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Citation: Jack, William, Adam Ray, and Tavneet Suri. "Transaction Networks: Evidence from Mobile Money in Kenya." *American Economic Review* 103, no. 3 (May 2013): 356–361. © 2013 The American Economic Association

As Published: <http://dx.doi.org/10.1257/aer.103.3.356>

Publisher: American Economic Association

Persistent URL: <http://hdl.handle.net/1721.1/88135>

Version: Final published version: final published article, as it appeared in a journal, conference proceedings, or other formally published context

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MONEY MANAGEMENT BY HOUSEHOLDS AND FIRMS IN KENYA[‡]

Transaction Networks: Evidence from Mobile Money in Kenya[†]

By WILLIAM JACK, ADAM RAY, AND TAVNEET SURI*

There is strong evidence that monetary transfers within networks of family members and friends are central to household risk sharing strategies and potentially to informal credit systems as well. In recent years, mobile money services that allow individuals to transfer purchasing power via short messaging service (SMS) have captured the attention of researchers, in part because they have the potential to revolutionize such transfers in developing countries where financial infrastructure and services are broadly lacking. The growth in these services in parts of the developing world has been remarkable, especially in Kenya, where at least 70 percent of households now have access to M-PESA, the country's largest mobile money product, only five years after its launch.¹ Transferring mobile money credits is convenient and cheap,² and high levels of liquidity are

provided by an infrastructure of roughly 35,000 “agents”—shopkeepers, gas stations, banks, and other institutions—who exchange credits for cash.³ Mobile money can be used to buy goods and pay bills, but the vast majority of transactions are within personal networks of family members and friends.

Jack and Suri (forthcoming) and Jack, Stoker, and Suri (2012) extend the previous literature on risk sharing (see Fafchamps and Lund 2003; De Weerd and Dercon 2006) to include mobile money transfers. They find that, by reducing the transaction costs of financial transfers, access to mobile money helped households smooth consumption in the face of shocks.

Fafchamps and Lund (2003) acknowledge that in-network transactions can be either altruistic or an extension of informal credit. They find that these personal transactions are, in fact, not gifts, but instead mostly informal zero interest loans. In the context of mobile technology, Blumenstock, Eagle, and Fafchamps (2011) attempt to identify the motives behind transfers of prepaid cell phone “airtime,” a precursor to the credits we study in this paper. They exploit transactional data before and after an earthquake in Rwanda and find suggestive evidence that reciprocity, rather than altruism, was the dominant characteristic of transfers to individuals affected by the earthquake.

In this paper we leverage unique household-level panel survey data collected in Kenya, and used previously in Jack and Suri (forthcoming), to investigate the characteristics of interpersonal transactions more closely. We first document the impact of M-PESA on the volume of

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[†]To view additional materials, and author disclosure statement(s), visit the article page at <http://dx.doi.org/10.1257/aer.103.3.356>.

¹For more extensive introductions to M-PESA and its remarkable growth, see Mas and Morawczynski (2009) and Morawczynski and Pickens (2009), among others.

²Mbiti and Weil (forthcoming) document the low cost of M-PESA compared with other means of sending internal remittances in Kenya.

³For comparison, there are about 1,000 bank branches in Kenya.

internal remittances, and then show that such transactions are more likely to be reciprocal for M-PESA users. That is, two-way flows are more likely to be observed for households with an M-PESA user, even though the volume of all types of transfers increases. Indeed, households with access to mobile money report relatively more credit and emergency-related transfers than nonusers, suggesting that both explicit credit and informal insurance arrangements can be more effectively sustained.

We hypothesize that the shift to reciprocal transactions could signal an important efficiency gain associated with mobile money. As well as reaching *geographically more distant* network members (with potentially uncorrelated risks), households with M-PESA might now reach network members who are *socially closer*, in the sense that they have more to lose from renegeing on informal credit and insurance commitments. We find that transactions of households with access to M-PESA travel about 100 km further than those of nonuser households. On the other hand, we lack good information on social proximity, so cannot comment on whether newly active network members are more trustworthy or have more to lose by deviating from cooperative behavior.

