The Rise of Mobile Money in Kenya: The Changing Landscape of M-PESA's Impact on Financial Inclusion

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Abstract

M-PESA, the hugely popular mobile money system in Kenya, has been celebrated for its potential to "bank the unbanked" and increase access to financial services. This paper provides evidence to support this idea and explores mechanisms through which this might be the case. It specifically looks at the savings products held by individuals and how this changes in relation to M-PESA use. It then constructs an index for measuring the extent to which individuals are integrated into the formal financial sector. This paper argues that M-PESA's effect on financial inclusion is a growing phenomenon, which suggests that keeping pace with the rapid evolutions of this mobile money system should be a high priority for researchers. As this paper elucidates, M-PESA has become notably more integrated with the formal financial sector in 2013 as compared to 2009, which holds implications for user behavior.

JEL Classification: O33, D14, O17, E42, G21, G23,O16

Keywords: Mobile money, savings, financial inclusion, technology

1. Introduction

Exclusion from financial services ranks among the most challenging obstacles facing the poor. The rise of mobile money, defined as the provision of financial services through mobile phones, has been heralded as a way to give the poor greater access to formal financial services. The high prevalence of mobile phones in Sub-Saharan has been a well-documented phenomenon, so the introduction of technology that transforms these phones into financial intermediaries could potentially have dramatic implications for development. Although mobile money technology is relatively new, it has seen remarkably rapid expansion. According to a 2012 Global Mobile Money Adoption Survey, 150 mobile money systems in 72 countries have been deployed, and another 109 projects are in planning phases (Penicaud 2013).

This paper focuses specifically on Kenya, a country that is often considered to be home to the world's most developed mobile money system. This system is called "M-PESA," a combination of "mobile" and "pesa," the Swahili word for money. M-PESA was launched in March 2007 by Safaricom, a telecommunications company that heavily dominates the cell phone market in Kenya. Its initial function was to serve as a simple mechanism for person-to-person transfers. Users go to M-PESA agent outlets, where they can exchange cash for "e-money" that can then be sent through their phone to the phone of another user. Users can also go to agents to convert their electronic money into cash. Uptake of M-PESA has been rapid and extensive, having been adopted by nearly 70% of the adult population within four years of launch (Jack and Suri 2014).

Another notable characteristic of the Kenyan context is the size and reach of the mobile money system relative to the rest of the financial sector. Significantly more

people have mobile money accounts than bank accounts, in large part due to the low-start up costs and high availability of agent locations. As of 2011, there were 28,000 M-PESA agent outlets in Kenya but only 850 bank branches (Jack and Suri 2014). Company reports show that 12,000 new agents were added in 2012, bringing the total up to nearly 40,000 agents.[1]

Safaricom regards M-PESA as a critical revenue source and has implemented a number of innovative changes to the system since its inception. What began as a system for simply texting money from person to person has now grown to provide a suite of financial offerings, ranging from Lipa Karo (for school fee payments) to PesaPoint (an ATM for accessing the M-PESA account). As M-PESA's website proudly proclaims, Safaricom believes that their mobile money system has increased financial inclusion and "ushered [in] a new era of financial empowerment…that drastically changed and continues to change the lives of Kenyans."

Given the rapidly expanding nature of M-PESA services as well as its users, this paper hypothesizes that significant differences in the nature of the M-PESA system can be observed over time. It shows that M-PESA has indeed become more integrated into the formal sector over time and increasingly promotes the formal sector presence of its users. This paper updates existing insights into the M-PESA system with a dataset from 2013, which is more recent than any datasets in the existing scholarly literature. Even recently published articles use data that might be outdated in key ways. For example,

[1]http://www.safaricom.co.ke/safaricom_annual_report/pdfs/Safaricom_Annual_Report.pdf

[2] 1 Kenyan Shilling=0.012 USD

[3] According to World Bank data, Kenya's annual per capita GNI (in current US$) was $780 in 2009 and $860 in 2012, which represents a 10% increase. The Expense variable in this paper also increases by 10% from 2009 to 2013. The Expense variable's average corresponds to an annual figure of approximately 1127

Jack and Suri (2014) use data collected between 2008 and 2010. This paper argues that an increased focus should be paid to questioning and updating our understanding of M-PESA. It especially encourages research in the area of how M-PESA interacts with other financial products, given the tremendous benefits that could be reaped from a mobile money system that allows excluded individuals to interact with the formal financial sector for the first time.

2. Literature Review

A number of studies have examined mobile money's capacity for increasing the welfare of users. These have found that M-PESA decreases the transaction costs of transferring money. Kenya has high rates of rural-urban migration and thus many long-distance remittances, which were transported through risky, inconvenient, and expensive methods such as bus-driver couriers or money transfers through Western Union (Mbiti and Weil 2011). One micro-study found that rural users saw an increase in income after using M-PESA, driven by the increased ease of receiving remittances (Morawczynski and Pickens 2009). There is convincing evidence that M-PESA allows users to send and receive more remittances with wider risk-sharing networks, which enhances their ability to hedge risk and smooth consumption. When faced with unexpected adverse events, M-PESA users do not experience a change in consumption, while non-users see a decrease (Jack and Suri 2014). Looking specifically at negative health shocks, Suri, Jack and Stoker (2012) find that M-PESA users can pay for healthcare costs without cutting back on other expenditures such as food. Customers also benefit from M-PESA when it exposes existing financial service providers to greater competition. This can result in

higher quality services and downward pressure on prices, as was seen with Western Union (Mbiti and Weil 2011).

The nature of the relationship between M-PESA and other financial products remains a matter of debate. One theory posits that M-PESA substitutes with informal savings products and complements with formal ones. Jack and Suri (2011) find that over 75% of users use M-PESA for saving and cite ease of use and safety as reasons for doing so. Qualitative analysis reports that users have moved money away from informal savings, especially saving at home, into M-PESA (Morawcyznski and Pickens 2009). On the other hand, M-PESA's innovations may increase access to formal savings by reducing the limitations of geographic distance, which Demirguc-Kunt and Klapper (2012) identify as one of the most commonly-cited barriers to having a formal savings account. In 2010, Safaricom introduced M-KESHO, an interest-garnering savings account with Equity Bank that has no opening fees and can be entirely accessed through M-PESA . Following this launch, other banks also began making partnerships with M-PESA, allowing their financial services to "ride on the rails" of the M-PESA network. Users can now use M-PESA to deposit money into accounts with 36 different banks, 28 of which also allow withdrawals from the account to be made over M-PESA (Financial Access Initiative 2010). In 2012, Safaricom partnered with the Commercial Bank of Kenya to launch M-Shwari, an M-PESA-based savings and loan product that has seen fairly high rates of uptake (Kaffenberger 2014).

