The Economics of M-PESA[1]

WILLIAM JACK[2]

GEORGETOWN UNIVERSITY

AND

TAVNEET SURI[3]

MIT SLOAN

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[2] wgj@georgetown.edu
[3] tavneet@mit.edu

I. Introduction

Mobile phone technology has reduced communication costs in many parts of the developing world from prohibitive levels to amounts that are, in comparison, virtually trivial. Nowhere has this transformation been as acute as in sub-Saharan Africa, where networks of both fixed line communication and physical transportation infrastructure are often inadequate, unreliable, and dilapidated. While mobile phone calling rates remain high by world standards, the technology has allowed millions of Africans to leap-frog the land-line en route to 21st century connectivity.

Early on in this revolution, cell phone users figured out that they could effectively transfer money across wide distances. Phone companies have long allowed individuals to purchase "air-time" (i.e., pre-paid cell phone credit that can be used for voice or SMS communication) and to send this credit to other users. It was a small step for the recipient user to on-sell the received air-time to a local broker in return for cash, or indeed for goods and services, thus effecting a transfer of purchasing power from the initial sender to the recipient.

In March 2007, the leading cell phone company in Kenya, Safaricom, formalized this procedure with the launch of M-PESA, an SMS-based money transfer system that allows individuals to deposit, send, and withdraw funds using their cell phone. M-PESA has grown rapidly, currently reaching approximately 38 percent of Kenya's adult population, and is widely viewed as a success story to be emulated across the developing world.

This paper provides a description of the service and a review of the potential economic effects primarily at the household level, but also in terms of macroeconomic and monetary aggregates. It then provides a detailed portrayal of patterns of use across urban and rural populations, using data from the first large household survey focused on money transfer services in Kenya.[4]

II. Context

Mobile phones and mobile banking in Kenya

The adoption of mobile phones has occurred at perhaps the fastest rate and to the deepest level of any consumer-level technology in history. Figure 1 illustrates the speed of adoption compared with a variety of product innovations. While cumulative forces are of course important, making it difficult to compare directly across innovations, it is nonetheless informative to note that cell phones have been adopted more than five times as fast as fixed line telephone services, which took 100 years to reach 80 percent of country populations.

[4] Mobile payment systems have also been developed in other developing countries. In the Philippines Globe Telecom operates GCASH, and in South Africa WIZZIT facilitates mobile phone-based transactions through the formal banking system (Ivatury and Pickens, 2006). Similarly mobile banking technologies have developed in Sudan and Ghana, and in a number of countries is Latin America and the Middle East (Mas, 2009). For related overviews, see also Mas and Rotman (2008) and Mas and Kumar (2008), as well as other publications of the Consultative Group to Assist the Poor, at www.cgap.org .

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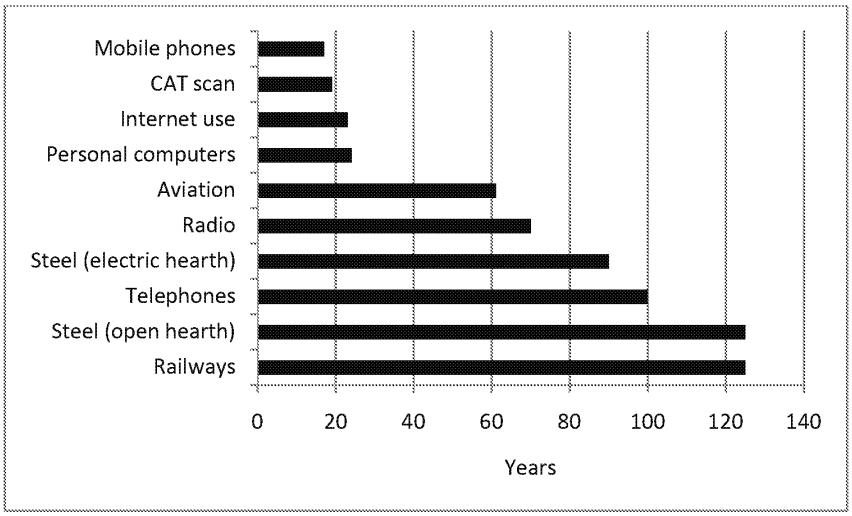

Figure 1: Technology adoption for select innovations (number years to reach 80% coverage)[5]

One of the reasons mobile phone technology has spread quickly is that it has followed other technologies that may have eased the way. Figure 2 confirms this sequencing property is likely at work, at least in the US: many of the new technologies that were introduced before about 1950 (with the exception of radio) were relatively slow to diffuse through the population, whereas those introduced in the second half of the century saw generally steeper adoption rates. Nonetheless, the speed of adoption of cell-phones, especially in the developing world, remains unprecedented.

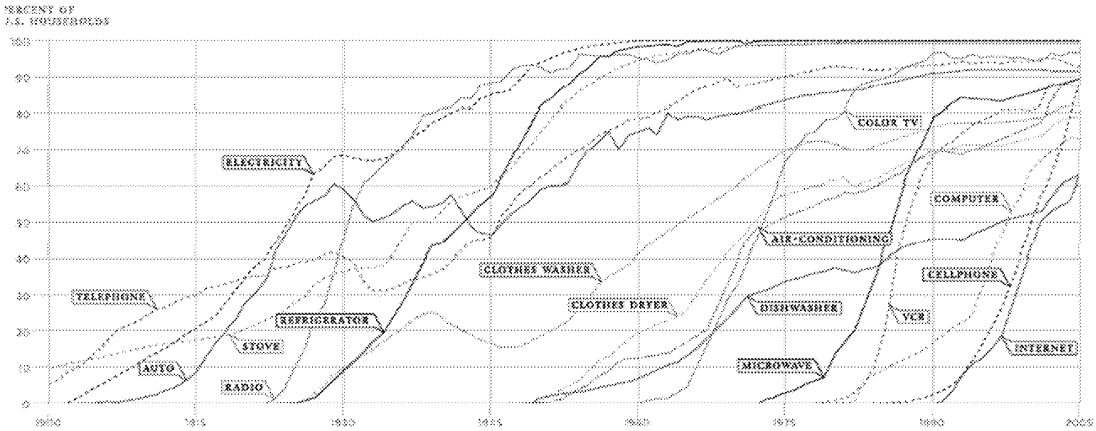

Figure 2: Technology adoption is getting faster[6]

[5] Data from World Bank.
[6] Source: New York Times, February 10, 2008.

