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M-PESA and financial inclusion in Kenya: of paying comes saving?

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Mobile financial services are said to promote inclusion. However, only 7.6 per cent of Kenyans have ever saved on an M-PESA account. This paper uses a novel, three-step probit analysis to identify the socio-demographic characteristics of, successively, respondents who do not have access to a SIM card, have access to a SIM but do not have an M-PESA account, and, finally, have an account but do not save on it. We find that those who are left behind are predominantly those who would benefit most from formal saving, namely the poor, the non-educated, and, in the final step, also women.

Keywords – financial inclusion, saving, Kenya, mobile financial services, M-PESA

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1. Introduction

Just like many other countries at a similar stage of economic development, Kenya is characterised by a low rate of financial inclusion. Financial inclusion refers to access to financial services such as deposit, transfer, and payment services, as well as saving, credit, and insurance. In 2014 only 55.2 per cent of the Kenyan population over 15 had an account at a formal financial institution, compared to 93.6 per cent in the United States (Demirgüç-Kunt & Klapper, 2014).

Informal financial systems are well developed in Kenya (Gugerty, 2007; Johnson, 2016). However, it is commonly believed that widespread access to formal financial tools reduces poverty, stimulates investment, and creates growth, particularly in rural areas (Morduch, 1994; Binswanger & Khandker, 1995; Beck, Demirgüç-Kunt & Levine, 2005). Especially the ability to save in a secure way would make the difference, as it increases the resilience of the poor to income shocks and may, ultimately, even enable them to invest in a business.

It is thus not surprising that the promotion of formal saving in developing countries is drawing the attention of a growing research community. In this paper, we study the uptake of so-called mobile financial services (MFS) in Kenya. MFS are said to promote financial inclusion, not only by directly giving users access to financial services by way of their mobile phone account, but also by supposedly

functioning as a stepping stone toward the adoption of a traditional bank account [1]. Kenya is a country where MFS could have a particularly high impact, for a number of reasons. On the demand side, there is the high level of poverty in combination with the importance of rural areas. Specifically, the high dependence on agriculture is a vector of financial instability among rural households, which, in turn, implies that emergency remittances – often from relatives who live in the city – are of vital importance. On the supply side, the penetration of bank accounts is low [2], particularly in rural areas, but adoption of M-PESA – the leading local mobile money transfer service – is widespread. In our analysis, we will even assimilate MFS in Kenya with M-PESA, representing as it did 96 per cent of all MFS accounts in the country in 2013 (InterMedia, 2013), and 95 per cent of the value of all MFS transfers in 2014 (Winn, 2016).

In particular, we look into which socio-demographic factors promote or inhibit saving on MFS. Unlike existing studies, which simply compare MFS users and non-users in terms of savings (and/or remittances), we tackle this question in three steps. We first examine which Kenyans own or have access to a SIM card, as this is an essential precondition for being able to open an M-PESA account. In a second step we then examine which individuals in this subsample have an M-PESA account. In a third and final step we examine which M-PESA users actually save on their mobile phone account. In each of these steps, we perform our analyses for three, increasingly narrow (sub)samples, namely the full sample, the rural population, and, finally, inhabitants of rural areas who do not own a bank account and who never send remittances. The idea is to gradually zoom in on the poorer, more vulnerable groups in the Kenyan population. Tellingly, as we do so, all three indicators that we focus on – access to a SIM, possession of an M-PESA account, and saving on M-PESA – progressively go down.

To improve our understanding of the behaviour of all these population segments, the paper first analyses the body of articles on the uptake of MFS in Kenya. We highlight that the existing literature finds different propensities to use M-PESA as a tool for saving. We show that this is due to conceptual differences and also to the timing of the studies, a crucial factor when analysing any fast growing technology. In the empirical part of our paper, we perform probit analysis on data taken from the Financial Inclusion Insights Program survey conducted by InterMedia in 2013 among 3,000

[1] This is a key premise of the recent report of the CPMI-World Bank Group Task Force on the Payment Aspects of Financial Inclusion (PAFI): "a transaction account is an essential financial service in its own right and can also serve as a gateway to other financial services" (CMPI & World Bank, 2016, p. 2).

[2] Based on a nationally representative dataset collected by FinAccess Kenya in 2006 – that is, prior to the launch of M-PESA – Johnson and Nino-Zarazua (2011, p. 482) report that only 18.5 per cent of Kenyans used formal services, 8.1 per cent used semi-formal services, 35.0 per cent used the informal sector, and no less than 38.3 per cent were completely excluded. For more recent figures, see Evans and Pirchio (2014).

respondents. We find that those who are 'left behind' are predominantly those who would benefit most from formal saving, namely the poor, the non-educated, and, in the final step, also women. Moreover, the problem is, by and large, bigger for the rural than for the urban population. As such, our paper brings a sobering note to the more optimistic results of, in particular, Suri and Jack (2016), who estimate that M-PESA has lifted 2 per cent of Kenyan households out of poverty.

The remainder of the paper is structured in six sections. Section 2 explains the concept of M-PESA as well as its state of affairs in Kenya around the time of the data collection. Section 3 reviews the literature. In Sections 4 and 5 we present, respectively, the survey data and our methodology. Finally, Section 6 presents our results and Section 7 concludes.

2. M-PESA Identikit

The basic concept of MFS is simple: mobile phone airtime is transferred by way of text messages and a network of agents working for the MFS provider allows users to withdraw money from or deposit money into their mobile account. In Kenya, M-PESA was launched in 2007 after Safaricom, a leading mobile services provider, had noticed that customers exchanged airtime to transfer money between them. M-PESA formalised this practice, and the concept expanded fast, in part thanks to the high penetration rate of mobile phones [3]. By 2013, 74 per cent of the population over 15 had an account with one of four MFS providers: M-PESA, Airtel Money, yuCash, and Orange Money (di Castri & Gidvani, 2013).

Today, M-PESA offers multiple services (see Table 1), but, as explained, money transfers were developed first. This service only relies on the airtime account and enables user-to-user transfers. Transfers to non-users are also possible but incur higher charges. Nowadays the transfer option can also be used to pay in shops. M-PESA mobile banking, for its part, comprises services similar to those offered by traditional banks. Some of these services require a link between the user's mobile account and a bank account. For instance, in 2010 M-PESA in partnership with Equity Bank developed M-KESHO. M-KESHO offers a suite of financial services, such as insurance, but also an interest-paying bank account held at Equity Bank. The interest rate ranges from 0.5 per cent to 3 per cent, depending on the amount saved (Mbiti & Weil, 2014). M-PESA has also developed M-SHWARI,

[3] In June 2015, 83.9 per cent of the population had a mobile phone subscription. In December 2007 this number was 30.5 per cent. Data from the Communication Authority of Kenya, respectively: <http://ca.go.ke/images/downloads/STATISTICS/Sector per cent20Statistics per cent20R2015.pdf> and <http://ca.go.ke/images/downloads/STATISTICS/Sector per cent20Statistics per cent20Report per cent20Q2 per cent202008.pdf>

this time in partnership with Commercial Bank of Africa (CBA). At 5 per cent, the interest rate on an M-SHWARI account is higher. It also provides micro-loans for a period of thirty days.

Table 1. Penetration of M-PESA uses (N = 3,000)

	Number	Percentage
Own a SIM card [a]	2459	82.0
Own or have access to a SIM card [b]	2836	94.6
Use M-PESA	2180	72.7
Use M-KESHO	34	1.1
Use M-SHWARI	283	9.4
Mobile money transfers		
Withdraw money	2307	76.9
Deposit money	1878	62.6
Pay for goods at a store	54	1.8
Receive money for regular support	1236	41.2
Send money for regular support	1119	37.3
Receive money for emergency	763	25.4
Send money for emergency	766	25.5
Mobile banking		
Save money for future purchase/payment	205	6.8
Receive a salary	59	2.0
Take a loan	37	1.2
Receive state aid or pension	18	0.6
Buy insurance	5	0.2

Notes. Source: InterMedia, The Financial Inclusion Insights Program, 1. [a] 'Own a SIM card' includes 9 respondents who have a mobile phone but say they do not own a SIM card. [b] 'Own or have access to a SIM card' includes 2 respondents who have a mobile phone but say they do not own a SIM card.

Given this wide range of MFS in Kenya, how did we define MFS-enabled financial inclusion for the purposes of our paper? Our starting point was Klapper and Singer (2014)'s broad definition of financial inclusion as "access to and usage of appropriate, affordable, and accessible financial services".

However, we opted for a narrow definition of 'financial services'. We do not consider the mere use of an M-PESA account for person-to-person transfers to be sufficient for 'real' financial inclusion. The ability to receive remittances by way of M-PESA is an obvious improvement over past practices (see Section 3), but it does leave recipients in a dependent position. In line with the old saying that we paraphrase in the title of our paper – "Of saving comes having" – we consider the ability to save as a

necessary condition for full financial inclusion. In other words, we think that mobile payments are not enough [4], and we therefore set out to examine to what extent 'paying' leads to 'saving' – and, hopefully, ultimately 'having'. From this perspective, saving on M-KESHO and M-SHWARI clearly qualifies. But we also consider people who simply save on their mobile account as financially included, even though such funds do not earn any interest. Demombynes and Thegeya (2012) call this "basic mobile savings", as opposed to "bank-integrated mobile savings".

In the survey data that we exploit (see Section 4), the proportions of people using M-PESA for the different operations are as listed in Table 1 [5]. As can be seen, basic operations such as withdrawing, depositing, or receiving and sending money are widely used. Kenyans seem, however, less keen on the more evolved mobile banking services, since only 6.8 per cent of the respondents had, at the time of the survey, ever saved with M-PESA [6].