Although much of the excitement surrounding M-PESA concerns its ability to connect the financially excluded, the literature finds that better-off individuals actually use the product more. On average, M-PESA users are more likely to be wealthier, better

educated, urban, and already banked (Aker and Mbiti 2010). People with bank accounts use it nearly three times as much as those without bank accounts (Mbiti and Weil 2011). This user disparity declines over time as a larger and more diverse portion of the population starts using M-PESA. Jack and Suri (2011) conduct two rounds of surveys (in 2008 and 2009) and confirm that earlier adopters of M-PESA are more privileged in a number of ways than later adopters.

This selection bias amongst M-PESA users implies the presence of endogeneity concerns that make it more difficult to establish causality. Simply looking at the relationship between an individual's savings formality level and their M-PESA usage would lead to bias, because it might be that financial-savviness makes individuals both more likely to adopt M-PESA and more likely to have formal savings. Demombynes and Thegeya (2012) use community M-PESA adoption rate as an instrument for individual M-PESA use, reasoning that community take-up should affect individual M-PESA take-up but not individual financial savviness. They conclude adoption and find that M-PESA increases an individual's likelihood of having savings. Similarly, Mbiti and Weil (2011) construct an instrument based on several measures of a community's dissatisfaction with alternative money transfer methods (for example, the proportion of people who felt the post office was the slowest way to transfer money). They reason that viewing alternative transfer methods unfavorably predicts M-PESA take-up but not savings. This study finds that M-PESA makes people less likely to use informal savings but more likely to be banked. However, the instruments in both papers fail to account for the possibility of a common community effect that influences both M-PESA take-up and savings behavior, so endogeneity remains a concern. Consequently, this paper focuses on changes within

the same individual to remove the environmental effects that might otherwise bias the analysis.

The literature has also provided support for the opposing theory that M-PESA may make formal savings less attractive. Decreasing the transaction costs of savings accounts do not necessarily make them more attractive. One study in Kenya found that ATM cards actually decreased account use for people with low levels of intra-household bargaining power (Schaner 2013). These savers, who are often women, are pressured to use their funds to support other family members and have a harder time refusing when their money is more liquid. In addition, there is evidence that people might choose to forego bank usage for reasons other than inaccessibility—namely, feelings of distrust or disillusionment towards banks (Dupas et al. 2012). Moreover, an analysis of M-banking in South Africa found that the system did not meaningfully expand the access frontier of financial products, although the author suggests that remains a possible development in the future (Porteous 2007).

This paper extends the literature by exploring the relationship between M-PESA and savings using recently released data. It focuses specifically on financial inclusion, something that has been regarded by policy makers as a central priority. When people have access to a diverse array of financial services, they are better equipped to handle adverse situations and increase welfare outcomes. Burgess and Pande (2005) show that bank branch expansion significantly alleviated poverty in rural India. Formal institutions generally have access to larger capital sources, provide greater reliability, and have been shown to hold large potential benefits for the poor (Brune et al. 2011; Allen et al. 2013). However, it has also been well-noted that the formal financial

sector often excludes the poor, who often do not meet the requirements for acquiring certain financial products.

3. Theoretical Framework

This paper explores the substitutive effect of M-PESA by testing the popular theory that M-PESA users shift funds away from informal savings and into M-PESA, which they consider to be a superior savings device. It also investigates whether M-PESA also causes shifts in funds away from formal savings. In the next sections, it looks at changes in an individual's formality level to see, on balance, whether these shifts make users more included in the formal financial sector. "Formality level" refers to the types of savings products used by an individual. Between 2009 and 2013, the M-PESA system expanded both its user base and service offerings. One main structural change was the integration of banks into the M-PESA network. This should theoretically increase the use of formal bank products, both by enabling people to access new formal products like M-KESHO, and by lowering the transaction costs associated with formal bank accounts in general. However, this has not yet been tested empirically. However, this paper looks at differences between findings in the 2009 and 2013 datasets to provide such evidence.

This paper looks at change within individuals by comparing each respondent's financial situation in the past to that same individual's current financial situation. This allows for observations of change over time that keep constant the various personal and community-based variables that might influence usage of both M-PESA and formal financial products. Past studies have used community-level instruments, but these do not completely address this endogeneity concern. Several factors, such as a community's feelings of trust in financial innovations, could theoretically increase both M-PESA use

and bank use. So, focusing on change within individuals allows for greater isolation of the M-PESA effect.

To measure this change, this paper constructs an index of financial inclusion. The aim of doing so is simply to enable empirical comparisons of change over time. Financial inclusion is broadly defined as a person's ability to access financial services, but the nuances of this definition vary from source to source. Usage of formal accounts is a central indicator of financial inclusion that is employed, even across different measurements. The World Bank's Global Findex database considers "formal accounts" to include microfinance institutions (MFIs) and cooperatives, as well as banks and credit unions (Demirguc-Kunt and Klapper 2012). Others such as the CRISIL financial inclusion index look specifically at bank branches, noting that Non-Banking Finance Companies (NBFCs) and MFIs can be added if reliable data later deems this appropriate ("CRISIL"). Financial Sector Deepening-Kenya identifies four levels of formality: excluded, informal, formal other, and formal ("Appendix" 2009). For the purposes of this paper, the "formal" sector includes only banking institutions, as this allows for a group that is clearly and cohesively and defined.

As articulated in a working paper from the International Monetary Fund, "a formal consensus on how [financial inclusion] should be measured has yet to be reached" (Amidzic et al. 2014). This paper does not aim to take a stance on this issue and instead employs two methods of calculating an individual's financial inclusion level to establish a range of possibilities. The first looks at the *most* formal product a person is using. This view considers a person to be fully financially included as long as he has one formal savings product, regardless of what other savings product he uses. This interpretation

assumes that the most defining characteristic of one's financial inclusiveness is whether or not he uses any kind of formal savings. The next view looks at *how* formal the basket of products used by an individual is, on average. This view considers someone who uses only formal products to be more included than someone who uses formal and informal products, since the latter scenario implies that an individual cannot have all her financial needs met through formal means. This interpretation sees financial inclusiveness as a measure of how fully an individual's financial behaviors are integrated into the formal sector. There is no established precedent for which assumption is more valid, and both interpretations answer interesting questions in the M-PESA context, so the paper proceeds using both.

Finally, this paper acknowledges that increased accessibility of the formal financial sector does actually decrease its attractiveness in certain situations. This studies the people on the sending end of support transfers. Since individuals feel more social pressure to support friends and family when they can tap into their savings and disseminate it with ease, M-PESA may make some bank accounts less attractive than, for example, a ROSCA where money is held by other individuals. Studying whether or not M-PESA has this perverse effect can serve as another test of how integrated M-PESA is into the formal system.

4. Data

This paper uses data from the FinAccess Surveys, which were conducted with support of Financial Sector Deepening Kenya, The Financial Access Partnership, and the Central Bank of Kenya. These are nationally-representative household surveys conducted in 2006, 2009, and 2013; this paper draws upon the two most recent waves. A major

limitation of the data is that it does not follow the same panel of individuals across the years. However, this dataset is still highly regarded for its representative sampling and is commonly used in the literature.