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The spread of mobile phone technology has been especially rapid and broad in Africa where penetration rates stood at some 32 percent in 2008, still well below the global average of 60 percent at that time, but much higher than the 7 percent coverage rate that prevailed just four years before. This pattern stands in contrast to the adoption of other technologies such as improved seed and fertilizer, which have been frustratingly weak. Since Solow's (1956) seminal contribution to the theory of economic growth, and following later developments (e.g., Romer 1986 and Lucas, 1988), economists have understood that higher rates of adoption of modern technologies may accelerate the development process.

In Kenya, the first mobile phone companies were publicly owned, and began operations in the mid-1990s on a small scale. Over time mobile phones in Kenya have eclipsed landlines as the primary means of telecommunication: while the number of landlines had fallen from about 300,000 in 1999 to around 250,000 by 2008, mobile phone subscriptions had increased from virtually zero to nearly 17 million over the same time period (Figure 3).[7] Assuming an individual has at most one cell phone,[8] 47% of the population, or fully 83% of the population 15 years and older, have access to mobile phone technology.

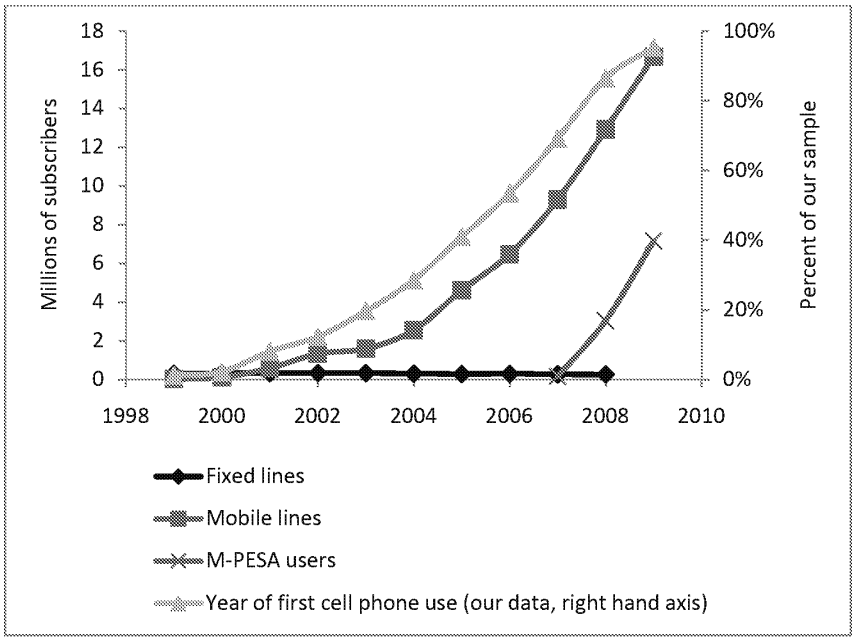

Figure 3: Phone use in Kenya

Safaricom, which began operations in 1997, is currently the largest mobile phone operator in Kenya, controling nearly 80 percent of the market, ahead of its two nearest rivals (Zain and Orange). Recent

[7] Figure 3 includes information on the share of our sample who had started using a cell phone by year. The evolution of this figure follows closely that from the aggregate data on cell phone use, providing partial validation of our sampling methodology.

[8] This is not quite true, as some individuals own two (or more) phones, so as to take advantage of different tariff policies of the competing providers.

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and prospective entry into the sector is expected to put a squeeze on Safaricom's market share, which some commentators (including its chief executive) expect to fall to around 65 percent over the next 3 to 4 years.[9]

In April 2007, following a donor-funded pilot project, Safaricom launched a new mobile phone-based payment and money transfer service, known as M-PESA.[10] The service allows users to deposit money into an account stored on their cell phones, to send balances using SMS technology to other users (including sellers of goods and services), and to redeem deposits for regular money. Charges, deducted from users' accounts, are levied when e-float is sent, and when cash is withdrawn.

M-PESA has spread quickly, and has become the most successful mobile phone-based financial service in the developing world.[11] The average number of new registrations per day exceeded 5,000 in August that year, and reached nearly 10,000 in December (see Figure 4). By August 2009, a stock of about 7.7 million M-PESA accounts had been registered. Ignoring multiple accounts and those held by foreigners, this suggests that about 38 percent of the adult population has gained access to M-PESA in just over 2 years.

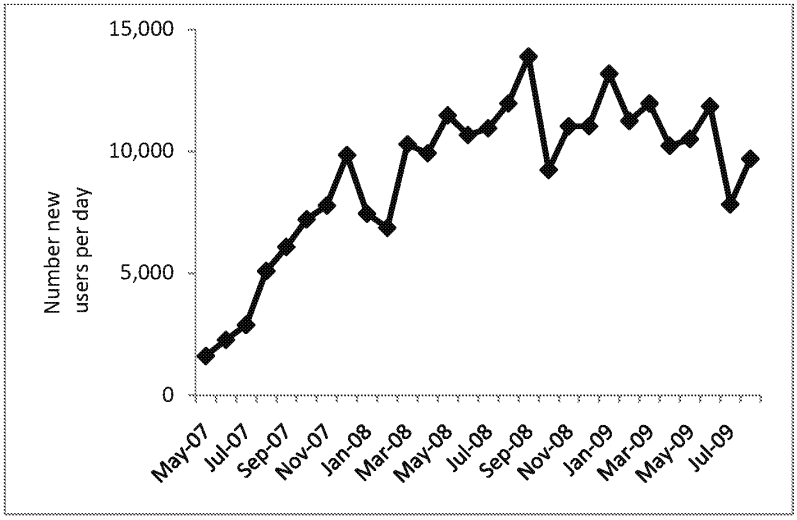

Figure 4: Average daily growth in M-PESA registrations by month

Since the launch of M-PESA in March 2007, wary of regulation by the Central Bank of Kenya, Safaricom has been at pains to stress that M-PESA is not a bank. On the other hand, the ubiquity of the cell phone across both urban and rural parts of the country, and the lack of penetration of regular banking

