a payment system, mobile money cannot fulfill its promise as a genuine payment system unless it can provide these other services at a sensible fee structure.

In the case of G2P transactions, it is important to mention innovations that are working towards delivering such services. In India, along with the universal ID (called Aadhaar), there has been a rollout of smartcards using a biometrically authenticated payments infrastructure through which government payments can be made to households. Muralidharan et al. (2016) evaluated the impact of these smartcards on beneficiaries of the government's rural employment guarantee and pension programmes in Andhra Pradesh. They find that payments made using smartcards were faster, more predictable, and involved less leakage than the existing system, especially for the employment programme. In an accompanying study, Muralidharan et al. (2018) look at the general equilibrium effects of the smartcards being used in the employment programme. They find an increase in income, 90% of which came from private sector earnings (the remainder came from increases from the programme itself). Similarly, Banerjee et al (2020) study the effects of a universal basic income (UBI) using a large-scale experiment in Kenya. The UBI is implemented by GiveDirectly and is delivered via mobile money. Approximately 20,000 adults are getting some form of a UBI in this experiment. During the COVID-19 pandemic, a lot of cash transfers have been delivered through mobile phones and mobile money accounts, given that the costs of delivering such welfare payments is dramatically lower through telcos than via in-person delivery, especially in the context of a pandemic.

Although the literature on mobile money is growing, research on the innovations that are already building

24 Mas and Mayer (2011) hypothesise that households need to manage their budgets, savings, and payments in order to better manage their livelihoods, and the services available to the poor rarely combine these needs. They suggest how mobile money may provide an avenue and set of products to do this.

25 For the Safaricom product timeline, the reader is referred to the following webpage: http://www.safaricom.co.ke/mpesa_timeline/timeline.html. In April 2009, Safaricom partnered with Kenya Power to enable customers to pay electricity bills through M-PESA. Starting in October 2010, customers could pay at supermarkets using M-PESA. Similar bill-payment services are now provided by many mobile money providers.

26 One nongovernmental organisation, Give Directly, operates in East Africa using mobile money to distribute cash transfers, though they do not yet reach anywhere near the scale of a G2P programme.

on mobile money has been lagging. In the spirit of spurring new research ideas, we outline some of the more recent product innovations that have built on existing mobile money systems and encourage researchers to catch up with the innovations. Whether these innovations ultimately deliver improvements in livelihoods to households is still an open question.[27]

In 2013, Safaricom launched Lipa-na-M-PESA, a product that encourages retail payments over the M-PESA platform. Before this, the transaction fees on M-PESA, as on all other mobile money systems (see Figure 3), were too high for basic retail payments, especially because the incidence of those fees falls on the end consumer and not on the retailer. Lipa was an attempt to lower these transaction fees to 1% of the transaction size, which was then further lowered to 0.5% in March 2017 for transactions above KShs 200 (US$ 2) and 0% for transactions less than KShs 200. The retailer can choose to either pay it or pass on the fee to the consumer.[28] In practice, there has been a mix of retailers choosing to pay it or pass it on, though it is slowly becoming the norm for the retailer to pay the fee. The use of Lipa is still quite limited (especially in rural areas), leaving a lot of room for mobile money to help improve trade.

In March 2017, the Kenyan Treasury launched a pilot version of a digital government bond called M-Akiba. It is a three-year infrastructure bond that is purchased over mobile phones. The backend system is built to allow individuals to use the KYC behind their mobile money accounts to open a Central Depository System (CDS) account through their mobile phone in a few key strokes. Individuals can then actively purchase and trade these bonds on the underlying digital platform (which links to the bond exchange). These bonds come with a coupon rate payout of 10% per annum, paid every 6 months. To make this happen, Kenya passed legislation that lowered the minimum investment in treasury bonds to KShs 3,000 (US$ 30) from KShs 100,000. The government also allowed for a CDS account to be opened via a mobile phone, and allowed individuals to use mobile money to purchase and trade treasury bonds over a mobile phone. M-Akiba will serve as a positive real return savings instrument for low-income households, hence the name: M for mobile and Akiba meaning savings in Swahili. The March 2017 bond issue was only for KShs 150 million (US$ 1.5 million) because it is a pilot version, and it closed in just over two weeks. The Kenyan Treasury opened M-Akiba's second issuance in June 2017 and a third issuance that occurred in two tranches in July and September 2019 (the third has a one-year maturity date). In total, the government managed to raise KShs 1 billion (US$ 10 million) through M-Akiba. Of course, the use and impacts of M-Akiba are yet to be studied.