Table 1 shows that the populations in 2009 and 2013 have similar baseline characteristics. In this paper, "M-PESA User" is the central explanatory variable, and the other variables listed in Table 1 are included as controls in all analyses. The portion of the sample that is classified as an M-PESA user below might seem surprisingly low given statistics about mobile money takeup. That is because the "M-PESA User" variable reflects whether someone reports being a "registered user," but people can use mobile money without being registered. When phrased as "have you ever used" M-PESA/mobile money, the number of users increases to 38.62% and 77.75% of the 2009 and 2013 samples, respectively. This paper uses the registered users number because it is easier to answer accurately and because these people are more likely to use M-PESA on a regular basis, so this measure lends itself to more valuable insights about the impact of M-PESA. The phrasing on this question is slightly different between the two years: the 2009 survey asks about M-PESA while the 2013 survey asks about "mobile money," which includes competitor systems offered by companies such as Airtel, Orange, and YuMobile. However, this paper uses "M-PESA" to refer to this entire category because Safaricom's mobile money market share is very large (around 80%), the other systems do not dramatically differ from M-PESA, and terminology is kept consistent with 2009 (Kuria 2014).

The "Monthly Expenses" variable is a proxy for wealth and is expressed in

Kenyan Shillings.[2] Since the 2009 survey did not ask directly about income, this paper constructs a measure using total monthly spending on a set of items that were asked about in both years. This variable increases from 2009 to 2013 at a rate alongside per capita GNI, which adds validity to this measure as a proxy.[3] "Educational level" refers to the highest level of education attained by the respondent on a scale of 1 (none) to 7 (university degree). The mean level, 3, corresponds to completion of primary school.

Table 1. Summary of Respondent Characteristics

	2009 N=6597	2013 N=5844
Variables	*% of Sample*	*% of Sample*
M-PESA User	27.65%	59.36%
Gender		
Male	41.31%	40.83%
Female	58.69%	59.17%
Household head gender		
Male	76.25%	69.03%
Female	23.75%	30.97%
Cluster type		
Rural	71.32%	64.37%
Urban	28.68%	35.63%
Marital status		
Single	23.47%	22.42%
Married/Live with Partner	60.19%	64.68%
Other	16.34%	12.90%
Is Household Head	48.70%	49.64%
Owns A Mobile Phone	46.67%	66.96%
	2009 Mean	2013 Mean
Age	38.71	36.33
Household Head age	45.48	41.88

[2] 1 Kenyan Shilling=0.012 USD

[3] According to World Bank data, Kenya's annual per capita GNI (in current US$) was $780 in 2009 and $860 in 2012, which represents a 10% increase. The Expense variable in this paper also increases by 10% from 2009 to 2013. The Expense variable's average corresponds to an annual figure of approximately 1127 USD and 1241 USD in 2009 and 2013 respectively. Although these numbers are slightly larger than the GNI figures, this may be attributable to the fact that all survey respondents are adults or due to a difference in applying exchange rates.

Monthly Expenses	7825.20	8618.41
Educational Level	3.10	3.18

After dropping individuals with missing answers to questions regarding key personal characteristics, this paper uses a sample of 6597 individuals in 2009 and 5844 individuals in 2013. The analyses in this paper were then restricted to people who said they had some role in household financial decisions, since these people are most likely to have accurate survey answers about household use of financial products. In addition, since the analyses are performed at an individual level, it only makes sense to draw conclusions about how someone's use of M-PESA impacts his use of other products if he plays a role in determining what other products he uses. 82% of the sample in 2009 and 90% of the sample in 2013 were considered decision makers.

A central question in these surveys that is exploited in this paper is one that asks respondents about their usage of various financial products. The list spans a huge variety of products, and this paper focuses only on products that are asked about in both the 2009 and 2013 surveys, so as to allow for comparisons. This paper looks at the following savings products and classifies them using formality levels seen below. Level 2 products are offered by a formal banking institution. Level 1 products span a variety of informal products, which are provided by organizations, colleagues, friends, family, or the user himself. Although there is notable variation in formality between products within Level 1, this paper considers them all to be in the same category to focus on the more clear distinction that exists between informal products and bank-offered products. Individuals without any of these savings products comprise Level 0. Figure 1 summarizes the products studied in this paper, using the same wordings and explanations as the

FinAccess surveys.

Figure 1. Savings Products by Formality Level

Formal (Level 2)
• Postbank account • Bank account for savings or investment (which pays interest) • Current account-with a checkbook • Bank account for everyday needs but no checkbook
Informal (Level 1)
• Savings account at Saving and Credit Cooperatives (SACCO) [organization which requires you to be member, e.g. agricultural or workplace co-op] • Savings at microfinance institutions [organization which mostly lends to members in a group] • Savings with an Accumulating Savings and Credit Associations (ASCA) [a group that lends to other people with interest] • Savings with a Rotating Savings and Credit Association (ROSCA)/Merry-go-round [a group that collects money from each member and gives it to one person in turn] • Savings with a group of friends • Savings given to a family or friend to keep • Savings you keep in a secret hiding place

For each of these products, the FinAccess surveys ask individuals to identify as one of the following mutually exclusive and collectively exhaustive categories: 1.) currently has the product 2.) used to have the product but no longer has the product 3.) never had the product. Category 2 is interesting because it demonstrates change within an individual, although this change is only observed in one direction. The survey does not ask about how long someone when they started using the products they use, so it is challenging to directly measure positive change and consequently difficult to know the direction of net change. However, given the rarity of panel data on this topic, this measure of change still provides interesting insights. Also, if we assume that people do not change products on a very frequent basis, any evidence of some kind of change is

interesting. Another limitation of the data is that it does not record magnitudes—we know whether or not someone is using a product, but not how much he puts in it or how often he uses it.

5. Empirical Specification & Results

5A. Dropping Informal and Formal Savings

What products do people shift away from when they have M-PESA? The following regressions address this question:

$$(1) \qquad DropInformalSavings_{it} = \alpha + \beta_1 MPESAUser_{it} + \beta_2 X_{it} + \varepsilon_{it}$$

$$(2) \qquad DropFormalSavings_{it} = \alpha + \beta_3 MPESAUser_{it} + \beta_4 X_{it} + \varepsilon_{it}$$

where $DropInformalSavings_{it}$ is a variable, for individual *i* from Year *t* , that equals 1 if that person answers "used to have, but no longer have" to one or more of the products listed in the Informal category from Figure 1, and equals 0 otherwise. $MPESAUser_{it}$ is a variable, for individual *i* from Year *t* , that equals 1 if that person currently is an M-PESA user and equals 0 otherwise. X represents a set of controls, as listed in Table 1 and Table 2.