Note that MFS and banking inclusion are not exclusive. Some people own both an M-PESA and a bank account, others own just one of the two, and some none. The main factors limiting the adoption of formal bank accounts are distance, cost, and paperwork (Allen, Demirgüç-Kunt, Klapper, & Martinez Peria, 2016). Conversely, M-PESA allows immediate remote transfers, it is relatively cheap, and one only needs an ID to open an account. Even the more advanced services such as M-KESHO and M-SHWARI retain the original spirit of M-PESA: opening an account is free and charges are relatively low. To sign up for M-KESHO, people also do not need to go to a bank; they can do so by way of Safaricom agents (Demombynes & Thegeya, 2012). These advantages over traditional banking would suggest that M-PESA can indeed increase financial inclusion.

3. Related Literature

Following Donner and Tellez (2008), we discuss the relevant articles about M-PESA depending on

[4] This is in line with the PAFI Task Force mentioned earlier: "While of utmost importance, access to and usage of a transaction account to facilitate payments and to store value is just an initial step in becoming fully financially included, which involves having access to the whole range of financial products and services that meet the user's needs" (CPMI, 2016, p. 6). Johnson (2014, p. 3) is even more explicit: "Beyond use for payments, whether or not people actively save in these [e-money] accounts is a key issue for financial inclusion".

[5] Note that the number of people withdrawing money (2,307) is higher than the number of users (2,180). This is because even non-users can receive money.

[6] Note that in Kenya the average inflation rate between 2010 and 2013 was 8.2 per cent per year, so that real interest rates were in fact negative. In line with Demombynes and Thegeya (2012, p. 14), we therefore assume that the main motivation to save on M-PESA lies in decreasing one's vulnerability toward thieves or toward relatives pleading for money.

whether they study, respectively, adoption, usage, or the impact on society.

3.1. Adoption

What motivates or restrains a potential user to adopt M-PESA? Most studies focus on the role of socio-demographic variables. Porteous (2007) draws the profile of early adopters of M-PESA and finds that people who are less educated and less at ease with mobile phone technology were less likely to adopt. Using data from the nationally representative 2009 FinAccess survey, Aker and Mbiti (2010) find that MFS adopters in East Africa were, at the time, mainly well-off: adoption proved positively correlated with education, bank account possession, urbanity, and wealth. In the same line, using the same dataset, Johnson and Arnold (2012) find that the factors associated with M-PESA adoption are similar to those for bank accounts – with one key exception. Unlike for bank accounts, age does not have a significant positive impact on M-PESA adoption.

Interestingly, in a 2008 article Ivatury and Mas (2008) predicted that by 2011 the poor, who were unserved by banks at the time of their study, would use M-PESA more than the rich. A paper by Jack and Suri (2014) provides indications as to whether this prediction became true. Jack and Suri observe that while during the first round of their survey, in 2008, only 25 per cent of M-PESA users were previously unbanked and 29 per cent came from rural areas, a year later these figures were 50 and 41 per cent, respectively. Similarly, the share of primary educated users went up from 20 per cent in 2008 to 32 per cent in 2009. Also, whereas adoption was initially mostly restricted to men, the practice spread among women.

Morawczynski (2008), for her part, analyses to what extent M-PESA adoption is linked not so much to socio-demographic characteristics but to demand for financial services, accessibility, and perceived usefulness. Using evidence for areas where traditional banking facilities are scarce, she finds that the dense network of M-PESA agents in these places and the resulting speed of the transfer have a strong impact on adoption. The security offered by M-PESA as a store of value is also positively correlated to adoption. In a later paper, Morawczynski and Pickens (2009, p. 2) find that urban users adopt M-PESA because it is “cheaper, easier to access, and safer than other money transfer options”. Morawczynski and Pickens also observe a prescription effect between urban and rural users. Urban M-PESA users tend to encourage their social circle to adopt the system, which increases its utility and helps spread the use of M-PESA from cities to the countryside.

3.2. Use

The positive effects of M-PESA identified below, in Section 3.3, revolve around two major uses: remitting (especially in case of an emergency), and saving. To start with remittances, Mbiti and Weil (2014) observe that 50 per cent of the users send money with M-PESA, while 65 per cent receive money. Jack and Suri (2014) identify a pattern where urban family members supports their rural relatives, a situation that probably results from a migration process. More in particular, Morawczynski and Pickens (2009) observe money flows between male urban senders and female rural recipients. Johnson's 2010/2011 data for three rural areas support the view that there is a strong pattern of receipt of funds from spouses or children who are 'sending money home', but also suggest "strong patterns of transactions with other relatives and an important though smaller role for friends" (Johnson, 2016, p. 91).

Turning to saving, between the two rounds of their survey Jack and Suri (2014) effectively see an increase in the use of M-PESA as a savings tool. In round 1 about 75 per cent of the adopters used M-PESA for saving, while by round 2, in 2009, this had increased to 81 per cent. Note that in Jack and Suri's broad definition 'saving' refers to any form of keeping money in a storage means for more than twenty four hours. However, the percentage of households who save on M-PESA for emergencies also increased dramatically – from 12 per cent in round 1 to 22 per cent in round 2.

Exploiting data from the 2009 FinAccess survey, Mbiti and Weil (2014) find that 26 per cent of users save on M-PESA; that is, 35 per cent of the banked individuals do it, compared to only 19 per cent of the unbanked. Apart from the levels, this is in line with Jack and Suri (2014), who also find that M-PESA users who own a bank account are much more likely to save on M-PESA than those who do not. Mbiti and Weil furthermore estimate that M-PESA has reduced the prevalence of informal saving by 15 percentage points and the proportion of people stashing money away in secret places by 30 percentage points.

Demombynes and Thegeya (2012), for their part, use data from a dedicated survey conducted in 2010 among 6,083 individuals. They define respondents as having 'mobile savings' if they answer affirmatively to the question 'Do you save any portion of your income?' *and* list M-PESA as one of the places where they save. 15 per cent of the respondents (equivalent to 33 per cent of M-PESA users) said that they saved with M-PESA. Saving with M-KESHO remained very limited – 0.6 per cent of the sample and 1.3 per cent of the M-PESA users – and was largely restricted to the relatively wealthy.

Kikulwe, Fischer and Qaim (2014) conducted two smaller-scale surveys among 320 banana-growing farm households in the Central and Eastern provinces of Kenya. In 2010, over 40 per cent of the households stated that they use their mobile money account as a savings tool, and about 27 per cent used it as a means of transferring money to their formal bank account. The article does not provide details as to the definition of saving or the phrasing of the survey question.

Finally, Johnson (2014, 2016) reports on another smaller-scale survey conducted in 2010/2011 among 337 individuals from 194 households in three rural districts – two of which are considered higher-potential zones. Johnson finds that the majority of the M-PESA users withdrew funds completely after receiving a transfer. Some 34 per cent reported holding a balance on their phone.

Clearly, the large discrepancies in the propensity to save on M-PESA reported by the different studies might in part be caused by differences in the scope and representativeness of the surveys [7], but they also point toward a definition problem (Johnson, 2014, p. 3-4) [8]. For one, as Demombynes and Thegeya (2012, p. 10) stress, the responses to their questions "reflect each respondent's subjective understanding of what it means to 'save your money' and whether the respondent's use of each service constituted savings". For example, Plyler, Haas, and Nagarajan (2010) document that an emerging use of M-PESA consisted in weekly savings being spent at the end of the week. It is quite possible that some respondents see this as saving, even though the funds are meant for short-term consumption.

Still, when it comes to interpreting figures on the incidence of 'saving', the most pertinent remarks come from Johnson (2016). In her survey, the most common reason given for holding a balance on one's phone was safety (19 per cent). As one respondent put it, by keeping money in the phone "you can walk with the money and you don't have it" (Johnson, 2016, p. 92). As Johnson stresses, this is "not coterminous with a place to 'save' in the sense of building up balances but was more related to being able to move around with funds". She therefore stresses that "keeping money in an [M-PESA] account needs careful interpretation, especially when surveys ask about 'saving'" (Johnson, 2014, p. 13). And also: "Holding money for convenience, safety or an emergency reserve are valuable features that respondents feel the service offers, but this does not necessarily suggest that it is seen as a place which is useful for accumulating funds" (Johnson, 2016, p. 92).

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[7] Kikulwe et al. (2014, p. 12) state explicitly that their "study focused on banana growers in two provinces of Kenya, so the … numerical results should not be generalized widely".

[8] Johnson (2014, p. 13, footnote 11) points out that while under Jack and Suri (2014)'s accommodating definition of saving 81 per cent of the M-PESA users did so, the incidence is substantially lower – and of a similar order to those reported by the other studies – if ones focuses on those who do so because of safety (26 per cent) or for an emergency (22 per cent).

As will become clear in Section 5.1, the definition of saving in the survey that we exploit in this paper is more stringent than in the papers just discussed and, as a result, its incidence is substantially lower.

3.3. Economic Impact

We now discuss the literature that deals with the positive consequences of the two uses of M-PESA just documented. Where the impact of remittances is concerned, Jack and Suri (2011) note that traditional money transfers are far from immediate. A household that is faced with a shock thus needs to hold on for several days before the emergency money arrives. In addition, costs are high, so that money is only sent when the aid is essential. With M-PESA, transfers are immediate and fees are substantially lower – for both small and large amounts. This removes the threshold effect and enables emergency remittances of small amounts in response to small-magnitude shocks. Jack and Suri also stress that the availability of M-PESA should facilitate migration and allow households to send members further. This, in turn, would optimise their revenues, increase remittance flows, and improve the ability of families to share risks; see also Klapper and Singer (2014). In a sobering note, Jack and Suri warn that greater-distance labour migration might also *de*crease remittance flows – due to a weakening of the family links because of the very distance.