[9] See report by International Telecommunication Union, http://www.itu.int/ITU-D/ict/newslog/Safaricoms+Market+Share+To+Dip+From+80+To+65+As+Competition+Toughens+Kenya.aspx .
[10] Pesa is Kiswahili for "money" – hence M[obile]-Money.
[11] Similar services in Tanzania and South Africa, for example, have penetrated the market much less. See Mas and Morawczynski (2009).

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services,[12] led to hopes that M-PESA accounts could substitute for bank accounts, and reach the unbanked population. Our data, presented in more detail in the next section, suggest this is partially true, although M-PESA has been adopted by both the banked and unbanked in roughly equal proportions.[13]

While the sustained growth in M-PESA registrations is notable, the volume of financial transactions mediated through M-PESA should not be exaggerated. Table 1 reports that the volume of transactions effected between banks under the RTGS (Real Time Gross Settlement] method is nearly 700 times the daily value transacted through M-PESA. On the other hand, the average mobile transaction is about a hundred times smaller than the average check transaction (Automated Clearing House, or ACH), and even just half the size of the average Automatic Teller Machine (ATM) transaction.[14] Thus M-PESA is not designed to replace all payment mechanisms, but has found and filled a niche in the market in which it provides significantly enhanced financial services.

Table 1: Daily financial transactions, Oct 2007 - Sept 2008[15]

	RTGS	ACH	ATM	Mobile
Value per day (billion KSh)	66.3	8.5	1.0	0.1
Transactions per day (thousands)	1.0	39.2	180.2	107.2
Value per transaction (million KSh)	64.67	0.216	0.006	0.003

How does M-PESA work

Although M-PESA does not pay interest on deposits, and does not make loans, it can usefully be thought of as a bank that provides transaction services and that has operated, until recently, in parallel with the formal banking system.

Safaricom accepts deposits of cash from customers with a Safaricom cell phone SIM card and who have registered as M-PESA users. Registration is simple, requiring an official form of identification (typically the national ID card held by all Kenyans, or a passport) but no other validation documents that are typically necessary when a bank account is opened. Formally, in exchange for cash deposits, Safaricom issues a commodity known as "e-float," measured in the same units as money, which is held in an account under the user's name. This account is operated and managed by M-PESA, and records the quantity of e-float owned by a customer at a given time. There is no charge for depositing funds, but a sliding tariff is levied on withdrawals (for example, the cost of withdrawing $100 is about $1).[16] Figure

[12] In 2006 it was estimated that 18.9 percent of adults used a bank account or insurance product, and by 2009 this had increased to 22.6 percent. (Finaccess I.)

[13] In the time since our survey was first administered, there has been significant growth in the number of individuals, and households, with a bank account, due to the expansion of such institutions as Equity Bank and Family Bank. In addition, a number of banks have very recently allowed consumers to link there M-PESA and bank accounts. How these changes have affected the relationship between M-PESA registration and access to banking services remains to be seen.

[14] These data refer to a period before M-PESA could be used at ATMs.

[15] Source: Central Bank of Kenya, presentation at conference on Banking & Payment Technologies East Africa, 17-19 February 2009, Nairobi.

[16] The complete tariff schedule is available at http://www.safaricom.co.ke/fileadmin/template/main/downloads/Mpesa_forms/14th%20Tariff%20Poster%20new.pdf .

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5illustrates the schedule of total net tariffs for sending money by M-PESA, Western Union and Postapay (operated by the Post Office). The M-PESA tariffs include withdrawal fees, and are differentiated according to receipt by registered and non-registered user.

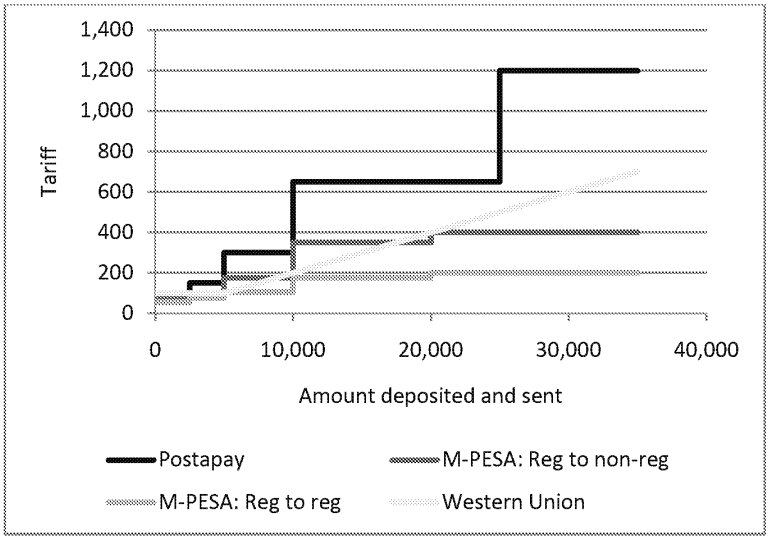

Figure 5: Total net tariff rates for depositing and sending money by Postapay and by M-PESA to a registered user and to a non-registered user

E-float can be transferred from one customer's M-PESA account to another using SMS technology, or sold back to Safaricom in exchange for money. Originally, transfers of e-float sent from one user to another were expected to primarily reflect unrequited remittances, but nowadays, while remittances are still an important use of M-PESA, e-float transfers are often used to pay directly for goods and services, from electricity bills to taxi-cab fares. The sender of e-float is charged a flat fee of about 40 US cents, but the recipient only pays when s/he withdraws the funds.