Table 2. OLS Results for Dropping of Savings

	DropInformalSave in 2009 (1)	DropFormalSave in 2009 (2)	DropInformalSave in 2013 (3)	DropFormalSave in 2013 (4)
MPESAUser	0.0423**	0.0710***	0.0792***	0.0299**
	(2.64)	(5.75)	(4.23)	(2.59)
Gender	0.0325	-0.0366*	0.0260	-0.0263*
	(1.47)	(-2.15)	(1.31)	(-2.14)
Age	0.00289***	0.00342***	0.00225**	0.00172**
	(3.70)	(5.67)	(2.59)	(3.23)
Hhold head age	-0.00104	0.000449	-0.000791	-0.000204
	(-1.20)	(0.67)	(-0.97)	(-0.40)
Hhold head gender	0.00647	-0.00744	0.0192	0.00190
	(0.27)	(-0.40)	(0.97)	(0.16)
Education	0.0214***	0.0220***	0.0140**	0.0143***
	(4.86)	(6.47)	(2.79)	(4.61)
Cluster	0.0290*	0.0120	0.0159	0.0266**
	(2.01)	(1.08)	(1.10)	(3.00)
Marital	0.0149*	0.00798	0.00159	0.0101*
	(2.29)	(1.59)	(0.25)	(2.57)
Expense	-0.000000446	0.000000347	0.000000346	0.000000755***
	(-1.90)	(1.92)	(0.95)	(3.38)
Is hhold head	0.0216	0.0168	-0.00939	0.0172
	(0.89)	(0.89)	(-0.50)	(1.47)
OwnMobile	0.00951	0.0438***	0.0152	0.0265*
	(0.64)	(3.85)	(0.78)	(2.19)
Constant	-.0941	-0.136***	0.0817	-0.0896**
	(-1.77)	(-3.30)	(1.59)	(-2.84)
Number of obs.	5415	5415	5251	5251
R-squared	0.0210	0.0830	0.0186	0.0422

t statistics in parentheses. * Significant at the 5 percent level, ** Significant at the 1 percent level, *** Significant at the 0.1 percent level

Columns 1 and 3 show the results of equation (1) for years 2009 and 2013 respectively. Columns 2 and 4 show the results of equation (2) and together demonstrate that M-PESA has a statistically significant substitutive relationship to dropping savings, for both formal and informal products in both years.

In 2009, being an M-PESA user is associated with a 4.2% increase in the likelihood of dropping informal savings and a 7.1% increase in the probability of dropping formal savings. This runs counter to the conventional belief that M-PESA moves people from informal to formal methods. M-PESA substitutes, in a certain sense, with formal savings to a greater extent than it does with informal savings. However, this does not prove that people are substituting from formal savings to informal savings, since entirely different individuals could be driving the significance of the two coefficients. One explanation may be that those who drop formal savings are the financially elite who have multiple accounts and have high product mobility. So, M-PESA may make them drop some of their bank accounts, but they still have other ones and might even pick up new ones—the net effect is unknown. Another explanation is that M-PESA users are more likely than non-users (especially in 2009, where there is greater user selection bias) to have formal accounts in the first place. When the dependent variable equals "0", it does not distinguish between those who had formal accounts that they still presently hold and those who never had formal accounts. Perhaps many 2013 M-PESA users fall into the latter category and thus do not have a "1" for the dependent variable, but not because they feel less disillusionment with formal accounts than 2009 users do.

In 2013, this regression suggests a reversed finding—being an M-PESA user is associated with a larger increase in the probability of dropping an informal savings product than a formal savings product (7.9% and 3.0%, respectively). This might be because people with informal savings are more likely to be looking for alternative places to save their money, and M-PESA offers superior security and reliability. In addition, there is less selection bias in 2013, because this year also contains the effect of some late adopters of M-PESA. These people render the average M-PESA user in 2013 to be less financially elite than the average M-PESA user in 2009. Users in 2013 may thus be less likely to drop formal savings because they did not have these accounts in the first place.

Comparing between years, there is an increase from 2009 to 2013 in the magnitude of β_1, the relationship between M-PESA and dropping informal savings. However, the coefficients are not statistically different.[4] However, formal savings see a decrease in magnitude of β_3 from 2009 to 2013. These two coefficients are found to be statistically different at a 5% significance level.[5] This regression cannot say whether this difference is due to changes in the user base, structural changes in M-PESA services, or changes in how the same people use M-PESA after having it for longer. Still, it possibly provides further evidence that there is a meaningful difference between 2009 and 2013 users, where the latter category consists of less financially savvy users who are also less likely to have had formal savings in the past.

While M-PESA is often thought of as a substitute for informal savings, this result presents evidence that it might also substitute for formal savings. This could happen if,

[4] A test of the null hypothesis, $\beta_{1,2009} - \beta_{1,2013} = 0$ has a p-value of .1373, so the null hypothesis that the two coefficients are statistically the same cannot be rejected.
[5] A test of the null hypothesis $\beta_{3,2009} - \beta_{3,2013} = 0$ has a p-value of .0197, so the null hypothesis can be rejected.

for example, someone feels that his bank is too difficult to access or untrustworthy, so he would rather save with M-PESA. However, this question needs further research, as this regression cannot rule out the possibility that there is a counteracting complementary relationship that is even stronger and results in M-PESA on balance increasing formal savings. In addition, these results do not say anything about causality. It is not known when these changes happened, so it is possible that some changes happened prior to M-PESA, in which case the changes certainly cannot be attributed to M-PESA. It is also possible some unconsidered effect is driving both M-PESA adoption and savings dropping behavior. Still, it may be reasonable to assume that reported drops are the ones people remember and are thus fairly recent and roughly take place around the time of M-PESA introduction.

5B. Constructing a Savings Formality Index

This next section considers how a person's previously held basket of financial products compares to what they currently have. In the previous section, there was no differentiation between those who drop some kind of formal savings but still have other kinds of formal savings, compared to those who drop formal savings and now don't have any formal savings. So, this section constructs an index that measures current and former savings levels to identify changes in a person's financial inclusiveness. The dependent variable is constructed as follows. A more positive value represents movement towards greater savings formality, while a negative value means someone is trending towards a lower savings formality level.

$$\Delta SavingScore = SavingScore_{current} - SavingScore_{Past}$$

This paper does not take a singular stance on how this index should be constructed and instead employs two methods that are each justified on different grounds. It looks at each respondent's highest level and his or her average level of savings formality. This paper also considers two different but equally plausible assumptions about what products an individual used in the past. The FinAccess surveys do not provide direct information on respondents' past product use, but this logically must be some combination of the products they 1.) currently have 2.) used to have but no longer have ("dropped") . This paper considers both extremes: a.) when *all* of someone's currently held products were also held in the past and b.) when *none* of someone's currently held products were also held in the past. The true percentage of current products that were held pre-MPESA must fall somewhere between these two assumptions. Because this paper is not equipped to definitively choose between the different approaches described here, it explores all of them to establish a range of plausible scenarios. After applying combinations of both methods and both assumptions to the data, patterns that hold true across all four scoring systems are accepted as highly robust.