Morawczynski (2009), in her qualitative study, conducts two interrelated surveys (in an urban slum and in a rural village where some of the urban dwellers migrated from), and analyses the evolution in financial behaviour as a result of the adoption of M-PESA. Morawczynski observes an increase in total remittance flows, resulting in a decrease in the financial vulnerability of the receivers. As for social networks, she finds a two-sided effect. On the one hand, the possibility to remit safely without traveling reduces urban migrants' visits to their village. But on the other hand the links are strengthened by the increase in the amounts, which was perceived by rural recipients as proof that migrants "had not forgotten their obligation to the village whilst residing in the city" (Morawczynski, 2009, p. 500).

Jack and Suri (2014) demonstrate quantitatively that M-PESA remittances effectively improve the ability of households to smooth shocks. Jack and Suri find a reduction of per capita consumption of 7 per cent among non-user households facing shocks, while consumption of households with access to M-PESA is not affected. Aker and Mbiti (2010) also find improved resilience to income shocks thanks to well-allocated remittances [9]. The qualitative study by Plyler et al. (2010) confirms the findings of

[9] Surprisingly, they find mainly urban-urban money transfers by way of MFS, in contrast with the rest of the literature.

the quantitative analyses: participants credited M-PESA with boosting local consumption thanks to 'rescue money'. This shock smoothing was also perceived as having increased agricultural productivity. In the same line, the regression results of Kikulwe et al. (2014) suggest that mobile money use is welfare-enhancing for smallholder households, who constitute the majority of the rural poor. One important, direct pathway is through higher remittances received. But mobile money apparently also stimulates more commercially-oriented farming: M-PESA users "apply significantly more purchased inputs – such as fertilizer, pesticides, and hired labor – and sell a larger proportion of their harvest in the market" (Kikulwe et al., 2014, p. 12).

Beyond an increase in remittance flows, Jack and Suri (2011) also predict an increase in net household savings – because of the secure storage provided by M-PESA – as well as higher investment in human and physical capital, which would also be better spread geographically [10]. However, as Arestoff and Venet (2013, p. 3) point out, where the impact on savings is concerned, the results are less clear-cut than for money transfers. Demombynes and Thegeya (2012) apply probit analysis to their survey data and, after controlling for differences in socio-demographic characteristics and after using an instrument, find that M-PESA users are 20 per cent more likely to have "savings of any kind". This said, in spite of their use of instrumental variables Demombynes and Thegeya's regressions might suffer from an endogeneity problem, in that the causality could also run from savings to M-PESA adoption [11].

In a recent paper, Suri and Jack (2016) provide the most comprehensive evaluation of the welfare effects of M-PESA to date – in two respects. For one, they do not limit their analysis to the two channels just discussed (that is, remittances and savings), but also look into the possible effects of migration and changes in occupational choice. Second, whereas their earlier work (Jack and Suri, 2014) documented the short-term economic benefits of consumption smoothing thanks to M-PESA, their new paper tries to gauge the long-run impacts. To that end, Suri and Jack complemented the 2008 and 2009 rounds of their household panel survey – exploited in Jack and Suri (2014) – with three additional

[10] In a study for Burkina Faso, Bensch et al. (2015) find that take-up rates of heavily promoted improved cooking stoves, which have a demonstrable high return for adopters, are low because of the upfront investment costs. Bensch et al. suggest that strategies that would help households overcome liquidity constraints would improve adoption rates.

[11] Indeed, there is little doubt that those who report *not* having any savings *in any of the forms* ('basic mobile savings', 'bank-integrated mobile savings', and 'other' – with the latter including informal savings) are poorer than average. Some of them may not have access to a SIM card and are thus simply not in a position to register for M-PESA. Our step-wise approach circumvents this problem by first filtering out those without access to a SIM.

rounds (conducted in 2010, 2011, and 2014). To identify the causal effects of M-PESA they use changes in access to mobile money – quantified by the number of M-PESA agents within one kilometer of the household – rather than adoption itself. Specifically, they compare outcomes, as measured in the 2014 survey, of households that saw large increases in agent density between 2008 and 2010 with outcomes of households that experienced smaller increases over the same period.

Suri and Jack estimate that access to M-PESA effectively raised per capita consumption and lifted at least 194,000 Kenyan households, or 2% of the total, out of poverty. They point out that the higher observed consumption levels could be driven by multiple mechanisms, and find some support for the savings and occupational choice channels. In particular, they find that an increase in M-PESA agent density positively affects total financial savings of households – though *not* savings on M-PESA itself. Also, individuals who experienced larger increases in M-PESA access were less likely to be working in farming and more likely to be working in "business or sales".

Suri and Jack also provide tentative evidence concerning the financial 'stepping stone' effect of M-PESA anticipated by other authors. Mbiti and Weil (2014), for example, predict that generalised adoption of M-PESA in Kenya would in the long run increase the proportion of banked people by 28 percentage points and in this way provide financial security to a greater share of the population. This view is also embraced by Klapper and Singer (2014), who assume that M-PESA could be "an entry point into the financial system" for the unbanked. Suri and Jack, in their regressions, find that the change in access to mobile money effectively predicts the adoption of a bank account. They are, however, quick to point out that this "may be driven by the supply-side response as banks began either competing with mobile money or collaborating with M-PESA to create bank accounts like M-Shwari" (Suri and Jack, 2016, p. 1291).

Finally, perhaps the most interesting result of Suri and Jack relates to the empowerment of women, which is a key issue in Kenya. Indeed, several articles focus on rural areas or urban slums, where gender inequalities are strong, especially when it comes to the household economy management. Morawczynski and Pickens (2009) and Jack and Suri (2011) already saw great improvement in women independence thanks to more regular and immediate remittances. The explanation would seems to be that in patriarchal households the privacy offered by M-PESA as a store of value gives greater power to women, who can manage the household liquidity with less control by the male head. Suri and Jack (2016) further underpin this beneficial effect: their regressions show that consumption growth, the reduction in poverty, and the switch away from subsistence agriculture into business or retail are all

more pronounced for female-headed households.

4. Data

The survey that we exploit was conducted between 2011 and 2013 as part of InterMedia's Financial Inclusion Insights Program, which is supported by the Bill & Melinda Gates Foundation. It covers eight countries (Kenya, Nigeria, Tanzania, Uganda, Bangladesh, India, Indonesia, and Pakistan) and aimed to gather information about financial behaviour at the household level. Households were chosen randomly, based on the latest available census.

Table 2. Descriptive statistics (N = 3,000)

	Percentage
M-PESA users	72.7
Bank account owners	28.2
Age	
15-25	22.3
26-30	17.2
31-35	13.1
36-40	12.2
41-55	20.8
Over 55	14.4
Gender	
Female	62
Male	38
Education	
No education	33.3
Primary	39.1
Secondary	25.6
College	2.0
Urbanity (Urban = 1)	36.7

As explained, we focus on Kenya, for which the data pertain to 2013. Table 2 contains selected descriptive statistics. Table A.1 in the Appendix contains the full set. The proportion of owners of an M-PESA account (72.7 per cent) is consistent with the ratios found in the literature (see Section 2). The proportion of bank account owners (28.2 per cent) is lower than the 55.2 per cent given by Demirgüç-Kunt and Klapper (2014). This is due to our focus on bank accounts, while Demirgüç-Kunt

and Klapper also consider accounts at other financial institutions.

Turning to gender, it is clear that women are overrepresented: the national gender ratio for Kenya in 2011 was 1 [12]. The age distribution is also different from official numbers for 2014 [13], with an under-representation of the young. These differences might be due to the way the survey was implemented. 64 per cent of the interviews were conducted between Monday and Friday, probably in part at times when many men and youngsters were at work or at school [14].

5. Methodology

While our main goal is to explain saving on M-PESA, as announced in the Introduction we do not just perform a simple probit analysis on a binary variable that indicates whether or not the respondent has used M-PESA as a savings tool. Rather we also examine the determinants of two crucial preconditions. The result is a three-step approach in which we, first, examine which Kenyans have access to a SIM card; second, which of these individuals have opened an M-PESA account; and, third, which M-PESA users actually save on this account.

As we wanted to focus on the more vulnerable groups in the Kenyan population, we, in parallel, also narrow down our scope in another respect. At each step, we start with an analysis of the full sample but then zoom in on the rural population and on inhabitants of rural areas who never send remittances (and who do not own a bank account), in that order.

Because working with subsamples introduces a risk of selection bias, we use a two-stage Heckman procedure for steps 2 and 3 [15]. As selection variables we use the variables that proved significant in the first steps, namely: age, education, wealth, gender, and family size. In what follows, we explain our dependent and independent variables.

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[12] Central Intelligence Agency <https://www.cia.gov/library/publications/download/download-2012/factbook.zip>.

[13] Central Intelligence Agency <https://www.cia.gov/library/publications/the-world-factbook/geos/ke.html>.

[14] Note that Dupas and Robinson (2013) also have an imbalance between women and men in their dataset, and this notwithstanding the fact that they target non-polygamous and non-female-headed households.

[15] In the literature, the dominant method would seem to be the use of dummies. Johnson and Arnold (2012, p. 741-742) have in their regressions for the adoption of M-PESA dummies for owning and having access to a phone. Kikulwe et al. (2014, p. 7) and Munyegera and Matsumoto (2016, p. 130) – in a paper on Uganda – also use a dummy for mobile phone ownership. Murendo, Wollni, de Brauw, and Mugabi (in press), in another paper on Uganda, use the number of mobile phones owned by the household. We will show later that the use of such variables hides a number of interesting relationships; see footnote 36.

5.1. Dependent Variables

As explained above, we use three different dependent variables: access to a SIM card, adoption of M-PESA among potential users (that is, people having access to a SIM card), and, finally, use of M-PESA as a savings tool. All three variables are on the individual level and are of a binary nature. The first variable takes a value of 1 when the respondent either personally owns one or more SIM cards, or can use somebody else's. Apparently the latter is sufficient for having an M-PESA account: of the 377 respondents who do not own a SIM card but have access to one, 38 reported owning an M-PESA account.