I. Data

Our analysis is based on panel survey data collected in Kenya between September 2008 and December 2009. The first round of surveys, collected in fall 2008, included 3,000 households randomly selected from geographic areas covering 92 percent of the national population.⁴ Areas of the country with high numbers of M-PESA agents were oversampled in order to increase the chances of drawing households with at least one M-PESA user (we use sampling weights to account for this). Given the explosive growth of M-PESA, it was not nearly as difficult as expected to survey users: on a weighted basis, 43 percent and 69 percent of surveyed households had at least one M-PESA user in the first and second survey periods, respectively. The second survey was administered in December 2009 and included 2,018 of the original 3,000

households (attrition was substantial).⁵ In this paper, we use the balanced panel of 2,018 households. We do not use later rounds of surveys as they did not collect as detailed information on the types of transactions we study in this paper.

The two rounds of surveys we use in this paper contained sections on remittances sent and received at the household level. Among other things, these sections included questions about the item transferred (cash, food, mobile money balances, airtime, or other), the means of and reason for the transfer (as perceived by the interviewee), information about the counterparty, and information on the purpose (if any) of the transaction. Our survey data also includes the location of and distance to the counterparty as estimated by the interviewee.

In addition to the household surveys, we make use of data from interviews of approximately 7,700 M-PESA agents across Kenya, collected in spring 2010 by Jack and Suri. This “agent survey” covered the then-entire population of M-PESA agents in each of the administrative locations from which households in the household survey were drawn and includes agent GPS locations and information about when each agent began serving M-PESA customers.⁶

II. Estimation Strategy

Our empirical analysis is divided into two stages. In the first section, we confirm that M-PESA does in fact affect the volume, number, amounts, distance traveled, and reciprocity of transactions within personal networks. We then test whether M-PESA users make different kinds of transactions compared with nonusers. In particular, we examine the extent to which M-PESA users extend or repay credit, and make or receive insurance-type transfers for emergency purposes, compared with nonusers.

In all of our analysis, we report simple OLS results using a dummy for M-PESA user status on the right-hand side, plus a set of controls. We recognize, of course, that user status is correlated with unobservables that could influence the

⁴ The northern and northeastern regions of the country were excluded from the sample because they are sparsely populated, and because they had limited cell phone coverage and few M-PESA agents at the time.

⁵ See Jack and Suri (forthcoming) for an extensive discussion of attrition.

⁶ For a more comprehensive description of the household survey sampling methodology and survey instrument, as well as the agent survey, see Jack and Suri (forthcoming).

dependent variable. So, in the spirit of Jack and Suri (forthcoming), we show results from reduced-forms specifications using proximity to an M-PESA agent as a proxy for access to the service. A more complete discussion of endogeneity and identification issues can be found in Jack and Suri (forthcoming).

A. Level of Transaction Activity

We restrict our analysis to transfers of currency or M-PESA “e-float” credits and study a range of outcome variables including dummies for sending and receiving transactions, the total number of transactions, amounts sent and received, the average distance between counterparties in a transaction, and whether households engaged in reciprocal transactions.

Each of our survey periods covers a six-month transaction history which allows us to observe short-term reciprocation within a survey round (as well as across rounds). The reciprocity variable is constructed as a dummy for whether a household engaged in any transaction in the last six months that saw a reciprocal (reverse) transaction from the same counterparty (e.g., spouse, parent, child, other relative, or friend in a given location) in that six-month period.⁷ On average, in our data about 21 percent of transactions are reciprocal in nature.