This paper employs the following three regressions to investigate changes in savings level: the first looks at scores for the dataset overall (with Year as a dummy variable that equals 0 for 2009 data and equals 1 for 2013 data), and the next two look at each of the datasets separately to see how the landscapes differ between the two years. Again, M-PESA user status is the explanatory variable and X represents a set of controls.

$$(3) \quad \Delta SavingsScore_i = \alpha + \beta_1 MPESAUser_i + \beta_2 X_i + Year_i + \varepsilon_i$$

$$(4) \quad \Delta SavingsScore_{i,2009} = \alpha + \beta_1 MPESAUser_{i,2009} + \beta_2 X_{i,2009} + \varepsilon_{i,2009}$$

$$(5) \quad \Delta SavingsScore_{i,2013} = \alpha + \beta_1 MPESAUser_{i,2013} + \beta_2 X_{i,2013} + \varepsilon_{i,2013}$$

A limitation to this approach is the ambiguity relating to just how long a period of time the "past" covers. Note that the "past" does not correspond to any specific year, although "present" is known to correspond to 2009 or 2013 depending on what dataset the respondent belongs to. This analysis is most meaningful if "past" and "present" matched to pre- and post- M-PESA adoption periods (for those who do adopt it). However, it is unknown when products were dropped, and it is possible some of these changes occurred before M-PESA even existed. Then, it would be inappropriate to attribute these changes to M-PESA. Fortunately, it is fairly uncommon for people to report dropping a savings product. A variable measuring the total number of products dropped (which theoretically ranges from 0 to 11, the number of savings products analyzed in this paper) has the following summary statistics: a mean of 0.49 total drops, a standard deviation of 0.88 drops, a min of 0, and a max of 8. Since M-PESA is, for many Kenyans, the largest exogenous shock to their financial behavior in recent memory, mobile money likely relates to many of the drops that people remember to report on the survey. Further, this paper employs a variety of regressions, thereby reducing the likelihood of observing spurious relationships between M-PESA and dropping behavior. Still, it is important to note that these findings do not imply causality, which is an area that should be explored in future research.

Method 1: Maximum Savings Formality

The first scoring method looks at the highest level of formality associated with an individual's savings products. The index is created according the labels in Figure 2. The past score is estimated in two ways: the "lower estimate" assumes that a person's currently used products are all new—none of them were in the past. The "higher

estimate" assumes that a person's currently used products were all also used in the past. For example, if a person has "2" in either $SavingsScore_{current}$ or $SavingsScore_{Past}$ (lower estimate), that person would have also have a 2 in $SavingsScore_{Past}$ (higher Estimate).

Figure 2. Method 1 SavingsScore Label Explanations

$SavingsScore_{current}$		$SavingsScore_{Past}$ (lower estimate)		$SavingsScore_{Past}$ (higher estimate)	
2	Has formal savings	2	Has dropped formal savings	2	Had or currently has formal savings
1	Does not have formal, does have informal savings	1	Has not dropped formal savings, but has dropped informal savings	1	Has never held formal savings. Had or currently has informal savings
0	Does not have any savings	0	Has not dropped any savings	0	Has never held formal or informal savings

Under the **lower-estimated-past assumption** (the middle column in Figure 2), no current products were used in the past. ΔSavingsScore ranges from -2 (someone has no current savings and used to have formal savings, so he has seen a decline in formality) to 2 (someone has formal savings and has not dropped any savings, so he presumably had no savings before).

Under the **higher-estimated-past assumption** (the right-most column in Figure 2), all current products were also used in the past. $SavingsScore_{Past} \geq SavingsScore_{current}$, thus ΔSavingsScore ranges from -2 to 0 (someone has *not* dropped any savings that are more formal than what they currently own, so her past formality presumably equals current formality).

The results of regressions 3-5 using the lower-estimated-past assumption are seen in Table 3. Being an M-PESA user is associated with a SavingScore change that is on average 0.135 points more positive. Although causality cannot be inferred, this shows that M-PESA user status induces movement towards increased formality. Columns 2 and

3 show results of equations 4 and 5, respectively. A test of whether β_1 from the 2009 analysis and β_1 and the 2013 analysis are statistically different reveals that they are different at a 10% significance level. The p-value for the null hypothesis that these coefficients are the same is equal to 0.084. Thus, being an M-PESA user results in a greater formality boost in 2013 as compared to 2009. This is heartening evidence that M-PESA's capacity to promote financial inclusion seems to increase over time. This might be attributable to the M-KESHO and m-Shwari accounts that were introduced between these two years. It is also possible that the integration of 36 banks into the M-PESA networks generally made bank accounts more attractive. Or, this SavingsScore boost might driven by users moving from savings level 0 to savings level 1. This could happen if M-PESA makes it easier for people to transact with informal savings partners, for example by making ROSCA savings groups more attractive by making it easier to transfer money to others.

Table 3. Method 1 OLS Results Using the Lower-Estimated-past Assumption

Dependent Variable=ΔSavingsScore			
	Overall (1)	2009 (2)	2013 (3)
MPESAUser	0.135***	0.0855*	0.176***
	(5.47)	(2.49)	(4.80)
Year	-0.300***		
	(-15.94)		
Gender	0.0789**	0.0994*	0.0646
	(2.72)	(2.10)	(1.66)
Age	-0.00442***	-0.00640***	-0.00261
	(-3.83)	(-3.82)	(-1.54)
Hhold head age	0.00113	0.00143	0.000638
	(0.96)	(0.78)	(0.40)
Hhold head gender	-0.0427	-0.0422	-0.0458
	(-1.41)	(-0.81)	(-1.17)
Education	0.0710***	0.0586***	0.0820***
	(10.45)	(6.22)	(8.33)
Cluster	-0.00501	-0.0107	0.00308
	(-0.24)	(-0.35)	(0.11)
Marital	0.00136	0.00545	-0.000923
	(0.15)	(0.39)	(-0.07)
Expense	0.00000205***	0.00000150**	0.00000328***
	(4.99)	(2.99)	(4.61)
Is Hhold Head	0.0658*	0.0951	0.0473
	(2.22)	(1.82)	(1.27)
OwnMobile	0.106***	0.123***	0.0891*
	(4.36)	(3.91)	(2.32)
Constant	0.409***	0.469***	0.0358
	(5.44)	(4.11)	(0.36)
Number of obs.	10666	5415	5251
R-squared	0.0734	0.0568	0.0675

t statistics in parentheses. * Significant at the 5 percent level, ** Significant at the 1 percent level, *** Significant at the 0.1 percent level.