Our second dependent variable, adoption of M-PESA, is self-explanatory. For the saving variables we exploit questions where M-PESA users were asked whether or not they had already saved money for a future purchase or payment on, respectively, M-PESA, M-SHWARI, M-KESHO, or on a bank account. Surprisingly, literally none report that they save on an M-KESHO account, which leaves us with three types of saving. As we are interested in the impact of M-PESA on financial inclusion, we decided to merge, in a variable 'saving on MFS', the categories 'saving on M-PESA' (that is, on the "mobile money account") and 'saving on M-SHWARI', even though the first type of saving is non-interest bearing while the second is.

Making a clear cut-off between the two types would have been difficult anyway. One reason is that the survey asks respondents whether they have "ever" saved on a specific means [16]. This implies that M-PESA users who initially only saved on their mobile account, but later migrated to M-SHWARI should normally have answered 'yes' on both accounts (pun intended). The survey questions may also have confused respondents. Indeed, a respondent who only ever has saved on M-SHWARI might also incorrectly have answered 'yes' on the question about saving on a mobile money account (because M-SHWARI requires an M-PESA account). In our sample, of the 40 respondents who (have) save(d) on M-SHWARI, 16 report that they (have) also save(d) on M-PESA. To be clear: the category 'saving on MFS' (228 respondents, 7.6 per cent of the sample, 10.5 per cent of M-PESA users) is in practice dominated by respondents who save on M-PESA but not on M-SHWARI; these respondents number 189, equivalent to 82.5 per cent of all MFS savers. Respondents who save only on M-SHWARI or on

[16] For saving on M-PESA the question was: "Have you ever used a mobile money account to do the following? [...] Save money for a future purchase or payment." When cross-tabulating the answers to this question with ownership of an M-PESA account, we discovered that there were 5 respondents who answered 'yes', whereas they do not personally own a mobile money account (M-PESA or other). All 5 do declare having already made use of M-PESA. A possible scenario is that these individuals stopped using M-PESA because they now save on somebody else's account.

both M-SHWARI and M-PESA make up respectively 10.4 per cent and 7.0 per cent of MFS savers.

As already announced at the end of Section 3.2, because of the more stringent definition (saving *for a future purchase or payment*) the incidence of saving in our dataset – 10.5 per cent of the M-PESA users – is markedly lower compared to the headline figures reported in earlier studies [17]. But on closer scrutiny it can be reconciled with the more detailed results reported by Johnson et al. (2012) and Johnson (2014, 2016). In Johnson's 2010/2011 survey, the main reasons given for holding a balance on one's phone were (multiple responses allowed): "because it is safer" (19 per cent of registered M-PESA users), "in order to have funds to send to family/relatives/friends when they need them" (18 per cent), "to buy airtime" (9 per cent), "in order to run my business easily" (7 per cent), "efficient, gives financial flexibility, available when needed" (5 per cent), "emergencies/unexpected needs" (4 per cent), "because it is the only place I have to save money safely" (4 per cent), "so that I can keep funds there and then transfer them to another saving place" (3 per cent), …, "so that I can save there and then transfer to a bank account" (2 per cent), etc. (Johnson et al., 2012a, p. 25, Table 4) [18]. As can be seen, the reasons that would qualify as 'saving' under our definition all run in the low single digits.

A final note is that the category 'saving on a bank account' (139, or 4.6 per cent of the sample), which we will examine as a point of comparison, is potentially quite diverse and might comprise respondents who do not have a mobile money account, respondents who already had a bank account before they started using M-PESA (maybe, in part, to have a remote control), and – given the not so accurate phrasing of the survey questions – possibly also M-SHWARI users who do not have a bank account apart from the CBA account that comes with M-SHWARI (see Section 2). Of the 40 people who (have) save(d) on M-SHWARI, 7 report that they (have) also save(d) on a bank account.

We now discuss our independent variables.

5.2. Independent Variables

Demographic variables allow us to understand the social conditions of the respondents. We choose the ones that are commonly used in the studies adopting the socio-individual approach (see Section 3.1), namely: age, gender, wealth, education level, literacy, geographical situation (urban or rural), and

[17] Studies for other countries also report substantially higher numbers. Murendo and Wollni (2016), for example, interviewed 482 households in 39 rural villages in Uganda. In their research, 57 per cent of the mobile money users stated that they use their mobile money account as a savings account.

[18] Johnson (2014, p. 12) and Johnson (2016, p. 92) report higher percentages, but these are in fact absolute numbers; see the second column of Table 4 in Johnson (2012a, p. 25).

family size. Table A.1 provides descriptive statistics.

Our choice of age phases was driven by the possible association between age and the motivations to save. In rural Kenya, where the population mainly consists of farmers, the propensity to save follows a hump-shaped curve (Kibet, Mutai, Ouma, Ouma, & Owuor, 2009). Many 15-25-year-olds still depend on their parents or are not able to put money aside. People in the 25-40 age bracket are typically responsible for their household and tend to save in order to improve their financial security. The effective retirement age in Kenya used to be 55. In 2009 it was put at 60 for certain professions (Were, 2009). We nevertheless keep 55 as the switch point, for we assume that the law did not yet have a significant impact in 2013 (when our data was collected). In short, the age range 40-55 is probably associated with intense savings to prepare retirement, followed by a decrease after 55, due to the fall in income.

Turning to wealth, in the Financial Inclusion Insights Program survey respondents are only asked about three categories of tools they own [19]. We used this information to build an index, ranging between 0 and 7, based on the number of tools declared. Our 'wealth' variable is thus of a completely different nature compared to studies for the developed world. It is more of an inverted poverty index [20].

For education we look at the highest level of schooling *completed* by the respondent. In the survey, respondents were also asked to accomplish a basic reading task. This allowed us to create a dummy that considers someone as literate as soon as he or she was not placed in the lowest category ("unable to read/understand the informed consent form") for either reading or understanding. A numeracy variable proved redundant, for the t-tests showed a high correlation with literacy.

6. Results

As announced, we first examine Kenyans' possession of or access to a SIM card, as this is indispensable to own an M-PESA account. In sections 6.2 and we then focus on, respectively, the adoption of M-PESA in general (that is, for any type of use) and the use of M-PESA as a savings tool.

[19] Tools asked about: iron (charcoal or electric), number of mosquito nets (three possible answers: "0", "1", "2 or more"), number of towels (three possible answers: "0", "1", "2 or more"), number of frying pans (three possible answers: "0", "1", "2 or more"),

[20] Other authors have used similar approaches. The income estimates of Johnson, Brown and Fouillet (2012b, p. 25), for example, are based on household characteristics and assets (fridge, radio/cd, iron, etc.). See also Johnson and Arnold (2012).

6.1. Precondition: SIM card access

Table 3 presents the results of our regressions for, respectively, ownership of and access to a SIM card. To be clear, the second variable encompasses the first: 82 per cent of our sample own a SIM card, but in addition quite a few respondents can use the SIM card of a relative or a friend, so that overall 94.6 per cent 'have access to' a SIM card. In other words, (only) 5.4 per cent of our sample are simply not in a position to open an M-PESA account [21].

Table 3. Possession of and access to a SIM card

	Urban + Rural		Rural		Rural non-senders	
	Possession	Access	Possession	Access	Possession	Access
	(1)	(2)	(3)	(4)	(5)	(6)
Outcome eq.						
Age	**	n.s.	*	n.s.	n.s.	n.s.
15-25	–	–	–	–	–	–
26-30	0.479***	0.369*	0.435***	0.401*	0.403**	0.397
	(4.85)	(2.25)	(3.47)	(2.01)	(2.70)	(1.84)
31-35	0.481***	0.262	0.515***	0.326	0.479**	0.382
	(4.55)	(1.61)	(3.92)	(1.67)	(3.12)	(1.77)
36-40	0.583***	0.287	0.581***	0.222	0.446**	0.111
	(5.24)	(1.71)	(4.39)	(1.17)	(2.78)	(0.53)
41-55	0.517***	0.294*	0.534***	0.352*	0.472***	0.297
	(5.68)	(2.16)	(4.89)	(2.24)	(3.58)	(1.73)
Over 55	0.192*	-0.0204	0.227*	0.0839	0.160	0.0956
	(2.00)	(-0.15)	(2.01)	(0.55)	(1.17)	(0.56)
Gender (Female = 1)	-0.178**	-0.152	-0.124	-0.118	-0.113	-0.0916
	(-2.80)	(-1.63)	(-1.67)	(-1.12)	(-1.25)	(-0.78)
Education	***	***	***	***	***	***
Non-educated	–	–	–	–	–	–
Primary	0.545***	0.678***	0.530***	0.680***	0.443***	0.615***
	(7.88)	(6.17)	(6.47)	(5.16)	(4.33)	(4.00)
Secondary	0.974***	0.874***	0.950***	1.016***	0.761***	0.671*
	(9.80)	(5.13)	(7.29)	(3.92)	(4.04)	(2.15)
College	No variation	No variation	No variation	No variation	No variation	No variation
Literacy	0.00769	-0.128	0.0143	-0.0748	-0.000429	-0.143
	(0.11)	(-1.17)	(0.17)	(-0.60)	(-0.00)	(-1.02)
Wealth	0.186***	0.250***	0.210***	0.285***	0.184***	0.299***
	(11.17)	(9.40)	(10.38)	(8.95)	(7.26)	(8.10)
Family size	-0.037***	0.00928	-0.0132	0.0323	-0.00459	0.0389*
	(-3.62)	(0.62)	(-1.14)	(1.83)	(-0.34)	(2.01)
Constant	-0.149	0.548**	-0.438**	0.206	-0.590***	0.0457
	(-1.26)	(3.14)	(-2.99)	(1.00)	(-3.33)	(0.20)
Pseudo R2	0.18	0.23	0.18	0.24	0.11	0.19
AIC	2322	994	1678	779	1204	665
BIC	2394	1065	1745	845	1262	724
Log likelihood	-1149	-485	-827	-378	-590	-321
Observations	2934	2934	1874	1874	994	994

t statistics in parentheses; *, ** and *** indicate significance at the 0.05, 0.01 and 0.001 level, respectively

[21] In principle, one needs to be 18 or older to open an M-PESA account, but in practice there are younger respondents who have one – perhaps because their parents have opened an account for them.