In late 2015, Safaricom made available an application programming interface (API) to allow for programmatic access to the M-PESA platform over the web, with a second generation launched in 2017.[29] APIs are a convenient approach for businesses to expose some of their core assets and to enable the emergence of a developer community around these assets. APIs come with instructions for developers on how to access them, as well as with terms and conditions, a pricing model, and other business contractual agreements. Exposing APIs has become a standard approach to creating B2B interactions over the internet without tedious human business development transactions in the way.[30]

Given the popularity of M-PESA, one could assume significant uptake of the API in Kenya.However, there have been few integration efforts till date. Vodafone Tanzania opened up its API to developers in late 2020. As more mobile money systems open up their APIs to developers, we can hopefully expect more innovations over these platforms. The universal access to mobile money presents a tremendous opportunity for an API model and could accelerate the fintech market across Africa. The value of global

27 Kendall et al. (2011) look at how some other market players use M-PESA as a platform to integrate more financial services using results from phone and internet surveys.

28 This is in contrast to Visa and Mastercard, where the incidence of the fee is always entirely on the retailer.

29 For more on APIs and M-PESA's initial API, the reader is referred to the Bankable Frontiers Association (Bank. Front. Assoc. 2016) and Morawczynski (2015). For more on the operational aspects of M-PESA's API from Safaricom, the reader is referred to http://www.safaricom.co.ke/business/corporate/m-pesa-payments-services/m-pesa-api.

30 For more information on APIs and their standardisation, the reader is referred to http://oldwww.acm.org/tsc/apis.html; Meyer (2016) provides more information on APIs in telcos.

fintech investments in 2015 was US$ 22.3 billion (Skan et al. 2016), with the United States having the largest sector, receiving US$ 4.5 billion in new funding in 2015. China had nearly US$ 2 billion, India US$ 1.65 billion, and Germany US$ 770 million. Whereas the growth in investments in Asia-Pacific have been dramatic (a fourfold growth between 2014 and 2015), there has been little investment in sub-Saharan Africa, where mobile money systems have no doubt been the most popular (Skan et al. 2016). Given that sub-Saharan Africa has some of the poorest economies in the world, it may also have the economies where the returns to fintech investments are the highest, as illustrated by the case of mobile money.

Democratising access to mobile money payment systems might well be the missing link between the current situation and potential significant increases in investments in fintech in the region. The big question is: what can we learn from these nascent innovations that can change the gestalt of payments and financial markets in developing economies? Although mobile money may seem revolutionary, aside from the dramatic adoption, it is far from revolutionising the role of financial markets or cash in these economies. Mobile money has been, in most cases, a cash-in cash-out system, with the majority of transactions being the purchase of airtime and small P2P remittances, generally once a month. In the success cases, cash has come into the financial system, and the flow through the system has often amounted to a sizeable fraction of GDP. However, these economies are not to be mistaken for cashless when compared, for example, to Sweden, where cash makes up only 2% of transactions (see Bank Int. Settl. 2015). Similarly, their financial flows are tiny when compared to the US financial system, which trades more than 60 times its GDP a day just through stocks, bonds, and derivatives. The benefits of cashless economies, especially in low-resource environments, remains an open question. Should these economies become cashless or close to cashless, and if so, how will that be accomplished? Will the banking system be the primary venue for this transformation, and if so, what sets of products and services will be needed to accomplish this? What will encourage financial market transformation in these economies? Will mobile money be the first stepping-stone towards new financial markets and transactions in these economies? Will it encourage broader, better-integrated, more secure platforms for transactions? There is a lot still to learn.

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