Table 2: Safaricom cell tower distribution by province

Province	Towers	Population per tower	Area per tower (sq mi)
Nairobi	584	4,872	0.5
Rift Valley	375	22,448	179.0
Coast	247	12,046	130.7
East	214	24,871	288.5
Central	206	19,048	24.7
Nyanza	162	30,771	38.5
Western	90	46,122	35.9
North-East	45	29,467	1,088.8
Total	1923	17,653	117.0

Fees are charged to the user's account, from which e-float is deducted. Additional cash fees are officially not permitted, but there is evidence that they are sometimes charged on an informal basis by agents.

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Transfers are, of course, subject to availability of network coverage, which has expanded consistently over the past decade. There are now nearly 2,000 Safaricom towers across the country (in addition to towers operated by competing providers), concentrated in areas of high population density. Table 2 gives a breakdown by province, and the most recent network coverage map is shown in Figure 6.

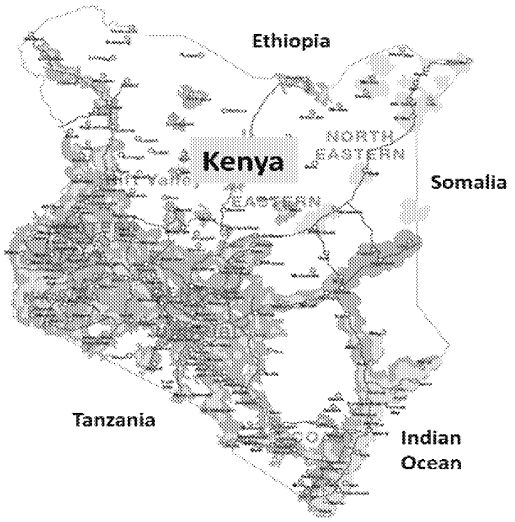

Figure 6: Safaricom network coverage, September 2009[17]

To facilitate purchases and sales of e-float, M-PESA maintains and operates an extensive network of over 12,000 agents across Kenya. As can be seen in Figure 7, the growth of this network lagged behind that of the customer base for the first year of M-PESA's operation during which time the number of users per agent increased five-fold, from a low of 200 to a high of 1,000. But since mid-2008, agent growth has accelerated and the number of users per agent has fallen back to about 600.

Registered M-PESA users can make deposits and withdrawals of cash (i.e., make purchases and sales of e-float) with the agents, who receive a commission on a sliding scale for both deposits and withdrawals.[18] M-PESA agents hold e-float balances on their own cell-phones, purchased either from Safaricom[19] or from customers, and maintain cash on their premises. Agents therefore face a non-trivial inventory management problem, having to predict the time profile of net e-float needs, while maintaining the security of their operations.

[17] Source: http://www.safaricom.co.ke/index.php?id=388

[18] The commission amounts are non-linear (and concave) in the size of the transaction. Some reports suggest that in response to this, agents encourage customers to split their transactions into multiple pieces, thereby increasing the overall commission.

[19] M-PESA requires that each agent has a bank account, so that funds can be transferred easily between them.

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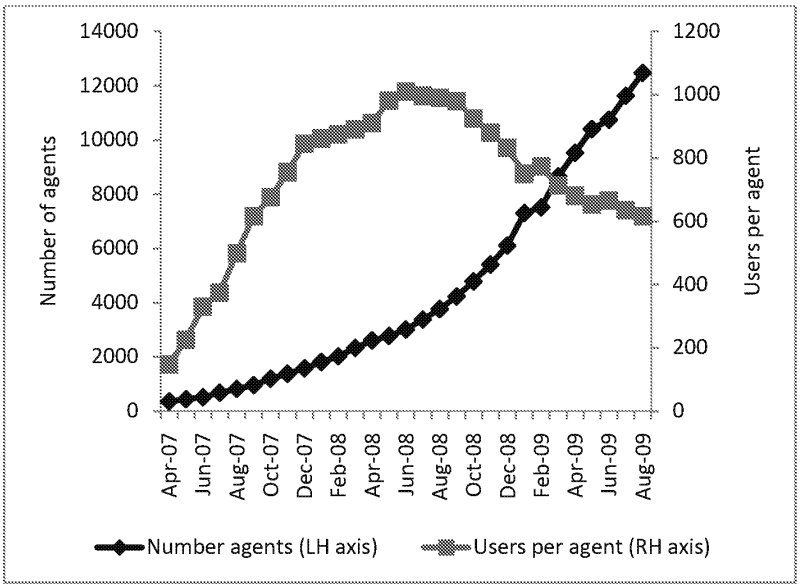

Figure 7: Expansion of the agent network[20]

In practice, agents are organized into groups. Originally, M-PESA required that agent groups operated in at least three different physical locations, so that the probability of imbalances arising within the group could be minimized. There are currently three agent group models in operation In the first, one member of the agent group (the "head-office") deals directly with M-PESA, while subsidiary agents, which are owned by the head office, manage cash and e-float balances through transactions with the head-office. Both the head office and the agents can transact directly with M-PESA users.

The second model under which agents are organized into groups is the Aggregator model. This model is similar to the first, with the aggregator acting as a head office, dealing directly with Safaricom and managing the cash and e-float balances of agents. However, the agents can be independently owned entities, with which the aggregator has a contractual relationship.

A final and more recent model allows a bank branch, referred to as a "super-agent," to perform the functions of the aggregator of the second model. The branch manages cash and e-float balances of a group of non-bank M-PESA agents, but unlike the regular and aggregator models, the bank does not trade e-float directly with M-PESA users.