Before we discuss the results, let us point out that while one would expect the education variable and the literacy dummy to be natural alternatives (which should not appear in one and same regression), oddly enough they proved to be correlated negatively (N = 2,996: t = 2.0; p = 0.04). We therefore included both in our regressions. We can already reveal that the literacy variable will at best be marginally significant.

If we then focus first on the full sample, we can see in regression (1) that, overall, those who are older than 25, male, educated, and are part of a 'wealthy' (in fact: non-poor) household have a higher probability of owning a SIM [22]. Conversely, the higher the family size, the lower the probability. An examination of the average marginal effects (AMEs) reveals, first of all, that the higher the education level, the stronger the effect: completion of primary education increases the probability of owning a SIM card by 12 percentage points compared to the non-educated, completion of secondary education increases it by 21 percentage points, and literally all respondents who have completed university own a SIM card; hence the "no variation" in Table 3. Turning to age, here too the effect increases in size as we move up the categories, but only up to a point (namely the 36-40 age bracket). Note in particular that while those over 55 do have a higher probability to own a SIM card than the 15-25 age group, at 4 percentage points the AME is substantially smaller than for all other age ranges (for which the AMEs lie in the 10 to 13 percentage points range). This might be an indication of technology aversion. But especially the difference between regressions (1) and (2) catches the eye. Once we broaden the dependent variable to those who do not own but have access to a SIM card, all of a sudden gender and family size play no role anymore, age becomes less significant, and the AMEs of education and wealth become substantially smaller (as do those of age). The general picture that emerges is one where some of the young, the women, and those in bigger households can use the SIM of a family member or friend. This system of shared ownership increases the reach of telecom services (and thus, at least in principle, of MFS), but as the results for education and wealth (and, when added, also urbanity) indicate, there is a group that is excluded from even this indirect access. Worryingly, in line with the results of Murphy and Priebe (2011, p. 5), this group is disproportionately composed of non-educated individuals who are part of a poor household living in rural areas [23].

[22] When added, urbanity also has a very significant positive effect.

[23] From a methodological angle, let us point out that, in their paper on Uganda, Murendo et al. (in press) also find that poor households have a lower probability to own a mobile phone, but only indirectly. Murendo et al. find that the number of mobile phones owned by the household has a significant positive impact on the adoption of mobile money, and when they split their sample into poor and non-poor households it becomes clear that the impact is substantially bigger for poor households (Murendo et al., in press, p. 12, Table 5). Our three-step approach has the advantage of directly uncovering such relationships.

This pattern is also evident in regressions (3)-(4) and (5)-(6), where we progressively zoom in on the more vulnerable groups in the Kenyan population. The rural population is vulnerable to weather hazards, which translates into volatile food prices and uncertain incomes. Such individuals are on average probably less able to cope with shocks. Among the rural population, many of those who never send any remittances are probably in a situation of strong financial dependence, and thus even more vulnerable to financial hazards. However, we noticed that some of these 'non-senders' do own a bank account, which is a sign of relative wealth. We therefore excluded these individuals and in (5)-(6) only consider the unbanked among the rural non-senders.

As can be seen, the results of regressions (3)-(6) are similar to those for the full sample, even though the negative impact of family size on SIM ownership loses its significance, gender is now at best significant at the 10 per cent level, and the presumed technology aversion of the +55 becomes slightly more salient. But, importantly, the beneficial effect of shared ownership of SIMs is even more prominent than for the full sample, and increasingly so the more we zoom in on the more vulnerable groups. While only 77.4 per cent of the rural population own a SIM, 92.7 per cent have access to one, which implies an increase in reach of 15.3 percentage points (compared to +12.6 for the full sample). For the rural non-senders, these numbers are 61.6 per cent, 86.5 per cent, and 24.9 percentage points. Just as for the full sample, those who do not have access to a SIM are predominantly non-educated and poor. Stronger still, the AMEs of education and wealth increase in size when we move from the full sample to the rural sample, and a second time when we move from the latter to the rural non-senders. Interestingly, family size – which for the full sample has a significant negative impact on SIM ownership – now has a significant positive impact on access in regression (6).

6.2. M-PESA adoption

In Table 4 we explain the possession of M-PESA by those respondents who are in a position to adopt; that is, who at least have access to a SIM card [24]. As a point of comparison we also explain the possession of a bank account. From regression (4) onward we again zoom in on the more vulnerable population groups.

[24] One could argue that we should have restricted our sample even more, namely to respondents who have access to a SIM of Safaricom, the mobile provider behind M-PESA. However, while we can identify which SIM(s) people own, the survey question about access to a SIM does not inquire about the provider. Reassuringly, of the respondents who own a SIM, 94 per cent have a Safaricom SIM (either exclusively or as one of their SIMs, respectively 70 per cent and 24 per cent).

Table 4. Possession of formal accounts by individuals who have access to a SIM card

	Urban + Rural			Rural	Rural non-senders
	M-PESA	M-PESA	Bank account	M-PESA	M-PESA
	(1)	(2)	(3)	(4)	(5)
Outcome equation					
Age	***	***	***	*	**
15-25	–	–	–	–	–
26-30	0.380***	0.345***	0.462***	0.347**	0.123
	(4.46)	(4.17)	(5.04)	(2.77)	(1.09)
31-35	0.492***	0.391***	0.502***	0.512***	0.358*
	(5.21)	(4.31)	(5.09)	(3.40)	(2.16)
36-40	0.608***	0.485***	0.678***	0.578***	0.451*
	(6.14)	(5.09)	(6.79)	(3.41)	(2.40)
41-55	0.573***	0.432***	0.829***	0.654***	0.567**
	(6.83)	(5.43)	(9.34)	(3.68)	(2.73)
Over 55	0.508***	0.254**	0.829***	0.569**	0.553**
	(5.36)	(2.90)	(8.12)	(2.89)	(2.74)
Gender (Female = 1)	-0.105	-0.182**	-0.520***	-0.102	-0.0541
	(-1.81)	(-3.25)	(-9.25)	(-1.23)	(-0.71)
Education	***		***	***	***
Non-educated	–	–	–	–	–
Primary	0.401***		0.334***	0.489***	0.595***
	(6.00)		(4.27)	(6.04)	(7.57)
Secondary	0.811***		1.029***	0.929***	1.248***
	(9.27)		(11.77)	(7.50)	(8.87)
College	1.161***		2.188***	6.848	No variation
	(3.58)		(8.82)	(0.00)	
Literacy	0.118	0.109	-0.0354	0.0972	0.141
	(1.92)	(1.81)	(-0.55)	(1.22)	(1.61)
Wealth	0.0932***	0.146***	0.153***	0.152***	0.126***
	(5.79)	(10.55)	(8.74)	(7.39)	(5.78)
Family size	-0.0505***	-0.0691***	-0.0388***	-0.0386	-0.0535**
	(-4.78)	(-6.80)	(-3.42)	(-1.53)	(-3.29)
Constant	-0.0763	0.317**	-1.717***	-0.431	0.0135
	(-0.66)	(3.23)	(-12.00)	(-0.95)	(0.03)
Selection equation					
Age	-0.0193	-0.00922	-0.00883	0.110***	-0.0202
	(-0.79)	(-0.38)	(-0.36)	(7.92)	(-1.36)
Education	0.550***	0.643***	0.542***	-0.185***	-0.480***
	(7.14)	(8.43)	(6.97)	(-5.47)	(-12.41)
Wealth	0.253***	0.242***	0.252***	-0.00208	-0.0906***
	(9.78)	(9.45)	(9.57)	(-0.16)	(-6.37)
Gender	-0.113	-0.0847	-0.153	-0.174***	0.0774
	(-1.22)	(-0.92)	(-1.64)	(-3.43)	(1.42)
Family size	0.0143	0.0202	0.0151	0.108***	0.0669***
	(0.97)	(1.36)	(0.99)	(10.61)	(6.72)
athrho	-0.962*	-1.299*	0.379	-0.181	-1.172
	(-2.18)	(-2.49)	(0.60)	(-0.38)	(-1.28)
Chi2	6.3	27.5	0.63	0.15	1.1
p	0.012	0.000	0.429	0.695	0.292
Log likelihood	-1831	-1880	-1874	-2767	-2128
Censored	162	162	162	1238	2135
Uncensored	2832	2832	2832	1756	859

t statistics in parentheses; *, ** and *** indicate significance at the 0.05, 0.01 and 0.001 level, respectively

If we then discuss our results in the order in which the variables appear in Table 4, we first observe that, with the exception of the 26-30-year-olds in regression (5), every age range has a significantly higher probability to own an M-PESA account than the 15-25. This is fairly unusual, in that the young are typically among the early adopters of new technologies [25]. However, the innovation we examine in this paper has a crucial financial dimension. As we pointed out in Section 5.1, a substantial portion of the 15-25-year-olds may still depend on their parents. Even in developed countries, it is therefore not exceptional to see that the youngest do not use the latest in payment technologies. For example, where the Netherlands are concerned, Jonker (2007) finds that younger consumers between the age of 15 and 24 are the heaviest cash users, even more so than those over 65.

