The Effect of Mobile Money on Borrowing and Saving: Evidence from Tanzania

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Supplemental Information

S1 Institutional Background in Tanzania

In 2008, the Bank of Tanzania issued letters of no objection to the partner banks of Vodacoms M-PESA and Zantels Z-Pesa (Di Castri & Gidvani, 2014), which allowed Vodacom and Zantel to start mobile money services. Following this no objection letter, in the same year, Vodacom Tanzania introduced mobile money services through M-Pesa products and Tigo Mobile and Airtel introduced Tigo Pesa and Airtel Money in 2009, respectively. In 2010, Zantel introduced Ezy Pesa. By 2015, Vodacom had reached a market share of 54 percent with M-Pesa mobile money services followed by Tigo Pesa (29 percent), Airtel Money (13 percent), and Ezy Pesa (4 percent).

Regarding the content of the services of those products, the bilateral connections between mobile network operators and bank payment systems have enabled customers to transfer funds between bank accounts and mobile wallets in both directions. More specifically, mobile money users can save to their bank account in three ways. First, those with a smartphone can use mobile money applications (Tigo Pesa, MPESA, HaloPesa, TTCL Pesa) to send to or save money in bank accounts. Second, those with GSM cellular phones can use Unstructured Supplementary Services Data (USSD), which has the option to send to or save money in bank accounts. Third, mobile money users can visit their nearest mobile money agent to save money to their bank accounts. Similarly, mobile money users can withdraw money from their bank accounts.

Regarding saving, mobile money providers offer safe interest-bearing savings accounts, and these increased the proportion of Tanzanians who saved using mobile financial services by 20 percent from 2011 to 2014. The interest rates of those mobile money operators are generally above the average interest rates provided by banks. A mobile money savings account allows each customer to save up to 3 million TZS or

1,400 USD (World Bank, 2017b).

Regarding borrowing, although borrowing from mobile money operators has become feasible, its size remains small, as we show in the next section. Only 2.5 percent of households borrow from mobile money operators. Among those who borrow from any source, 90 percent borrow from the informal sector. This suggests that the direct effect of the use of mobile money on borrowing from mobile money operators is minor.

S2 Explanation of the Dataset

The FinScope Tanzania 2017 dataset was commissioned by the Financial Sector Deepening Trust in partnership with the Bank of Tanzania, Ministry of Finance and Planning, National Bureau of Statistics, Office of Chief Government Statistician Zanzibar, representatives of providers of financial services, and non-governmental organizations and other private sector players. The survey was conducted by Ipsos Tanzania under the technical advisory of Yakini Development Consulting. The Tanzania Population and Housing Census 2012 was used as a base sampling frame to achieve a representative individual-based sample for the population aged 16 years and older through the application of a three-stage stratified sampling approach.

In the first stage of the three-stage sampling, the enumeration areas were randomly sampled. In the second stage, from the sampled enumeration areas, 10 households were selected at random, and in the third stage, from the list of all adult household members in the sample, one adult household member was randomly selected to be interviewed. In our analysis, we restrict the sample to households where the head of the household was the respondent to the interview.

The education level of the heads of the households is classified into eight categories. The variables representing household income sources are classified into nine categories.

Population density is created using the dataset of the population count of Tanzania for 2015 provided by the Center for International Earth Science Information Network (Center for International Earth Science Information Network - CIESIN - Columbia University, 2016). This dataset is created from the detailed geographical information of the census dataset, and the resolution is 1 km. To calculate population density at each household location, we form a circle with a radius of 5 km and calculate the