The super-agent model is one example of the integration of M-PESA services into the banking system. Other developments in this vein have seen users with accounts at certain commercial banks (about 72% of user households in our data have at least one bank account – see Table below), being able to transfer funds between those accounts and their M-PESA accounts, often via ATMs.

[20] Source: Safaricom.

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The cash collected by M-PESA in exchange for e-float is deposited in bank accounts held by Safaricom. Originally, all funds were held in just one account at the Commercial Bank of Africa, but recently Safaricom has opened accounts at an additional bank to diversifying its risk. These accounts are regular current accounts, with no restrictions on Safaricom's access to funds. In turn, the banks face no special reserve requirements with regard to M-PESA deposits, which are treated as any other current account deposit in terms of regulatory policy of the Central Bank. There is no explicit requirement, for example, for Safaricom to give notice of its intention to withdraw "large" quantities of cash at a given point in time. As M-PESA continues to expand, and these balances grow, the authorities may decide to revisit this arrangement. An alternative approach, adopted in the Philippines, is to institute a 100 percent reserve requirement vis-à-vis mobile banking deposit balances held in accounts at commercial banks. The success of M-PESA has rested in part on the trust that customers have in one of Kenya's most well-respected private companies, the parent. But if faith in the banking system erodes, a run on M-PESA could be sparked, thereby exacerbating the position of the banks in which it holds deposited funds.

Because they are held in regular current accounts at commercial banks, M-PESA deposits in the banking system are insured under the Deposit Protection Fund.[21] However this deposit insurance, designed for individual bank account holders, provides insurance on deposits up to a maximum of KSh 100,000, or about $1,300. Thus M-PESA deposits are virtually completely uninsured against bank failure.

Finally, as M-PESA deposits enter the banking system, they only reduce cash in circulation to the extent that banks comply with or exceed official reserve requirements. But as e-float becomes more widely acceptable as an easily transferable store of value, it will adopt the features of money. The practical implication of this is that M-PESA could increase the money supply, with possible impacts on inflation and /or output. Of theoretical interest is the possibility that two monies could co-exist in equilibrium. We will address these issues in more detail in future work.

III. Potential economic impacts on households

M-PESA facilitates the safe storage and transfer of money. As such, it has a number of potential economic effects. First, it simply facilitates trade, making it easier for people to pay for, and to receive payment for, goods and services. Electricity bills can be paid with a push of a few buttons instead of traveling to an often distant office with a fistful of cash and waiting in a long queue; consumers can quickly purchase cell phone credit ("airtime") without moving; and taxi drivers can operate more safely, without carrying large amounts of cash, when they are paid electronically.

Second, by providing a safe storage mechanism, M-PESA could increase net household savings.[22] Third, because it facilitates inter-personal transactions, it could improve the allocation of savings across households and businesses by deepening the person-to-person credit market. This could increase the average return to capital, thereby producing a feed-back to the level of saving.

[21] See http://www.centralbank.go.ke/dpfb/background.aspx
[22] By net, we mean net of losses due to theft, etc.

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Fourth, by making transfers across large distances trivially cheap, M-PESA improves the investment in, and allocation of, human capital as well as physical investment. Households may be more likely to send members to high-paying jobs in distant locations (e.g., the capital), either on a permanent or temporary basis, and to invest in skills that are likely to earn a return in such places but not necessarily at home.

Fifth, M-PESA could affect the ability of individuals to share risk. Informal risk-sharing networks have been found to be an important, although not fully effective, means by which individuals spread risk, making state-contingent transfers among group members. By expanding the geographic reach of these networks, M-PESA may allow more efficient risk sharing, although the risk-reducing benefits might be mitigated due to issues of observability and moral hazard when parties are separated by large distances.

Sixth, a further risk-related effect arises if M-PESA facilitates timely transfer of small amounts of money. Instead of waiting for conditions to worsen to levels that cause long term damage, M-PESA might enable support networks to keep negative shocks manageable. For example, a household head with access to M-PESA who suffers a mild health shock might receive a small amount of money via M-PESA that allows him to keep his children in school. If this money was delayed, or the sender waited until the recipient "really needed it", the children might have quit school, the effects of which may be hard to reverse.

Seventh, if M-PESA allows households to spread risk, they may be led to make more efficient investment decisions, avoiding the trade-off between risk and return that they would otherwise face.

M-PESA could conceivably alter bargaining power and weaken incentives within households or other networks. Economically weaker family members might expect larger and more regular remittances from better-off city-dwelling relatives, who themselves might find it hard to justify not sending money home. This could weaken incentives for rural household members to work or innovate, offsetting some of the efficiency-enhancing benefits of improved geographic labor allocation and risk sharing.

Conversely, M-PESA could have the effect of empowering certain household members who have traditionally had less bargaining power, in particular women. Especially among poorer segments of the population, remittances and transfers received (and sent) via M-PESA are less visible than those transmitted by other means, such as delivery by a friend or relative. Granted this information advantage, recipients could be in a position to keep more of the funds they receive. Evidence suggesting the spending patterns of women and men differ (see, e.g., Chattopadhyay and Duflo, 2004) then implies that the advent of M-PESA could have real effects on the allocation of household spending. These are issues we hope to explore more fully in future work.

IV. Survey and data

Survey methodology

In September 2008 we undertook a survey of 3,000 randomly selected households across Kenya. At the time, both cell phone tower and M-PESA agent coverage were very limited in the remote northern and eastern parts of the country, so these areas were excluded from the sample frame. The non-excluded area covered by the sample frame included 92 percent of Kenya's population, and 98 percent of M-PESA

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agents as of April 2008. We randomly selected 118 locations (the second-smallest administrative unit), in which there were 300 enumeration areas routinely visited by the Kenyan National Bureau of Statistics. Ten households in each enumeration area were randomly chosen to take part in the survey – the GPS-recorded locations of these households are shown in Figure 8. In order to increase our chances of interviewing households in which someone used M-PESA, we over-sampled locations on the basis of the number of M-PESA agents present. All figures presented below have been reweighted accordingly.