For the first part of the empirical work, we therefore estimate β in several equations of the following form:

$$(1) \quad y_{ijt} = \alpha + \beta User_{ijt} + \gamma X_{ijt} + \phi_j + \theta_t + \varepsilon_{ijt},$$

where y_{ijt} is the outcome variable of interest for household i in district (location) j and survey round t , $User_{ijt}$ is an indicator equal to one if a household had at least one M-PESA user in survey round t , and X is a vector of controls including household demographics and gender of the household head. ϕ_j and θ_t are location and survey round (time) dummies, respectively. As a robustness check, we also estimate β using a reduced-form version of equation (1), in which $User_{ijt}$ is replaced with $Agent_{ijt}$, where $Agent_{ijt}$

is a dummy variable for whether a household is further than the median distance away from the closest M-PESA agent (the results are virtually identical if we use the distance to the closest agent, but the coefficient on the dummy variable is easier to interpret).

B. Transaction Types

Next, we estimate the impact of M-PESA on the types of transactions that are conducted. Respondents were asked to report if a remittance was (i) an extension of credit, (ii) a repayment of debt, (iii) support for emergency needs, (iv) a form of regular support, or (v) for no particular reason.

As mentioned above, in our data, about 21 percent of transactions are reciprocal. For nonusers of M-PESA, only 11 percent are, and of these, 53 percent are transactions for regular support (though overall only 8 percent of all regular support transactions for nonusers are reciprocal), 13 percent are for emergency help, and 22 percent are transactions for no particular purpose. There are very few credit transactions for nonusers, only about 4 percent. Looking at M-PESA users, about 22 percent of transactions are reciprocal. Of these, 42 percent are regular support (but overall 17 percent of regular support transactions are reciprocal for users), about 14 percent are credit, 11 percent are emergency help, and 19 percent have no particular purpose.

To examine the types of transactions more formally, we use an OLS specification of the following form:

$$(2) \quad m_{ijt} = \alpha + \lambda User_{ijt} + \gamma X_{ijt} + \phi_j + \theta_t + \varepsilon_{ijt},$$

where m_{ijt} is a dummy variable for whether a household conducted a transaction of type m , and $m \in \{\text{regular support, credit, emergency, other}\}$. All other notation is the same as in equation (1). Again, we also report results from the reduced-form specification with $Agent_{ijt}$.

For equation (2) we report results for two different outcome variables. First, we look at whether a household conducts a transaction of a given type. Second, we look at the fraction of all transactions that a household conducts of a given type, conditional on the household's transacting at all (some households in our sample do not conduct any transactions in a given period).

⁷ We have also broadened this definition to be across survey rounds, but it does not change the results much as most of the reciprocal transactions we see in the data occur in the six-month window of a survey round.

TABLE 1—IMPAIRS OF M-PESA ON TRANSACTION FREQUENCY, VOLUME, DISTANCE, AND RECIPROCITY

	Received dummy (1)	Sent dummy (2)	Total number of transactions (3)	Sqrt amt rec'd (KSh) (4)	Sqrt amt sent (KSh) (5)	Mean distance traveled (6)	Reciprocal transactions dummy (7)	Reciprocity, conditional (8)
<i>Panel A. User</i>								
M-PESA user	0.374*** (0.020)	0.343*** (0.020)	2.024*** (0.116)	33.067*** (2.762)	32.642*** (2.484)	105.211*** (13.224)	0.132*** (0.013)	0.118*** (0.019)
Constant	0.196** (0.094)	-0.078 (0.081)	0.974 (0.614)	14.732* (8.931)	6.313 (10.747)	334.177*** (73.517)	-0.049 (0.031)	-0.035 (0.058)
Mean of dep var for nonuser	0.235	0.294	1.183	13.260	18.105	186.729	0.040	0.090
Observations	4,301	4,301	4,301	4,301	4,301	2,749	4,301	2,847
<i>Panel B. Reduced form</i>								
> median distance to an agent	-0.045* (0.025)	-0.108*** (0.026)	-0.286* (0.148)	-4.570* (2.596)	-5.546* (3.084)	-39.210*** (14.268)	-0.036** (0.017)	-0.045* (0.026)
Constant	0.261*** (0.099)	0.048 (0.093)	1.367** (0.680)	21.073** (9.797)	13.592 (11.331)	404.829*** (78.946)	-0.006 (0.032)	0.041 (0.058)
Observations	4,301	4,301	4,301	4,301	4,301	2,749	4,301	2,847