Turning to gender, it is of crucial importance to factor in the multicollinearity between gender and education, in that women are, on average, less educated than men (N = 2996: t = 5.1; p = 0.00). Indeed, regression (2) – where we have omitted the education variable – gives the impression that there is a gender effect. However, once education is included in regression (1) – and also in regressions (4) and (5) for the rural subsamples – we find that gender as such does not restrict women's access to M-PESA. Note that Johnson and Arnold (2012, p. 742) also find an insignificant effect of gender on M-PESA adoption. There is, however, a gender effect for the possession of a bank account, in regression (3). This is plausible in a patriarchal society such as Kenya, where in most households the male head will be the owner of the account [26], not unlike for the mobile phone. For education itself, we find, as expected and in line with Johnson and Arnold (2012), that the educated have a higher probability of owning an M-PESA account [27]. Note also that the AMEs (not reported) increase with the education level. Both observations also hold – in fact even more strongly so – for the possession of a bank account in model (3). To be clear: in model (5), all respondents who have completed college own an M-PESA account.

The impact of literacy is less apparent than expected: it is only significant at the 10 per cent level in regressions (1) and (2). It is also relatively small: being literate increases the probability of owning an M-PESA account with 3 percentage points. Note that Porteous (2007) explains that literacy is in fact

[25] At first sight, this result would also seem to clash with those of Johnson and Arnold (2012, p. 741) and Kikulwe et al. (2014), neither of which find a significant effect of age. But then in both papers age is entered as a continuous variable. In addition, Kikulwe et al. (2014) work with household-level data and use age of the household head.

[26] Dupas and Robinson (2013) reveal that in rural areas 10 per cent of the women have a bank account while for men this number is 21 per cent.

[27] Kikulwe et al. (2014, p. 7, Table 3) find a significant positive effect of the education level of the household head.

not enough to describe people's ability to use a formal account, and speaks of "financial capability" [28], which makes our result even more surprising. Still, apparently the bulk of the Kenyan population is able to use M-PESA. Maybe this is because the required skills are basic, maybe people get help from family members or M-PESA agents.

'Wealth' is positively correlated to adoption across the board. Being below a minimum threshold of possession of essential tools apparently precludes M-PESA adoption, which seems logical. Finally, family size has a negative effect on the adoption of M-PESA. It is not significant for the rural subsample in (4), but becomes significant again once the remittance senders and bank account owners have been filtered out.

To complete the profile of M-PESA users, it can be noted that, when introduced in models (1) and (2), urbanity is positive and highly significant (not reported). The same is true if possession of a bank account is added to models (1), (2) and (4). This is not surprising given that regression (3) shows that the possession of a bank account is explained by the same variables as the possession of an M-PESA account [29]. We find that 91 per cent of the banked population also use M-PESA, compared to 65 per cent of the unbanked. This is a strong indication that M-PESA and banks are complementary, at least for the bank account owners [30]. However, the relative importance of the unbanked among the M-PESA users has clearly increased over the years. Jack and Suri (2014) found that the unbanked accounted for 25 per cent of M-PESA users in 2008, and 50 per cent in 2009. We find that in 2013, at least 64 per cent of M-PESA users were previously unbanked.

To conclude, even though higher education, bank account possession, urbanity, and higher 'wealth' still significantly increase the probability of owning an M-PESA account – four results that are in line with Aker and Mbiti – we notice a general tendency of democratisation of M-PESA.

6.3. Saving

In Table 5 we now analyse which factors increase M-PESA users' propensity to save [31]. As mentioned

[28] The understanding of financial topics and the ability to put that knowledge into practice.

[29] Note that our results in regression (3) are consistent with those of Allen et al. (2012), who find, for formal accounts in general, that adopters are mainly male, urban, and relatively well-off.

[30] Arestoff and Venet (2013, p. 4) call this the "additive model" of mobile banking: "People already have a bank account and new financial services become available through their mobile phone". We are more interested in the "converted model", where people (especially the poor) replace informal by formal services.

[31] As a reminder: 'saving on MFS' comprises both respondents who save only on an M-SHWARI account and those who save on M-PESA; see Section 5.1. In regressions 2 and 3 we encountered non-concavity issues so

in the literature review, saving can be understood in many ways. We use the definition of the survey (see Section 5), which also happens to correspond best to the behaviour we want to observe.

In Table 5 two observations stand out. The first is that in regression (1) several variables now have a negative sign. For age this is not surprising across the board. As explained in Section 5.2, after retirement a decrease in the propensity to save is only normal. However, we also find a very significant negative coefficient for the 41-55 age category and a less significant one for the 31-35 category. We have no ready explanation for these results. To continue, the negative coefficients for education and wealth are indications that the richer respondents are less likely to save on MFS because they have other alternatives, such as bank accounts [32].

The second major observation is that several of the socio-demographic characteristics that proved important in the previous two steps now play almost no role anymore, especially not in regression (3) for the most vulnerable group. In fact, in regression (3) simply none of the variables in the outcome equation is significant. In other words, we are unable to explain the saving behaviour in this subgroup. This is probably due to the low variation in the dependent variable: out of the 448 individuals in this regression, a mere 12 (or 2.2 per cent) save on MFS. We therefore concentrate on regression (2).

In regression (2), the impact of education and wealth does not surprise. Gender has its usual negative sign and is significant at the 1 per cent level [33]. An analysis of the average marginal effects indicates that among the rural population women are 2.1 percentage points less likely to save than men. At first sight, the gender effect would thus seem limited. However, given that, overall, only 5.4 per cent of the rural population saves on MFS, the impact of gender, controlling for education, is in fact very substantial. Note also that the impact increases the more one focuses on the vulnerable groups – although cautiousness is warranted, because gender is not significant in regressions (1) and (3). In the full sample (where 7.6 per cent saves on MFS), the AME of gender is 1.6 percentage points; among the rural non-senders the corresponding figures are 1.2 per cent and 2.8 percentage points.

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instead of the default Stata method we had to use the "difficult" regression option for regression (2), and a combined Stata modified Berndt-Hall-Hall-Hausman, Newton-Raphson, Davidon-Fletcher-Powell, and Broyden-Fletcher-Goldfarb-Shanno (technique (bhhh 3 nr 3 dfp 3 bfgs 3)) optimisation method of the default Stata method for regression (3).

[32] Note in this respect that the significance of wealth disappears when we add a dummy to the regression that captures whether or not the respondent sends remittances by way of M-PESA. The same is true when we limit the sample to the unbanked (N = 1,403). The picture that emerges is one of people living in the city who use M-PESA to send money to urban relatives but do not use it to save.

[33] Note that Demombynes and Thegeya (2012) find that men are more likely to have savings of any kind (not just on their mobile account).

Table 5. Saving on MFS – M-PESA users

	Urban + Rural (1)	Rural (2)	Rural non-senders (3)
Outcome equation			
Age	***	***	
15-25	–	–	–
26-30	-0.0437	0.142	-0.0517
	(-0.61)	(0.97)	(-0.10)
31-35	-0.174*	0.302*	-0.0739
	(-2.14)	(2.04)	(-0.15)
36-40	-0.152	0.187	0.0342
	(-1.74)	(1.20)	(0.06)
41-55	-0.304***	0.128	-0.177
	(-3.60)	(0.86)	(-0.26)
Over 55	-0.554***	-0.141	-0.486
	(-5.13)	(-0.72)	(-0.53)
Gender (Female = 1)	-0.0478	-0.279**	-0.669
	(-0.65)	(-3.00)	(-1.09)
Education	**	n.s.	
Non-educated	–	–	–
Primary	-0.174	0.297*	-0.0233
	(-1.25)	(2.24)	(-0.05)
Secondary	-0.292	0.531***	0.421
	(-1.41)	(3.77)	(0.37)
College	-0.850**	0.286	No variation
	(-3.06)	(0.79)	
Literacy	0.0702	-0.00895	0.732
	(1.24)	(-0.09)	(1.12)
Wealth	-0.0614*	0.1000***	0.153
	(-1.99)	(3.66)	(0.96)
Family size	0.0176	0.0112	-0.0796
	(1.28)	(0.60)	(-0.69)
Constant	-0.0936	-2.549***	-2.808
	(-0.30)	(-11.64)	(-1.07)
Selection equation			
Age	0.0979***	0.145***	0.0549***
	(6.41)	(10.47)	(3.29)
Education	0.501***	0.0498	-0.214***
	(12.55)	(1.49)	(-5.09)
Wealth	0.155***	0.0730***	-0.0263
	(10.69)	(5.57)	(-1.66)
Gender	-0.137*	-0.148**	0.0858
	(-2.47)	(-3.01)	(1.42)
Family size	-0.0396***	0.0488***	0.0270**
	(-3.91)	(5.58)	(2.67)
athrho	-1.676**	2.421	0.290
	(-2.79)	(0.03)	(0.11)
Chi2	4.78	1.66	0.01
p	0.029	0.198	0.937
Log likelihood	-2188	-2273	-1266
Censored	818	1723	2546
Uncensored	2176	1271	448

t statistics in parentheses; *, ** and *** indicate significance at the 0.05, 0.01 and 0.001 level, respectively

7. Discussion and conclusions

This paper has looked into the uptake and use of M-PESA mobile financial services in Kenya. In particular, we wanted to find out to what extent the success of M-PESA as a money transfer mechanism has also resulted in higher financial inclusion, which we equate with being able to save. To answer this question, we exploit survey data collected among 3,000 respondents by InterMedia as part of the 2013 Financial Inclusion Insights Program. Specifically, we use a three-step probit procedure to identify the socio-demographic characteristics of, successively, the respondents who do not have access to a SIM card, have access to a SIM card but have not opened an M-PESA account, and, finally, have an M-PESA account but do not save on it. Figures 1-3 summarise our main results.