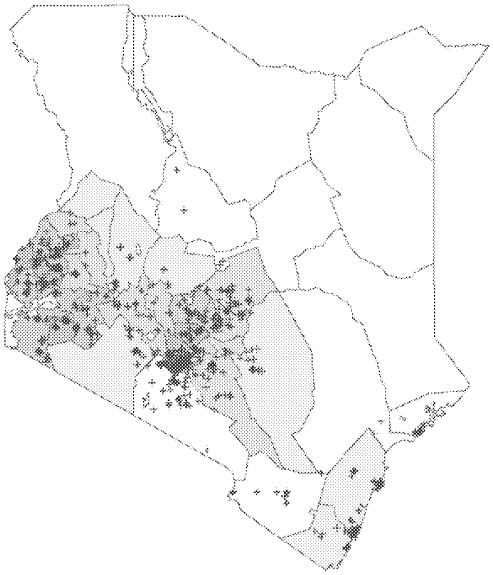

Figure 8: Interviewed households (+ Households visited; lighter areas have higher poverty rates)

During the interviews we collected information on basic household composition and demographic data, data on household wealth and assets, consumption, positive and negative shocks, and remittances. We also asked for information on the use of financial services, savings, etc., and collected detailed data on cell phone use and knowledge in general, and use of M-PESA in particular.

Summary statistics

Table 3 reports summary statistics of the households we interviewed, weighted so as to be representative of the 92 percent of the Kenyan population living in the areas from which our sample was drawn. The first panel reports that about 44 percent of households had at least one member who had used M-PESA at least once. By our definition, a user does not have to have a registered M-PESA account, as s/he could use someone else's phone to make a transaction.

The second panel reports household-level income and wealth indicators - users report annual expenditures which are on average 67 percent higher than those of non-users, and they report asset holdings that are on average 113%percent higher. Figure 9 graphs the empirical wealth distributions for both users and non-users. These distributions share a largely common support, although there is clear evidence that users are typically wealthier and better off.

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Table 3: Household characteristics

	Non-users	Users	All hhlds
Number of households	1,685	1,315	3,000
Share of total	0.56	0.44	1.00
Income and wealth			
Annual Hhld Expenditure (KSh)	197,344	329,348	255,211
	(318,896)	(430,102)	(377,428)
Assets (KSh)	98,679	209,785	147,579
	(386,257)	(534,084)	(460,483)
Wealth index	-0.542	0.690	0.000
	(1.626)	(1.778)	(1.802)
Other characteristics			
Share of households with at least one cell phone	0.53	0.91	0.70
Share of households with at least one bank account	0.36	0.72	0.52
Share of the unbanked population in each category	0.75	0.25	1.00
Share of the banked population in each category	0.39	0.61	1.00
Share of rural population in each category	0.71	0.29	1.00
Share of urban population in each category	0.48	0.52	1.00

Notes: All figures reweighted accordingly. Standard deviations in ( ).

The bottom panel of Table 3 shows that 70 percent of households report having a cell phone,[23] and that user-households are much more likely to own one (91 percent) than non-user households (53 percent). In our sample, 52 percent of all households had at least one bank account,[24] and the share of user households with a bank account was twice that of non-users. At the time of the survey, M-PESA had reached25 percent of households without a bank account, and 61 percent of banked households.

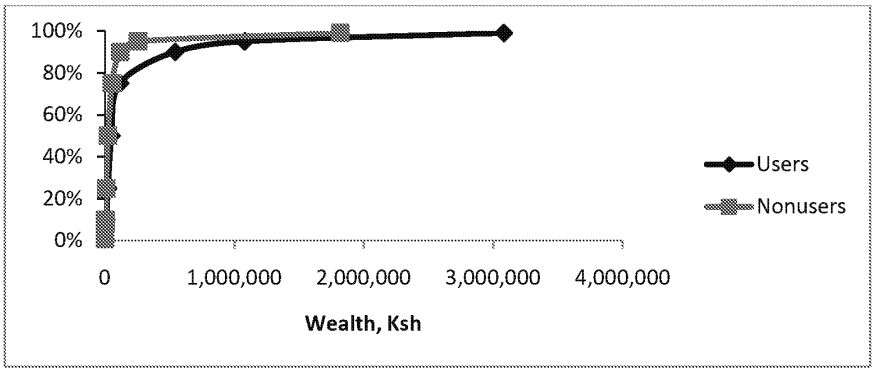

Figure 9: Empirical wealth distributions of users and non-users

[23] 77 percent of households reported having used one.

[24] Individual-level data from other sources (e.g., Finaccess?) suggest that at the time of our survey, the banked population was at most 20 percent. However, that figure reflects the share of individuals with an account, and we believe the access of a household to banking services is perhaps more suggestive of financial integration.

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We also collected individual-level demographic and other data on all household members in our sample. Table 4 reports summary statistics by user status. The average age of users and non-users were the same, although users were more likely to be men than women, and were more likely to be literate than the population average. M-PESA users have typically completed a higher level of education: for example, 46 percent of users have completed secondary school, and 10 percent have a university degree, while the corresponding figures for non-users are 37 percent and 4 percent, respectively.

Table 4: Individual characteristics

	Non-users	Users	Total
Count	5,556	1,429	6,985
Demographics			
Age (years)	35.1	35.6	35.2
	(15.5)	(12.1)	(14.8)
Sex (share male)	0.46	0.61	0.49
	(0.50)	(0.50)	(0.50)
Share who can read	0.88	0.96	0.90
	(0.32)	(0.18)	(0.30)
Share who can write	0.87	0.96	0.89
	(0.33)	(0.18)	(0.31)
Educational attainment (share)			
None	0.23	0.08	0.20
	(0.42)	(0.27)	(0.40)
Primary	0.29	0.18	0.27
	(0.45)	(0.38)	(0.44)
Secondary	0.37	0.46	0.39
	(0.48)	(0.50)	(0.49)
University	0.04	0.10	0.05
	(0.20)	(0.30)	(0.22)
Other	0.08	0.19	0.10
	(0.27)	(0.39)	(0.30)

Remittances

The primary function of M-PESA, at least as it was conceived, is to reduce the costs of making remittances from one individual to another, especially across large distances. We collected detailed data on all kinds of remittances, both monetary and in-kind, and sent by all means. Table 5 reports the shares of households in our sample who sent or received remittances, by rural/urban location, and by M-PESA use.