Notes: The average exchange rate during the survey period was roughly 75 KSh to \$1. All regressions include survey round and location fixed effects.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

III. Results

A. Level of Transaction Activity

The results presented in panel A of Table 1 indicate that households with M-PESA users exhibit more remittance activity than those without. Specifically, households with at least one M-PESA user are 37.4 and 34.3 percentage points more likely to receive and send remittances, respectively, within their personal networks than nonuser households (see columns 1 and 2). User households are not only different from nonuser households in terms of their likelihood of transferring, but also in the frequency with which they engage in transfers. We find evidence that within a given survey round user households make approximately two more transactions than nonusers (column 3). User households also send and receive greater amounts in the aggregate. In columns 4 and 5, we show that the square root of amounts sent and received in Kenyan shillings (KSh) by user households is

33.1 and 32.6 higher than nonuser households.⁸ Looking at the average distance traveled by a transaction, we see that for user households this is about 100 km greater (column 6).

Given the fact that reciprocal transfers are more transaction-intensive than nonreciprocal transfers, we examine the impact of M-PESA on reciprocal transfers in columns 7 and 8. In column 7, we find that user households are 13.2 percentage points more likely to engage in at least one short-term reciprocal transfer (within one survey round) than nonuser households. When we restrict our sample to only those households that engaged in financial transfers, the user households were still 11.8 percentage points more likely to engage in reciprocal transfers (column 8).

We confirm the results of panel A through a reduced-form analysis in which we substitute the

⁸ The exchange rate during the survey period was roughly 75 Kenyan shillings per \$1.

TABLE 2—IMPAIRS OF M-PESA ON TRANSACTION TYPES

	Remittance for regular support (1)	Remittance for credit (2)	Remittance for emergency (3)	Fraction for regular support (4)	Fraction for credit (5)	Fraction for emergency (6)
<i>Panel A. User</i>						
M-PESA user	0.242*** (0.020)	0.151*** (0.014)	0.132*** (0.015)	-0.113*** (0.028)	0.047*** (0.014)	0.014 (0.018)
Constant	0.353*** (0.096)	-0.055 (0.048)	-0.067 (0.045)	1.201*** (0.185)	-0.095** (0.038)	-0.073 (0.047)
Mean of dependent variable for nonuser	0.293	0.039	0.073	0.608	0.060	0.112
Observations	4,301	4,301	4,301	2,822	2,822	2,822
<i>Panel B. Reduced form</i>						
> median distance to an agent	-0.067*** (0.026)	-0.032** (0.016)	-0.055*** (0.018)	0.027 (0.028)	-0.017 (0.013)	-0.034* (0.019)
Constant	0.433*** (0.104)	-0.015 (0.050)	-0.005 (0.047)	1.144*** (0.187)	-0.066* (0.039)	-0.034 (0.051)
Observations	4,301	4,301	4,301	2,822	2,822	2,822

Notes: The average exchange rate during the survey period was roughly 75 KSh to \$1. All regressions include survey round and location fixed effects.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

M-PESA user variable with a variable reflecting household-level M-PESA access. While the level of statistical significance declines in our reduced form regressions (panel B), these results are consistent in sign and reinforce all of our main results in panel A. Viewed together, our results in Table 1 present a consistent story that access to M-PESA increases the frequency, intensity, distance traveled, and reciprocity of transfers within personal networks.