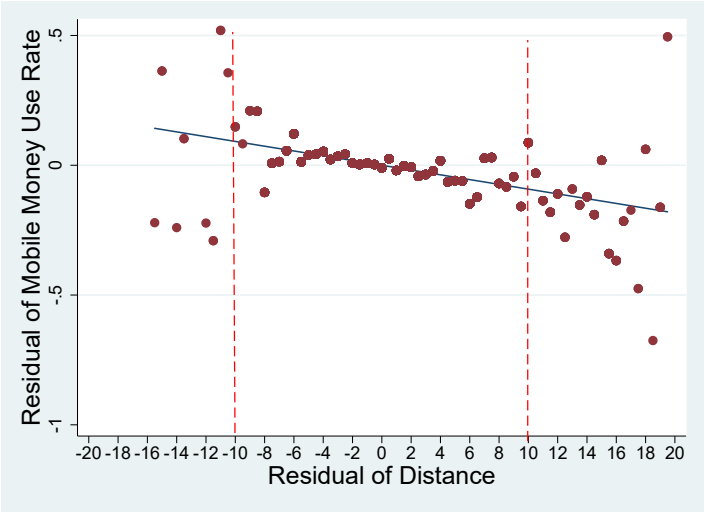
population density of each circle.

We use the night light luminosity data provided by the National Oceanic and Atmospheric Administration's National Geophysical Data Center (NOAA National Geophysical Data Center, 2019) following Henderson et al. (2012). To prevent endogeneity, namely, that mobile money affects economic activity and night light density, we use the night light luminosity data from 2007, the year before mobile money was introduced in Tanzania. The average built-up rate is created using the dataset provided by Wang et al. (2019), which was created using Landsat satellite imagery data. For both the night light luminosity data and the built-up rate data, we form a circle with a 5 km radius at the location of each household and calculate night light luminosity and the built-up rate.

S3 Relationship between the Distance to the Areas with Multiple Mobile Networks and Use of Mobile Money After Controlling for the Effect of the Control Variables

Figure S1 shows the relationship between each household's shortest distance to the areas covered by multiple mobile networks and the mobile money usage rate after controlling for the effect of the control variables. On the horizontal axis, we measure the residual from regressing each household's shortest distance to the areas covered by multiple mobile network accessibility on the control variables. On the vertical axis, we measure the residual from regressing the mobile money usage dummy on those control variables.

Figure S1: Shortest Distance to the Border of Multiple Network Areas and the Use of Mobile Money after Controlling for the Effect of the Covariates



Notes: The horizontal axis is the residual of the regression regressing the distance on all the covariates. The vertical axis is the residual of the regression regressing the mobile use dummy on all the covariates. The size of the bin is 0.5 km. The reference vertical lines are shown at the point where the distance is equal to -10 km or 10 km. The above graph shows that when the distance is within [-10,10], the relationship between the distance and average mobile money use rate is almost on the same line. The estimated coefficient of the slope of the fitted line is -0.011 and the robust standard error is 0.00039. R^2=0.52. For the estimation of the fitted line above, all the observations within [-20,20] are used.

S4 Orthogonality of a Negative Shock to the Distance from the Areas with Multiple Mobile Networks

One natural question from Figure 3 and Panel C of Table 5 is whether a household that is far away from the areas covered by multiple mobile networks experiences different types of negative shocks than a household located inside those areas. To examine whether such a case is plausible, we estimate the effect of the distance from the areas covered by multiple networks on the frequency of negative shocks. If the nature of a negative shock differs by location, its frequency is also likely to be different. For this purpose, in Table 6, we regress the negative shock dummy on the distance from the areas covered by multiple mobile networks with several control variables using OLS. The estimated coefficients are economically and statistically insignificant. This shows that when the distance to the areas covered by multiple mobile networks is 10 km away, the probability of experiencing a negative shock falls only by 2.1 percentage points (P-value=0.3). Thus, the frequency of experiencing a negative shock is similar in households with different locations, suggesting that the criticism that the nature of negative shocks is different at different locations is not justified.