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Table 5: Who makes remittances - both money and goods

	Send	Receive
Total	53%	44%
By geographic location		
Rural	38%	42%
Urban	61%	45%
By M-PESA use		
Non-user	38%	28%
User	72%	63%

On average, more households send remittances than receive, although many no doubt do both. The share receiving transfers is similar across rural and urban households (42% and 45%), but sending is performed by a larger share of urban households than rural. M-PESA users are much more likely to send or receive remittances than non-users. Our data (not reported above) indicate that of households who make or receive remittances, about 38% are net senders, 30% are net recipients, and 32% are neither.

Indicators of frequency and size of remittances sent and received are reported in Table 6.On average, households send and receive remittances once every three to four months. Monthly remittances sent are smaller, amounting to approximately 4.5% of monthly expenditure, while those received are about 5.6%. About a third of remittances are sent and received via M-PESA, and they tend to be smaller than the average remittance, amounting to about 2.5% of monthly household expenditure on average.[25]

Table 6: Remittances sent and received

	All	Users			Non-Users
	Total	Total	M-PESA	Other	Total
			Sending (*N*=1,741)		
Number per month	0.31	0.33	0.17	0.17	0.27
Value per month (% consumption)	4.5%	4.6%	2.3%	2.3%	4.4%
Value per transaction (KSh)	3,375	3,447	3,112	4,016	3,269
			Receiving (*N*=1,327)		
Number per month	0.23	0.23	0.13	0.10	0.22
Value per month (% consumption)	5.6%	5.9%	2.8%	3.2%	5.0%
Value per transaction (KSh)	5,062	5,854	3,738	10,291*	3,685

* Received has two large values of more 700,000 KSh (about USD1,000) for repayments of debts.

Table 7 reports the destination and origin of household remittances. Remittances appear to go from younger to older generations, as 47% of those sent are to parents, while 12% of remittances received are from them. M-PESA use is correlated with a smaller percentage of transfers with parents: non-users

[25] Note that these figures refer to the average of M-PESA remittances, not the average of *all* remittances sent by M-PESA users.

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send half of their remittances to their parents, and receive 16% from them, while users send 41% to their parents and receive 5% of remittance receipts from them. Users have correspondingly larger shares of their remittance portfolios linked to other relatives and friends.

Table 7: Destination and origin of remittances

	Destination			Origin		
	Non-MPESA transactions	MPESA transaction	Total	Non-MPESA transactions	MPESA transaction	Total
Spouse	9%	8%	9%	8%	18%	12%
Parent	50%	41%	47%	16%	5%	12%
Child	10%	8%	10%	23%	15%	20%
Other relative	16%	24%	19%	27%	32%	29%
Friend	6%	13%	8%	19%	24%	21%
Other	8%	6%	7%	7%	6%	7%
Total	100%	100%	100%	100%	100%	100%

Saving

Because individuals do not need to withdraw or send balances immediately, they are able to accumulate savings on their M-PESA accounts over time. Thus M-PESA has become a savings instrument, as well as a means to send money.[26] Table 8 reports shares of all households, and by user status, using various savings instruments. Many people – 77% of households – save money at home "under the mattress," but slightly more non-users do than users. Users are more likely to own stocks (possibly Safaricom shares, sold in an IPO shortly before our survey, though we do not have data to support this), and to have a bank account. But fully three quarters of households with an M-PESA user report using it to save.

Table 8: Savings instruments used by households

	Non-users	Users	All hhlds
M-PESA	0.00	0.75	0.33
Bank account	0.36	0.72	0.52
Mattress	0.81	0.72	0.77
SACCO	0.14	0.24	0.19
Merry-go-round	0.38	0.41	0.39
Household member	0.13	0.16	0.14
Family member	0.04	0.05	0.04
Friend	0.03	0.04	0.04
Advance purchase	0.04	0.04	0.04
Stocks	0.06	0.19	0.12

[26] Sometimes money is stored in an M-PESA account simply to save a person from carrying too much cash, especially for example on long and potentially dangerous bus trips.

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M-PESA users value the saving function it provides. When asked to rank savings instruments they use in order of importance, 21% say M-PESA is the most important, and 90% say it is one of the three most important. An M-PESA account appears to provide a safer means of saving than other instruments, and one that is comparable to a bank account. 10.5% of households report savings being lost or stolen. But only 1.4% report losing savings held in a bank and 1.6% say they lost savings from M-PESA.

Customer experience with M-PESA

The perceived safety of M-PESA and its convenience are major reasons that early adopters of the technology chose to use it. Table 9 reports households' primary reasons for using or not using M-PESA. Among users, 26% report that safety was their main motivation for adopting it, nearly twice as many (45%) say ease of operation was the main reason. About 12% say they use M-PESA for emergencies. For non-users the reason that was mentioned most often as the primary cause of non-adoption was lack of adequate access to the network of agents. In the year since the survey was fielded, the number of agents has risen from about 2,500 to more than 12,000, so this constraint is less likely to bind now.