B. Transaction Types

In Table 2 we present results on how M-PESA impacts whether and to what extent households use transfers for three specific purposes—the extension or repayment of credit, emergency support (insurance), or regular support. Consistent with our results in Table 1, user households engage in transfers for all three purposes more often than nonuser households (see panel A, columns 1–3). User households are 24.2, 15.1, and 13.2 percentage points more likely to remit for routine support,

credit, and insurance purposes, respectively. All of these effects are strongly significant, and they hold in our reduced-form regressions in panel B of Table 2. We also find that the composition of transfers, in terms their purposes, is different among user and nonuser households. The fraction of all transfers made for regular support is 11.3 percentage points lower for user households (panel A, column 4), implying that on a relative basis, user households are shifting toward transactions with purposes other than regular support. Somewhat reinforcing the result from column 4, in column 5 we find evidence that the fraction of transfers made in connection with credit arrangements is 4.7 percentage points higher among user households (significant at the 1 percent level). While the M-PESA user coefficient is positive for the fraction of transfers made for emergency or insurance purposes, this coefficient is imprecisely estimated (column 6). Although we lose significance on the coefficients of interest, our reduced-form regressions also provide weak evidence of a relative shift away from regular

support and toward credit- and insurance-based transfers among those households with superior access to M-PESA (panel B, columns 4–6).

IV. Final Remarks

The results presented in this paper add to existing evidence that mobile money systems in the developing world have allowed households to integrate more fully into the financial system, even if informally. Transaction activity amongst users of Kenya's remarkably successful M-PESA product is more intense than that of nonusers: they interact financially with personal networks more often and make larger transfers over larger distances. M-PESA users also exhibit a greater degree of reciprocity in their transactions than nonusers. While there are limitations to our data (most notably, there are gaps between the periods for which we have transaction data, and we do not have complete individual-to-individual transaction data), we nevertheless provide new evidence that mobile money is associated with a disproportionately large expansion of credit and insurance-like transactions, consistent with our results on reciprocity.

It is not clear from our data whether the lower transaction costs of mobile money make reciprocity feasible with a given network member, or whether mobile money expands personal networks to include previously inactive members who happen to be more suited to sustainable reciprocal relationships. However, we do know that transfers for M-PESA users are executed over longer distances. Also, we know that those who are brought into the network include both friends (users have about 0.5 more transactions with friends) and relatives outside the immediate family (users have about 0.4 more transactions with other relatives that are not a parent or a child). But whether these newly active members are inherently more trustworthy or otherwise suited to sustaining reciprocal relationships is difficult to tell.

Although it is beyond the scope of this short paper, there remains important research to be

undertaken on the nature and "terms" of reciprocity that accompany mobile money transfers. Without question, mobile money systems have fundamentally altered the extent to which resources can be transferred among households and individuals in places like Kenya. It is no great intellectual leap to assume that in so doing, mobile money has also fundamentally altered the contractual (whether informal or formal) understanding that accompanies resource transfers, and, therefore, the nature of credit and insurance in the developing world.

REFERENCES

- Blumenstock, Joshua, Nathan Eagle, and Marcel Fafchamps.** 2011. "Charity and Reciprocity in Mobile Phone-Based Giving: Evidence in the Aftermath of Earthquakes and Natural Disasters." Unpublished.
- De Weerd, Joachim, and Stefan Dercon.** 2006. "Risk-Sharing Networks and Insurance Against Illness." *Journal of Development Economics* 81 (2): 337–56.
- Fafchamps, Marcel, and Susan Lund.** 2003. "Risk-Sharing Networks in Rural Philippines." *Journal of Development Economics* 71 (2): 261–87.
- Jack, William and Tavneet Suri.** Forthcoming. "Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution." *American Economic Review*.
- Jack, William, Thomas M. Stoker, and Tavneet Suri.** 2012. "Documenting the Birth of a Financial Economy." *Proceedings of the National Academy of Sciences* 109 (26): 10257–62.
- Mbiti, Isaac, and David N. Weil.** Forthcoming. "Mobile Banking: The Impact of M-PESA in Kenya." In *NBER Project Africa Volume*.
- Mas, Ignacio, and Olga Morawczynski.** 2009. "Designing Mobile Money Services: Lessons from M-PESA." *Innovations* 4 (2): 77–92.
- Morawczynski, Olga, and Mark Pickens.** 2009. "Poor People Using Mobile Financial Services: Observations on Customer Usage and Impact from M-PESA." Unpublished.