Table S1. Orthogonality of Negative Shocks: The Effect of Distance on Negative Shocks (OLS)

Dependent Variable	Negative Shock Dummy				
	(1)	(2)	(3)	(4)	(5)
Distance from Network Area	0.00174	0.00192	-0.000753	-0.00100	-0.00214
	(0.00195)	(0.00196)	(0.00202)	(0.00204)	(0.00211)
R-squared	0.108	0.109	0.154	0.162	0.163
Control Variables					
Mobile Phone Ownership	Yes	Yes	Yes	Yes	Yes
Population Density & Night Light Luminosity		Yes	Yes	Yes	Yes
Region (31 Regions)			Yes	Yes	Yes
Demographic Characteristics				Yes	Yes
Distance to Financial Institutions					Yes
N	4,127	4,127	4,127	4,127	4,127

Notes: Robust standard error in parentheses. Notes of Table 3 apply.

S5 Robustness Checks

S5.1 Controlling for the District Fixed Effect

In our estimation, we included 30 region dummies in addition to the population density and average night light luminosity of the area in which a household is located. The idea of including population density and average night light luminosity is to control for the difference in the economic activity of areas. One might argue, however, that controlling for the difference in economic activity using the region fixed effect, population density, and average night light luminosity is insufficient.

In this robustness check, we include 170 district dummies to control for the difference in the economic activity of areas. Tables B1–B5 show the first- and second-stage results when we include these district dummies as control variables in addition to the other control variables. The estimated coefficients and their standard errors are similar to those in Section 5. The only difference is that we use Kleibergen–Paap Rank Wald statistics to test the strength of the first stage of the 2SLS estimation. When we include all the control variables and 170 district dummies, the Kleibergen–Paap Rank Wald statistics become 9.1, which is slightly smaller than the threshold value of 10. This is likely due to the inclusion of so many control variables. However, none of the estimated coefficients or standard errors change substantially compared with those with a smaller set of control variables and 170 district dummies. This suggests that even when controlling for the district fixed effect, our results are robust.

Table B1. First-Stage Estimation Results of 2SLS :
Including District Dummies (171 Districts) as Control Variables

Endogenous Variable	Use of Mobile Money Dummy				
	(1)	(2)	(3)	(4)	(5)
Distance from Network Area	-0.0153***	-0.0146***	-0.0112***	-0.00961***	-0.00929***
	(0.00178)	(0.00178)	(0.00219)	(0.00212)	(0.00217)
R-squared	0.226	0.235	0.333	0.384	0.387
Kleibergen-Paap Rank Wald	73.93	67.56	25.92	20.54	18.29
Control Variables					
Mobile Phone Ownership	Yes	Yes	Yes	Yes	Yes
Population Density & Night Light		Yes	Yes	Yes	Yes
Districts (171 Districts)			Yes	Yes	Yes
Demographic Characteristics				Yes	Yes
Distance to Financial Institutions					Yes
N	4,127	4,127	4,127	4,127	4,127

Notes: Robust standard errors in parentheses. Notes in Table 3 apply. *** p<0.01, ** p<0.05, * p<0.1.

Table B2. The Estimation Results of 2SLS

Estimated Coefficients of Mobile Money Use Dummy on Borrowing:

Including District Dummies (171 Districts) as Control Variables

Dependent variable	Borrowing Dummy				
	(1)	(2)	(3)	(4)	(5)
Panel A					
Use of Mobile Money Dummy	-0.167	-0.194	-0.169	-0.172	-0.0865
	(0.138)	(0.146)	(0.230)	(0.263)	(0.276)
R-squared	-0.029	-0.039	-0.028	0.003	0.032
Kleibergen-Paap Rank Wald	73.93	67.56	25.92	20.54	18.29
Panel B					
Use of Mobile Money Dummy	-0.144	-0.167	-0.152	-0.160	-0.112
	(0.133)	(0.140)	(0.222)	(0.255)	(0.272)
Negative shock dummy	0.205***	0.205***	0.201***	0.194***	0.190***
	(0.0186)	(0.0187)	(0.0204)	(0.0200)	(0.0205)
R-squared	0.018	0.010	0.014	0.039	0.055
Kleibergen-Paap Rank Wald	75.08	68.71	26.21	20.66	18.11
Panel C					
Use of Mobile Money Dummy	0.0968	0.0750	0.241	0.216	0.294
	(0.152)	(0.157)	(0.230)	(0.266)	(0.282)
Mobie Money × Negative Shock	-0.469**	-0.471**	-0.643***	-0.613***	-0.627***
	(0.195)	(0.196)	(0.198)	(0.194)	(0.194)
Negative Shock	0.472***	0.473***	0.567***	0.543***	0.547***
	(0.114)	(0.115)	(0.118)	(0.115)	(0.115)
R-squared	-0.049	-0.059	-0.080	-0.048	-0.031
Kleibergen-Paap Rank Wald	25.24	24.35	12.83	10.24	9.107
Control Variables					
Mobile Phone Ownership	Yes	Yes	Yes	Yes	Yes
Population Density & Night Light		Yes	Yes	Yes	Yes
Districts (171 Districts)			Yes	Yes	Yes
Demographic Characteristics				Yes	Yes
Distance to Financial Institutions					Yes
N	4,127	4,127	4,127	4,127	4,127