The Figures should be read as follows. The first bar represents the total number of respondents in the (sub)sample studied. The bars to the right then indicate, for each of the steps, how many overcome the adoption barrier and how many are 'left behind'. For example, in Figure 2 for the rural population the second bar indicates that 92.7 per cent of the 1,899 individuals in the subsample, or 1,760, have access to a SIM card [34], whereas 7.3 per cent have not (and are thus already financially excluded at this early stage). In the next step, we then analyse which of the remaining 1,760 have an M-PESA account, and so forth. As can be seen, eventually we are left with 103 respondents (or 5.4 per cent of the total) who actually save on MFS. At each stage, the small arrows beneath the bars indicate which socio-demographic characteristics explain the split-up in the next step. In other words, the arrows summarise the results of, respectively, Tables 3, 4, and 5. The rationale behind the bigger arrows is similar, yet different. These arrows summarise the results that are presented in Table A.2 in the Appendix. In this table, we throw overboard our three-step approach and rather explain directly, for the full (sub)samples (that is, irrespective of whether the respondents have access to a SIM or own an M-PESA account), who saves on MFS or not. The goal here is primarily to highlight the value-added of our three-step approach. Indeed, as we illustrate below, because an explanatory variable can be crucial in one step but not in the next or, stronger, because the direction of its impact can differ between steps, there may be little or no trace of its influence in a direct estimation as in Table A.2. Another advantage of our three-step approach is that it provides a better insight into the nature of the barriers to adoption.

[34] So, to be clear, for the first step in Figures 1-3 we use the results for access to a SIM, not those for possession. We come back to this below.

Figure 1 : Overview of results: Entire sample

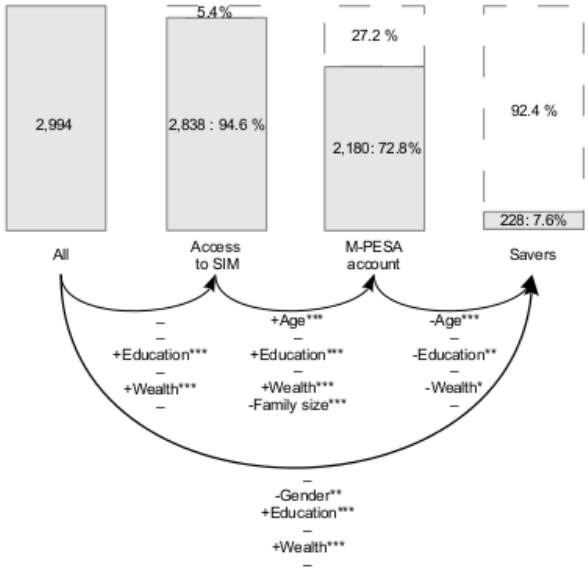


Figure 2 : Overview of results : Rural population

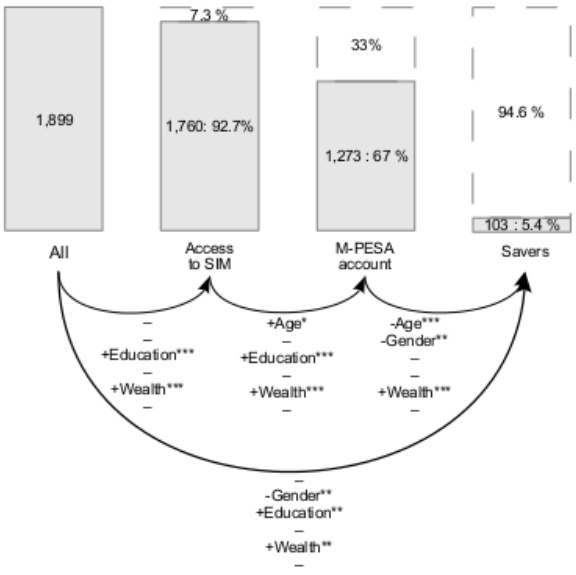
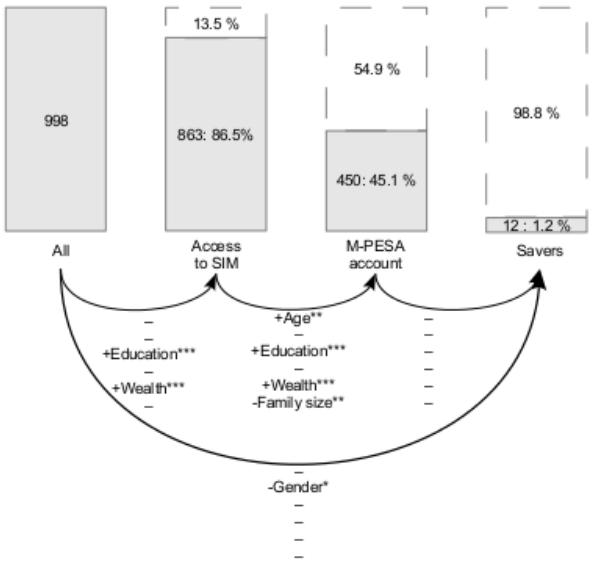


Figure 3 : Overview of results : Rural non-senders



To start with Figure 1 for the full sample, it can be seen that education and 'wealth' have a significant positive impact in the first two steps but a (smaller) negative impact in step three. The latter is not visible in the direct analysis because, overall, the positive impact dominates. This is a first instance where our three-step approach provides added value. Another illustration is that age is significant in steps two and three, but with a different sign so that its effect is absent in the direct analysis. Finally, gender is a special case: it has a significant negative impact in the direct analysis, but it is not significant in any of the three steps – at least not if one works with a 5 per cent significance cut-off. At 10 per cent, gender is significant in steps one and two; see regression (2) in Table 3 and regression (1) in Table 4. We come back to this below.

The results for the rural population, in Figure 2, are very similar as far as education, wealth, and age are concerned. The only difference is that education and wealth do not have a negative impact in step three. Perhaps the most interesting result in Figure 2 is the gender effect in the final step (and in the direct analysis): even after controlling for differences in education, female M-PESA users are less likely to save.

Finally, our three-step analysis for the rural non-senders (in Figure 3) is handicapped by the fact that we cannot explain the saving behaviour in the final step, probably due to the low variation (see section 6.3). But the results in steps one and two are very similar to those in Figures 1 and 2. Hence, a first general conclusion is that those who do not benefit from the positive effects of M-PESA (such as the ability to receive more frequent and faster remittances and, ultimately, the ability to save on a formal account) are for the most part the non-educated and the poor.

Then there is the issue of financial empowerment of women thanks to M-PESA. Gender has a significant negative effect in the direct analysis for all three samples – at the 1 per cent level in Figures 1 and 2, and at the 5 per cent level in Figure 3 – but our three-step analysis sends confusing signals. As can be seen, gender is not significant in any of the steps in Figure 3, only in the final step in Figure 2, and only at 10 per cent in steps one and two in Figure 1. It is, however, important to point out that in all three Figures the selection criterion in step 1 is access to a SIM (not possession), so an implicit assumption behind our three-step analysis is that it is sufficient to have access to a SIM (in step 1) to ultimately be able to save (in step 3).

This raises the question whether this assumption is realistic. A closer analysis of the data by means of t-tests showed, unsurprisingly, that respondents who have access to a SIM but do not own one have a

significantly lower probability to have an M-PESA account compared to respondents who have their own personal SIM – and this for all three samples. However, it is not as if there are none. In the full sample, for example, there are 43 respondents who do have an M-PESA account despite not owning a SIM. So we could hardly throw away these observations. This said, there are barely any respondents who save on MFS without *owning* a SIM: 3 in the full sample, 2 among the rural population, and one single individual in our most narrow sample.

Taken together, these observations suggest that having access to a SIM without owning one might be sufficient to open an M-PESA account (and thus to receive remittances [35]), but that it is an entirely different matter to entrust somebody else('s SIM) with your savings. In terms of methodology, this suggests that when studying the gender effect one should perhaps select on SIM ownership in step 1 rather than on mere access. We may thus have been too positive about the beneficial effect of shared ownership of SIMs in our analysis of Table 3.

When revisiting Table 3 with this new frame of mind, the gender effect indeed becomes more visible – in line with the direct analysis. In regression (1) of Table 3, for the full sample, gender is significant at the 1 per cent level and in regression (3), for the rural population, it is significant at 10 per cent. Also, if we change the selection criterion in Table 4 to possession of a SIM instead of possession or access (results not reported), the impact of gender drops dramatically. In regression (1) the AME goes from -0.028 and a significance level of 10 per cent to an insignificant -0.008; in regression (4) the AME drops from -0.026 to -0.012. In order words, this shows that women who *own* a SIM do not have a lower probability to have an M-PESA account [36]. The exclusion happens at an earlier stage (and is not captured by our original three-step analysis because of the assumption that just having access to a SIM is sufficient).

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[35] Among the respondents who have access to a SIM but do not own one (379 in the full sample), the receivers of remittances (61) outnumber the senders (37).

[36] The analysis in the main text may help understand why Johnson et al. (2012) and Johnson and Arnold (2012) find different results for gender. Johnson et al. (2012, p. 21) find that "being a man significantly increases the likelihood of access compared to being a woman – *a result we did not find in the analysis of the FinAccess 2009 data where gender was insignificant*". While the two papers use different samples collected in different years, the explanation might lie in the fact that, unlike Johnson et al. (2012), Johnson and Arnold (2012, p. 741-742) have in their regressions dummies for, respectively, owning and having access to a phone. These dummies, which have the biggest marginal effects on adoption of all the variables, probably capture the lower probability of women to own or have access to a phone and cause gender itself to be insignificant. Explained differently, Johnson et al. (2012), who do not control for phone ownership or access, in fact lump together steps 1 and 2 of our analysis, and the gender effect that they find probably relates mostly to exclusion in step 1 rather than step 2. Conversely, Johnson and Arnold (2012) do control for phone ownership/access and therefore have a cleaner analysis of step 2. In our view, this is another illustration of the value added of our three-step approach.

Together with our findings about the impact of gender on saving (especially for the rural population) – see Table 5 – as well as the direct analysis in Table A.2, this puts into perspective the results of, amongst others, Morawczynski and Pickens (2009) and Suri and Jack (2016) on the financial empowerment of women thanks to M-PESA. As mentioned in Section 3.3, Suri and Jack find that the beneficial effects of M-PESA are more pronounced for female-headed households and they estimate that the spread of mobile money induced no less than 185,000 women to switch into business or retail as their main occupation (Suri and Jack, 2016, p. 1289). Our results suggest that there are also women who are 'left behind'.