Next, Table 4 reports results of the higher-estimated-past assumption. These results fail to show that M-PESA has a statistically significant effect in any of the equations 3-5. This is not surprising, since the lower-estimated-past assumption is expected to overestimate the number of people that exhibit no change from the past to the present. In fact, 87.68% of the sample had a "0" for ΔSavingsScore. These individuals belong to the two groups: 1.) those who do not report dropping any products and 2.) those who report dropping savings product(s) that are of equal or lesser formality to currently held product(s). I then perform equations 3-5 on just this second group, to consider just the people who report some sort of dropping behavior. In other words, they "used to have but no longer have" one or more of the 11 savings products. Columns 4-6 show a statistically significant and positive effect. Conditional on someone being a person who has dropped a savings product, being an M-PESA user leads to a larger movement towards formality, meaning that it is associated with increased financial inclusion. Being an M-PESA User is associated with a formality score change that is 0.075 points and .105 points higher on average, in 2009 and 2013 respectively. The results from Table 4 do not contradict the story from Table 3 that being an M-PESA user boosts formality, and that this boost is greater in 2013 than in 2009. However, caution must be applied in interpreting how much the findings from Table 4 provide support, since the coefficient of interest in columns 1-3 are statistically insignificant.

Table 4. Method 1 OLS Results under the Higher-Estimated-Past Assumption

Dependent Variable = ΔSavingsScore						
	Overall (1)	2009 (2)	2013 (3)	Overall, if dropped in past (4)	2009, if dropped in past (5)	2013, if dropped in past (6)
MPESAUser	-0.00451	-0.00405	-0.00796	0.0962***	0.0750*	0.105*
	(-0.41)	(-0.29)	(-0.44)	(3.38)	(1.98)	(2.48)
Year	-0.0568***			-0.0971***		
	(-6.71)			(-4.43)		
Age	-0.00377***	-0.00447***	-0.00292***	-0.00466***	-0.00541**	-0.00373
Other Controls	varies	varies	varies	varies	varies	varies
Constant	-0.101*	-0.0829	-0.167**	-0.725***	-0.733***	-0.788***
	(-2.53)	(-1.57)	(-2.76)	(-6.83)	(-4.58)	(-5.48)
N	10666	5415	5251	3543	1574	1969
R-squared	0.0192	0.0296	0.0073	0.0461	0.0646	0.0374

t statistics in parentheses. * Significant at the 5 percent level, ** Significant at the 1 percent level, *** Significant at the 0.1 percent level. Other than age, no other controls were consistently significant across the regressions

Method 2: Average Savings Formality

This second approach to constructing a savings formality score looks at the "average" formality level for a person's basket of savings products. This differs from Method 1 because here, someone who has a formal savings product is given a different score depending on whether or not they also have informal savings. Again, the "lower estimate" assumes that the products a person held in the "past" exactly equals the products she reports dropping. The "higher estimate" assumes that a person previously held both the "dropped" products and the "currently held" products.

Figure 3. Method 2 Savings Score Label Explanations

$SavingsScore_{current}$		$SavingsScore_{Past}$ (lower estimate)		$SavingsScore_{Past}$ (higher estimate)	
2	Has formal savings only	2	Has dropped formal savings only	2	Had or currently has formal savings but has never had informal savings
1.5	Has formal and informal savings	1.5	Has dropped formal and informal savings	1.5	Has had experience with formal and informal savings
1	Has only incurformal savings	1	Has dropped informal savings only	1	Has never held formal savings. Had or currently has informal savings
0	Does not have any savings	0	Has not dropped any savings	0	Has never held formal or informal savings

As explained previously in the Method 1 section, the **lower-estimated-past assumption** creates a greater range of possible ΔSavingsScore values, here ranging from -2 to 2. Under the **higher-estimated-past assumption,** ΔSavingsScore can range from -2 (currently has no savings but previously had formal savings) to 0.5 (currently uses only formal savings but previously had both formal and informal savings).

The results of regressions 3-5 under the lower-estimated-past assumption for Method 2 are shown in Table 5. Several patterns are reminiscent of Table 3. The coefficient in column (1) again indicates that being an M-PESA user is associated with a more positive boost in ΔSavingsScore. When considering the 2009 and 2013 years separately, the effect is again more pronounced for 2013 than for 2009, and is actually not statistically significant at all in 2009. When testing the null hypothesis that β_1 in 2009 is equal to β_1 in 2013, we are able to reject this possibility at a 5% significance level. This indicates a fundamental shift in the way M-PESA relates to savings behavior between the

two years. This shift is of an optimistic nature, whereby M-PESA promotes formality to a greater extent in 2013 than in 2009.

Table 5. Method 2 OLS Results Under the Lower-Estimated-Past Assumption

Dependent Variable=ΔSavingsScore			
	Overall	2009	2013
	(1)	(2)	(3)
AMPESAUser	0.0727**	0.00714	0.117***
	(3.24)	(0.23)	(3.48)
Year	-0.320***		
	(-18.71)		
Gender	0.0657*	0.0763	0.0552
	(2.49)	(1.80)	(1.55)
Age	-0.00470***	-0.00691***	-0.00239
	(-4.48)	(-4.60)	(-1.54)
Hhold head age	0.00117	0.00124	0.000566
	(1.10)	(0.75)	(0.39)
Hhold head gender	-0.0418	-0.0417	-0.0428
	(-1.52)	(-0.89)	(-1.20)
Education	0.0474***	0.0287***	0.0666***
	(7.70)	(3.39)	(7.40)
Cluster	-0.0175	-0.0232	-0.00800
	(-0.93)	(-0.84)	(-0.31)
Marital	-0.00255	-0.000596	-0.00186
	(-0.31)	(-0.05)	(-0.16)
Expense	0.00000141***	0.00000116*	0.00000216***
	(3.79)	(2.57)	(3.32)
Is hhold head	0.0612*	0.0741	0.0552
	(2.27)	(1.58)	(1.63)
OwnMobile	0.0834***	0.0799**	0.0955**
	(3.77)	(2.82)	(2.72)
Constant	0.494***	0.639***	0.0169
	(7.24)	(6.24)	(0.18)
N	10666	5415	5251
R-squared	0.0615	0.0322	0.0504

t statistics in parentheses. * Significant at the 5 % level, ** Significant at the 1 % level, *** Significant at the 0.1 % level.

The same regressions are then run again under the higher-estimated-past assumption, with findings expressed in Table 6. As was true in Table 4, the coefficient on the M-PESA user variable in columns 1-3 fail to show significance. However, 85.39% of the sample (10,623 respondents) have a ΔSavingsScore of 0 by this measure. The higher-estimated-past assumption is constructed to overestimate the number of people who exhibit no change. Next, if the sample is restricted to only the individuals who report some sort of dropping behavior, columns 4-6 corroborate previous findings. Looking at this subpopulation, there is again a statistically significant positive effect of being an M-PESA user. This effect is stronger in 2013 in 2009, however a test of the statistical difference between the two coefficients does not allow us to reject the null hypothesis that these coefficients are the same. Although columns 4-6 prove to be an interesting exercise, its findings cannot be generalized, since they were performed on a group with particular savings characteristics.