Table 9: Reasons for household use, and non-use, of M-PESA for saving

Reason	Non-users	Users
Safety	0.03	0.26
Ease	0.01	0.45
Cost	0.08	0.07
No access	0.21	0.00
Confidentiality	0.02	0.02
Emergency	0.00	0.12
No Reason	0.28	0.08
No need	0.18	0.00
Other	0.19	0.01

Table 10: Reasons for individual non-use of MPESA

Reason	Non-users
Don't know about it	0.16
Don't need it	0.15
No network available	0.00
Celtel customer	0.04
Don't own a cellphone	0.27
Don't understand it	0.06
Too complicated	0.01
Too costly	0.01
Not safe/Don' t trust it	0.00
No agents where I live	0.01

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No agents where my recipient lives	0.01
Happy with existing money transfer service	0.03
Other	0.18
No response	0.08

Nonetheless, problems have been experienced by users, either due to their own errors or associated with the challenges faced by agents in managing their cash and e-float balances. For example 4.3% of users report having sent money to the wrong person at least once, although two-thirds of these retrieved the money, about half of them within a day.

Table 11: Delays to withdrawing money from M-PESA

Reason	Share of delays	Delay until withdrawal possible	
Deleted SMS	0.00	Hour or less	0.19
Agent had no money	0.69	Half a day	0.29
Agent not available	0.01	A day	0.35
Agent system down	0.08	A few days	0.13
Safaricom network down	0.11	A week	0.03
No ID	0.07	Several months	0.01
Other	0.04	Never	0.00

20% of users report at least once not being able to withdraw money from an agent when they wanted. Table 10 reports that of these, 69% were due to the agent having no cash, and 11% due to the Safaricom network being down. On the other hand, 83% of delayed withdrawals were resolved within a day.

We asked users about their experiences with the agent who was most conveniently located to them, as reported in Table 12. For these agents, a lower share of respondents, 15%, reported not being able to withdraw funds. Just 6% of users reported delays in being able to deposit funds in M-PESA, associated with inventory management issues faced by agents. Unlike a bank branch, an M-PESA agents cannot simply take cash and record the deposit in an account,[27] but must exchange cash for e-float.

Table 12: Reported experiences with agents

	Fraction
Fraction unable to withdraw money from agent	0.15
Fraction unable to deposit money with agent	0.06
Fraction asked by agent to show ID	0.76
Fraction who trust agent	0.65

Overall however, customers appear to value M-PESA services highly, especially when compared with other money transfer services. When asked to compare M-PESA with other such services in terms of a

[27] Although the agent is required by Safaricom to record transactions in a log book, this is not sufficient as it does not lead to a change in the customer's electronic balance.

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number of attributes, the responses were overwhelmingly positive, with large majorities responding that it was faster (98%), easier to use (99%), more convenient (96%), safer (98%), and cheaper (96%).

Similarly, when asked how happy they were with the service, measured on a scale from 1 (extremely unhappy) to 10 (extremely happy), more than half reported a rank of 10, and nearly 90% reported values of 8 or above (see Column I, Table 12). Asked what impact they would experience if M-PESA was to be shut down, the large majority reported that it would be large and negative (Column II, Table 12).

Table 13: Measures of satisfaction with M-PESA

I. **Happiness with M-PESA**			**II. Impact of closing down of M-PESA**	
Extremely unhappy	**1**	0.006	Large negative	0.84
	2	0.003	Small negative	0.12
	3	0.009	None	0.02
	4	0.001	Small positive	0.02
	5	0.005		
	6	0.022		
	7	0.069		
	8	0.123		
	9	0.229		
Extremely happy	**10**	0.534		

V. Conclusions

As the developed world begins to rebuild the recently collapsed global financial system, the financial architecture in parts of the developing world is being rapidly transformed. As the costs of mobile phone technology have fallen, and as the technology has been adapted to support financial services, mobile banking innovations have begun to spread across and within poor countries. The low cost, and the widespread unmet demand for financial services, as captured by low rates of bank access, means that mobile banking has the potential to reach remote corners of the socio-economic, as well as geographic, spectrum.

That potential appears to be being realized in Kenya, through M-PESA, a mobile banking system operated by Safaricom. We estimate that M-PESA has reached nearly 40 percent of the adult population after a little more than 2 years of operation. Part of this success is due to a rapidly expanding network of M-PESA agents, who now number over 12,000.

M-PESA is an innovation that clearly dominates its money-transfer predecessors on virtually all dimensions. Users say it is faster, cheaper, more reliable, and safer, and a very large majority report that they would suffer significant negative consequences if it were to be shut down.

These expressed preferences suggest that M-PESA is valued more by individuals than it costs. On the other hand, the precise source of these benefits – i.e., the specific economic impacts of M-PESA – are not easy to calculate. We have identified a number of potential economic effects of M-PESA at the

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household level – for example from impacts on saving and investment, to risk spreading and insurance. At the macroeconomic level, there could be important impacts on the money supply and inflation, with implications for the extent of Central Bank regulation and the conduct of monetary policy. We hope to explore these issues empirically in future work.

References

Chattopadhyay, Raghabendra and Esther Duflo (2004): "Women as policy makers: evidence from a randomized policy experiment in India," *Econometrica*, 72(5), 1409-43.

Ivatury, Gautam and Mark Pickens (2006): "Mobile Phone Banking and Low-Income Customers: Evidence from South Africa," Consultative Group to Assist the Poor, Washington DC.

Lucas, Robert (1988): "On the mechanics of economic development," *Journal of Monetary Economics,* 22, 3-42.

Mas, Ignacio (2009): "The economics of branchless banking," *Innovations*, 4(2), 57-76, MIT Press.

Mas and Morawczynski (2009): "Designing Mobile Money Services: Lessons from M-PESA," *Innovations*, 4(2), 77-92, MIT Press.

Mas, Ignacio and Sarah Rotman (2008): "Going Cashless at the Point of Sale: Hits and Misses in Developed Countries," Consultative Group to Assist the Poor, Focus Note No. 51, Washington DC.

Mas, Ignacio and Kabir Kumar (2008): "Banking on Mobiles: Why, How, for Whom?," Consultative Group to Assist the Poor, Focus Note No. 48, Washington DC.

Romer, Paul (1986): "Increasing Returns and Long-Run Growth," *Journal of Political Economy,* October, 94:5, 1002-37.

Solow, Robert (1956): "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*.

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