Finally, our analysis is obviously not without its limitations. Probably the most important is that whereas our analysis allows us to identify the socio-demographic characteristics that explain exclusion in each of the steps, we can say little about the nature of the underlying barriers. As Johnson and Arnold (2012, p. 720) point out (concerning step 2), "The ways in which [socio-demographic] patterns of access are related to barriers to access are complex, as these may operate through combinations of discriminatory policies, informational and contractual frameworks, pricing and product features". For example, in a paper on Uganda, Murendo et al. (in press) adopt a network-oriented explanation of MFS adoption, and argue that while social networks help spread information about MFS, the poorest households may reside in an 'information-poor' situation, preventing them from adopting MFS. Our approach cannot yield this type of insights. Another barrier, in particular in step 3, might be related to features of product design. Wyche et al. (2016) look into this and argue that their findings provide, not unlike the present paper, "a counter-narrative to the mostly optimistic stories about the possibilities of widespread mobile phone ownership throughout sub-Saharan Africa" (2016, p. 15). In particular, Wyche et al. rely on the amplification theory of technology – which holds that technology can amplify existing social inequalities – to study how rural Kenyan women interact with the products and services of Safaricom [37]. The interviews revealed a mismatch between the skills of the M-PESA users and, for example, the M-PESA interface (Wyche et al., 2016, p. 15). Worryingly, for some women even topping up a handset was overly complicated. As Wyche et al. (2016, p. 13) put it, "if women struggle just to add airtime to their handsets, it is unclear how they can take advantage of [more advanced] services"; that is, it is not very realistic to expect these women to save on MFS.

A number of other limitations of our research stem from the nature of the data that we use. For one, we have no information on informal savings and thus could not study whether M-PESA has triggered a

[37] They decided to focus on women "because they tended to be less capable of using their phones (compared to men)" (Wyche et al., 2016, p. 6).

transition from informal to formal saving. Second, our saving variables are very rough: not only are they yes/no dummies (which, by definition, do not provide any indication as to the level of the savings), they also lack a time dimension. As explained, the survey only asked respondents whether they had "ever" saved. Third, because of the absence of a precise time indication we could not analyse whether saving on M-PESA functions as a stepping stone toward saving on a bank account. However, in view of the limited number of respondents who save on M-PESA (6.8 per cent of the total sample) or, broader, on MFS (7.6 per cent), it is safe to state that the stepping-stone effect, if any, is only of marginal importance, especially so in rural areas [38]. Indeed, whereas Kenyans are 'paying' massively with M-PESA (that is, transferring money), in 2013 this was not yet true for saving.

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[38] Johnson (2016) suggests that this is due to a "rift" in social relations. Johnson interviewed 148 respondents in rural parts of Kenya in order to understand their financial practices, and in particular the social relational dimensions of debt that underlie M-PESA transfers. Her research highlights "a 'fiduciary culture' where relationships of equality and 'negotiability' dominate" (Johnson, 2016, p. 83), whereas relations with banks tend to be perceived as hierarchical. Johnson concludes that this "questions policy-makers' expectations that mobile money transfer will seamlessly facilitate engagement with the formal sector for savings and credit" (Johnson, 2016, p. 83).

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Appendix

Table A.1. Descriptive statistics

	Urban + rural		Rural		Rural using M-PESA		Rural banked using M-PESA		Rural non-senders	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
SIM cards										
Own	2459	82.0	1469	77.4						
Own or have access	2838	94.6	1760	92.7						
M-PESA										
Use	2180	72.7	1273	67.0	1273	100.0	402	100.0	450	100.0
Pay bills	290	9.7	133	7.0	122	9.6	65	16.2	26	2.7
Receive salary	113	3.8	55	2.9	55	4.3	26	6.5	7	1.6
Receive gov't pension	18	0.6	12	0.6	12	0.9	7	0.7	2	0.4
Buy	54	1.8	27	1.4	27	2.1	18	4.5		
Send money	1056	35.2	568	29.9	528	41.5	193	48.0		
Receive money	1149	38.3	693	36.5	636	50.0	207	51.5	115	25.6
Send emergency money	727	24.2	376	19.8	353	27.7	143	35.6		
Receive emergency money	720	24.0	407	21.4	378	12.6	143	11.2	46	10.2
Save	205	6.8	96	5.1	96	7.5	35	8.7	10	2.2
M-SHWARI										
Use	283	9.4	90	4.7	90	7.1	53	13.2	13	2.9
Save	40	1.3	11	0.6	11	0.9	6	1.5	2	0.4
Use M-KESHO	34	1.1	9	0.5	9	0.7	9	2.2		
Save on MFS	228	7.6	103	5.4	103	8.1	40	10.0	12	2.7
Bank account										
Have	846	28.2	444	23.4	402	31.6	402	100.0		
Save	139	4.6	53	2.8	49	3.8	49	12.2		
Save on MFS *and* bank account	45	1.5	19	1.0	19	1.5	19	4.7		

(*continued*)

Table A.1. (*Continued*)

	Urban + rural		Rural		Rural using M-PESA		Rural banked using M-PESA		Rural non-senders	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Age										
15-25	669	22.3	331	17.4	179	14.1	31	7.7	76	16.9
26-30	514	17.1	269	14.2	185	14.5	49	12.2	57	12.7
31-35	394	13.1	240	12.6	170	13.4	46	11.4	63	14.0
36-40	366	12.2	256	13.5	188	14.8	65	16.2	53	11.8
40-55	624	20.8	453	23.9	323	25.4	121	30.1	112	24.9
0ver 55	433	14.4	350	18.4	224	17.6	89	22.1	89	19.8
Gender										
Female	1861	62.0	1140	60.0	735	57.7	172	42.8	293	65.1
Male	1139	38.0	759	40.0	534	41.9	229	57.0	157	34.9
Education										
No education	999	33.3	812	42.8	399	31.3	75	18.7	205	45.6
Primary	1172	39.1	695	36.6	521	40.9	138	34.3	178	39.6
Secondary	769	25.6	369	19.4	328	25.8	169	42.0	66	14.7
College	60	2.0	21	1.1	21	1.6	19	4.7		
Literacy	1887	62.9	1453	76.5	818	64.3	252	62.7	348	77.3
Urbanity	1101	36.7								
Observations	3000	100.0	1899	100.0	1273	91.8	402	100.0	450	100.0

Table A.2. Saving on a formal account

	Saving on MFS			Saving on a bank account	
	Urban + Rural (1)	Rural (2)	Rural non-senders (3)	Urban + Rural (4)	Rural (5)
Outcome equation					
Age	n.s.	n.s.	n.s.	*	***
15-25	–	–	–	–	–
26-30	0.0900	0.199	0.106	0.423**	-0.0958
	(0.85)	(1.37)	(0.26)	(3.07)	(-1.26)
31-35	0.00128	0.364*	0.0993	0.340*	-0.0872
	(0.01)	(2.45)	(0.24)	(2.22)	(-0.48)
36-40	0.106	0.229	0.242	0.271	-0.235
	(0.88)	(1.48)	(0.59)	(1.69)	(-1.51)
41-55	-0.0227	0.163	0.0151	0.267	-0.361*
	(-0.21)	(1.11)	(0.04)	(1.86)	(-2.18)
Over 55	-0.352*	-0.142	-0.260	0.320*	-0.482**
	(-2.33)	(-0.73)	(-0.57)	(1.97)	(-2.69)
Gender (Female = 1)	-0.218**	-0.294**	-0.527	-0.330***	0.0740
	(-2.96)	(-3.16)	(-1.44)	(-3.76)	(0.77)
Education	***	**	n.s.	***	***
Non-educated	–	–	–	–	–
Primary	0.462***	0.368**	-0.0197	0.251	0.291***
	(4.22)	(2.69)	(-0.05)	(1.87)	(5.03)
Secondary	0.729***	0.530***	0.349	0.669***	0.703***
	(6.24)	(3.64)	(0.35)	(4.83)	(5.57)
College	0.187	0.173	No variation	1.128***	1.094***
	(0.68)	(0.50)		(5.04)	(5.08)
Literacy	0.112	0.00941	0.682	0.138	-0.0426
	(1.31)	(0.09)	(1.34)	(1.32)	(-0.83)
Wealth	0.0760***	0.0771**	0.121	0.0944***	0.0823***
	(3.70)	(2.84)	(0.81)	(3.75)	(4.98)
Family size	-0.0216	0.0205	-0.0546	-0.0281	-0.0990***
	(-1.40)	(1.16)	(-0.71)	(-1.51)	(-4.14)
Constant	-1.831***	-2.263***	-2.665***	-2.209***	-0.523
	(-9.42)	(-8.92)	(-3.67)	(-9.16)	(-1.53)
Selection equation					
Age		0.132***	0.131***		-0.0167
		(9.13)	(9.02)		(-1.11)
Education		-0.291***	-0.290***		-0.579***
		(-8.34)	(-8.33)		(-14.85)
Wealth		-0.0746***	-0.0759***		-0.162***
		(-5.37)	(-5.47)		(-11.22)
Gender		-0.173**	-0.166**		0.107
		(-3.29)	(-3.15)		(1.93)
Family size		0.125***	0.123***		0.0674***
		(11.39)	(11.31)		(6.60)
athrho		2.466	0.456		-2.543
		(0.09)	(0.36)		(-1.87)
Pseudo R2	0.09			0.13	
Chi2		3.95	0.08		1.84
p		0.045	0.772		0.174
Log likelihood	-741	-2068	-1602	-496	-1929
Censored		1099	2000		1099
Uncensored	2994	1895	994	2994	1895

t statistics in parentheses; *, ** and *** indicate significance at the 0.05, 0.01 and 0.001 level, respectively.