Table 6. Method 2 OLS Regressions under the Higher-Estimated-Past Assumption

Dependent Variable=ΔSavingsScore						
	Overall	2009	2013	Overall, if dropped in past	2009, if dropped in past	2013, if dropped in past
	(1)	(2)	(3)	(4)	(5)	(6)
MPESAUser	0.0134	0.0120	0.0140	0.115***	0.0796*	0.142***
	(1.38)	(1.08)	(0.85)	(4.39)	(2.46)	(3.48)
Year	-0.0673***			-0.146***		
	(-9.08)			(-7.25)		
Other Controls	varies	varies	varies	varies	varies	varies
Constant	-0.0561	-0.0289	-0.144**	-0.579***	-0.471***	-0.787***
	(-1.90)	(-0.78)	(-3.19)	(-6.88)	(-3.88)	(-6.85)
N	10666	5415	5251	3543	1574	1969
R-squared	0.0171	0.0214	0.0068	0.0617	0.0707	0.0534

t statistics in parentheses. * Significant at the 5 % level, ** Significant at the 1 % level, *** Significant at the 0.1 % level.

Discussion of Section 5B

Taken together, Tables 3-6 provide consistent evidence of a positive relationship between M-PESA and changes in savings formality. A cautious interpretation of Tables 4 and 6 would say that these do not contribute evidence but would still grant that they do not contradict the story from Tables 3 and 5. Considering the wide range of possibilities spanned by the different assumptions behind these four Tables, this consistency is notable.

M-PESA is often touted as "banking the unbanked," but this claim has not previously been subject to much statistical analysis. This paper provides evidence that M-PESA does indeed promote savings formality. This is likely a combination of reducing barriers to access and increasing incentives to use savings products. On one hand, M-PESA connects people to products they otherwise would not have been able to access, by decreasing geographic constraints and transaction costs. At the same time, M-PESA may also cause dispositional changes, whereby a person who has previously had little experience with financial products now thinks more deliberately about his finances.

In addition, a consistent story emerges regarding how the M-PESA landscape has changed from 2009 to 2013. The finding that M-PESA promotes savings formality to a greater extent in 2013 suggests that Safaricom's efforts to increase product offerings and quality of service have made M-PESA into an increasingly useful innovation. Since one of the most-celebrated aspects of M-PESA is its ability to integrate people into the formal financial sector, thereby increasing their livelihoods and possibly even contributing to economic growth, it is imperative for research on M-PESA take into account how the system changes over time, using the most recent data possible. The analyses here cannot

distinguish between M-PESA-related changes and user-related changes, and it is possible that the latter also contributes to boosts in savings formality. Perhaps people who have had M-PESA for longer are more likely to move towards formal savings, after gradually gaining comfort with M-PESA.

The question of how a changing user base might be impacting savings formality is a complex one. Both theory and evidence suggest that those who adopt technologies later are less privileged. One question in the 2013 survey identifies users who have adopted M-PESA in the past 12 months. This group is less well-off than their counterparts in the survey who adopted M-PESA earlier on, and Figure 4 shows a small sample of the many characteristics that follow this pattern. For example, the late adopters are less wealthy, less financially included, less educated, and less likely to be household heads. Similarly, the average 2013 M-PESA user is less wealthy, less financially included, and less educated than the average 2009 user.

Figure 4. Characteristics of M-PESA users

	2013 Users who Adopted in Past 12 Months (N=141)	2013 Users who Adopted Earlier (N=3328)	2013 Users Overall (N=3469)	2009 Users Overall (N=1824)
Mean Monthly Expenditures	8493.475	12028.26	11884.59	15011.03
Savings formality level (coded on a 0-4 scale, where 1 is rudimentary products, 2 is informal, 3 is semi-formal, and 4 is formal), based on someone's most formal product	1.55	2.16	2.13	2.86
Percentage of people who are banked	19.86%	36.03%	35.37%	55.98%
Education level (1-7 scale)	3.482	3.71	3.70	4.34
Percentage who are heads of households	39.01%	53.61%	53.0%	51.86%

The congruency of the above statistics suggests that the 2013 users are also less privileged in a number of ways that are not captured in this survey. The finding that M-PESA boosts savings formality in 2013 more than it does in 2009 is especially meaningful in light of the fact that 2013 users are less privileged. In one sense, it is surprising since the less well-off generally have a lowered capacity and willingness to access new opportunities and thus increase formalization. This suggests that M-PESA's effectiveness in 2013 is even more impressive than might be captured in this analysis. On the other hand, it might be the case that it was easier for the less-privileged to increase their formalization because they had a greater need to do so. Finally, there is the user-based explanation that the increased formalization boost in 2013 is driven by the fact that people have had the product for longer, and perhaps the same person's usage habits evolves over time towards a preference for formality.

5C. Perverse Effects of Bank Accessibility

Although counterintuitive, increasing access to the formal financial sector has been shown to result in lowered usage of these services in particular cases.[6] This is because people in developing countries feel particularly large pressures from family and friends to use their personal funds to support them. As M-PESA and banks became increasingly integrated, formal savings accounts have become more liquid. After all, it is now common for banks in Kenya to allow for money in someone's bank account to be converted to and from M-PESA's e-currency. The final empirical section of this paper looks at the degree to which individuals feel pressure from friends and families in light of

[6] Baland et al (2011) show that people will incur costs to signal to avoid requests for help from family members. Jakiela and Ozier (2012) find that women in Western Kenya place value in hiding income from relatives. Platteau (2000) identifies social norms that dictate people help friend and families when they have available funds.

the fact that mobile banking makes it harder to refuse requests for help. This is expected to play out differently in 2009 as compared to 2013 in regards to formal savings, since M-PESA was not structurally equipped to directly withdraw from banks in 2009. The following regressions are used:

(6) $$DropInformalSavings_{it} = \alpha + \beta_1 MPESAUser_{it} + \beta_2 SupportExpensePortion_{it} + \beta_3 MPESAUser_{it} \times SupportExpensePortion_{it} + \beta_4 X_{it} + \varepsilon_{it}$$

(6) $$DropFormalSavings_{it} = \alpha + \beta_1 MPESAUser_{it} + \beta_2 SupportExpensePortion_{it} + \beta_3 MPESAUser_{it} \times SupportExpensePortion_{it} + \beta_4 X_{it} + \varepsilon_{it}$$

The variables correspond to an individual *i* from year *t*. The dependent variables are binary, equaling 1 if that person has exhibited a drop in at least one product in that savings group. MPESAUser is again a dummy that equals 1 if someone is a registered user, and X represents the same set of controls as has been used throughout the paper. SupportExpensePortion is a continuous variable equaling the amount a person spends on supporting other family members each month, divided by a measure of total monthly expenditures. It is used here as a proxy for social pressure to support others. β_3 is the coefficient of greatest interest, since this interaction term describes the behavior of someone who has M-PESA and faces greater social pressure.

Table 7. OLS Results for the Impact of Social Pressure and M-PESA Use

	2009 Drop Informal Savings (1)	2013 Drop Informal Savings (2)	2009 Drop Formal Savings (3)	2013 Drop Formal Savings (4)
MPESAUser	0.0500**	0.0751***	0.0782***	0.0169
	(2.75)	(3.60)	(5.54)	(1.30)
SupportExpensePortion	0.00873	0.162*	0.0187	0.00637
	(0.21)	(2.46)	(0.59)	(0.16)
MPESAUser X SupportExpensePortion	-0.0878	-0.0612	-0.0757	0.114*
	(-0.94)	(-0.71)	(-1.05)	(2.12)
Gender	0.0215	0.0177	-0.0396*	-0.0254
	(0.94)	(0.84)	(-2.22)	(-1.94)
Age	0.00331***	0.00222*	0.00355***	0.00206***
	(4.01)	(2.43)	(5.53)	(3.61)
Hhold head age	-0.00146	-0.000923	0.000380	-0.000333
	(-1.62)	(-1.08)	(0.54)	(-0.62)
Hhold head gender	0.0123	0.0265	-0.00344	0.00209
	(0.48)	(1.27)	(-0.17)	(0.16)
Education	0.0204***	0.00849	0.0212***	0.0140***
	(4.54)	(1.61)	(6.07)	(4.25)
Cluster	0.0307*	0.0177	0.0128	0.0260**
	(2.09)	(1.17)	(1.12)	(2.76)
Marital	0.0146*	0.000348	0.00814	0.0112**
	(2.19)	(0.05)	(1.58)	(2.64)
Expense	-0.000000454	0.000000371	0.000000344	0.000000738**
	(-1.92)	(1.00)	(1.87)	(3.19)
Is hhold head	0.0105	-0.0108	0.0159	0.0172
	(0.41)	(-0.54)	(0.81)	(1.37)
OwnsMobile	0.00721	-0.0139	0.0422***	0.0223
	(0.48)	(-0.68)	(3.62)	(1.74)
Constant	-0.0715	0.136*	-0.137**	-0.0948**
	(-1.30)	(2.42)	(-3.20)	(-2.71)
N	5188	4886	5188	4886
R-squared	0.0206	0.0116	0.0817	0.0400

t statistics in parentheses. * Significant at the 5 % level, ** Significant at the 1 % level, *** Significant at the 0.1 % level.

The coefficient on the interaction term is only significant for the dependent variable of dropping formal savings in the 2013 dataset. This implies that being an M-PESA user and facing greater social pressure results in an increased likelihood of dropping a formal savings device, above the effect of simply having M-PESA or simply facing greater social pressure. This coefficient increases substantially, from -0.0757 in 2009, to 0.114 to 2013, reflecting the fact that M-PESA has much greater structural connectivity with banks in 2013 than in 2009. The fact that this interaction term is not significant in either year for the dependent variable of dropping informal savings might reflect the fact that M-PESA does not alter the accessibility of informal savings funds in any clear direction. For example, M-PESA might make someone with strong family pressures less likely to use a secret hiding place as a savings device because family members can access it. In this case M-PESA makes people more likely to drop this kind of informal savings. Or, maybe M-PESA lets someone join a Merry-go-round savings group they didn't have access to before. It might be harder for family members to tap into someone's funds when they are committed in this way, so an M-PESA user who faces social pressure might in this case be more likely to pick up this kind of informal savings.

As an additional test of the theory that M-PESA may induce movements away from formal savings for people who face particularly high social pressures, I apply the previously developed savings score indices. This serves as robustness check to show that the previous result is unlikely to be a spurious finding. This asks whether other measures of formality also tell a story that is consistent with the idea that M-PESA moves *certain* people *away* from formality to a greater degree in 2013 than in 2009. The equation has the same right hand side equations (6) and (7), but the dependent variable is

ΔSavingsScore, as defined in all of the four methods outlined in section B. The results for the coefficients of interest are displayed in Table 8. The coefficient on the interaction term is positively significant in 2009 using all four methods, meaning that someone who is an M-PESA user and faces high social pressure still sees a movement towards formality. However, this is no longer the case in 2013, where the coefficients are much smaller and oftentimes even negative. Although this negative relationship is not statistically significant, it is notable that all four methods affirm the idea that there is a shift between the two years. This can be taken as evidence that M-PESA users who faced high social pressures previously were still more likely to move towards formality in 2009. Perhaps, for example, because M-PESA was a more secure savings device than a secret hiding place. This was no longer the case in 2013, when M-PESA also exerts downward pressures on formality due to the decreased attractiveness of savings accounts.

Table 8. Social Pressure and M-PESA Use, As Measured Using Savings Scores

	2009, Method 1a	2013, Method 1a	2009, Method 1b	2013, Method 1b	2009, Method 2a	2013, Method 2b	2009, Method 2b	2013, Method 2b
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MPESAUser	0.0485	0.189**	-0.0168	0.00343	-0.0241	0.126**	0.00244	0.0198
	(1.25)	(4.58)	(-1.07)	(0.17)	(-0.69)	(3.34)	(0.19)	(1.08)
Support Expense Portion	-0.0574	-0.150	-0.0465	-0.0717	-0.0569	-0.167	-0.0394	-0.0890+
	(-0.66)	(-1.15)	(-1.32)	(-1.14)	(-0.73)	(-1.41)	(-1.40)	(-1.54)
AMPESAUserX SupportExpense Portion	0.389++	-0.215	0.134++	-0.0481	0.328++	-0.145	0.101+	0.00105
	(1.95)	(-1.27)	(1.67)	(-0.58)	(1.83)	(-0.93)	(1.58)	(0.01)

The "a" (as in in "method 1a") refers to the lower-estimated-past assumption, and "b" refers to the higher-estimated past assumption. T statistics are in parenthesis. + is significant at a 15% level, ++ is significant at a 10% level, * is significant at a 5% level, and ** is significant at a 1% level

6. Conclusion

Despite the attention and celebration that M-PESA has already received for increasing financial inclusion, this paper suggests that the best may be yet to come. This paper shows, using the most recent dataset on this topic to my knowledge, that M-PESA in 2013 differed in meaningful ways from the system that existed in 2009. There exists substantial differences between how M-PESA substitutes with other savings products, how it encourages individuals to alter the suite of savings products that they use, and how it causes people to respond to social pressures.

Future research on M-PESA must remember the ways in which this system is rapidly changing, keeping in mind that innovations in the M-PESA service may very well translate to large-scale shifts in the nature of the system. Data of an experimental and panel nature should investigate some of the potential reasons behind the shift that seems to have occurred between 2009 and 2013. It would be tremendous useful to disentangle the effects of changing user characteristics from the effects of a change in the actual M-PESA system.

This paper focuses a great deal on substitutive effects, and future research should investigate more directly the complementary relationship that M-PESA holds with other financial products. Doing so would shed light on the question of whether, on net, M-PESA has a more complementary or substitutive effect on various products. Although this paper does not investigate the impact of M-PESA on the credit and loans behavior of individuals, this is an area of potentially large movement. As M-PESA connects people to an increasingly diverse and sophisticated set of financial instruments, the need for research to keep pace with the system's innovation will be even more critical.

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