Notes: Robust standard errors in parentheses. Notes in Table 3 apply. *** p<0.01, ** p<0.05, * p<0.1.

Table B3. The Second Stage Estimation Results of 2SLS
Estimated Coefficients of Mobile Money Use, Negative Shock and Their Interaction
on Receipt of Remittance : Including District Dummies (171 Districts) as Control Variables

Panel A					
Dependent variable	Receipt of Remittance Dummy				
	(1)	(2)	(3)	(4)	(5)
Use of Mobile Money Dummy	0.698***	0.703***	0.744***	0.761***	0.843***
	(0.126)	(0.130)	(0.186)	(0.215)	(0.233)
Mobie Money × Negative Shock	-0.107	-0.104	-0.0328	-0.0565	-0.0579
	(0.160)	(0.160)	(0.165)	(0.163)	(0.168)
Negative Shock	0.0958	0.0943	0.0429	0.0600	0.0557
	(0.0932)	(0.0934)	(0.0979)	(0.0964)	(0.0997)
Control Variables					
Mobile Phone Ownership	Yes	Yes	Yes	Yes	Yes
Population Density & Night Light		Yes	Yes	Yes	Yes
Districts (171 Districts)			Yes	Yes	Yes
Demographic Characteristics				Yes	Yes
Distance to Financial Institutions					Yes
R-squared	0.261	0.260	0.211	0.218	0.188
Kleibergen-Paap Rank Wald	25.24	24.35	12.83	10.24	9.107
N	4,127	4,127	4,127	4,127	4,127

Notes: Robust standard errors in parentheses. Notes of Table 3 apply. *** p<0.01, ** p<0.05, * p<0.1.

Table B4. The Second Stage Estimation Results of 2SLS

Estimated Coefficients of Mobile Money Use Dummy on Varioius Saving Methods

	Dependent variable				
	(1)	(2)	(3)	(4)	(5)
Panel A.					
	Less Liquid Saving				
Use of Mobile Money Dummy	-0.240***	-0.250***	-0.419**	-0.443**	-0.454**
	(0.0866)	(0.0912)	(0.164)	(0.191)	(0.206)
Panel B.					
	Saving in Cash				
Use of Mobile Money Dummy	-0.179	-0.193*	-0.0554	-0.0625	-0.0633
	(0.110)	(0.116)	(0.182)	(0.213)	(0.226)
Panel C.					
	Saving in Mobile Money Account				
Use of Mobile Money Dummy	0.640***	0.623***	0.676***	0.640***	0.592***
	(0.104)	(0.108)	(0.170)	(0.195)	(0.204)
Panel D.					
	Saving in Saving Groups with MM Technology				
Use of Mobile Money Dummy	0.190***	0.196***	0.226***	0.234**	0.229**
	(0.0512)	(0.0537)	(0.0854)	(0.101)	(0.109)
Panel E.					
	Saving in Saving Groups without MM Technology				
Use of Mobile Money Dummy	0.0361	0.0195	0.0450	0.0336	0.141
	(0.0931)	(0.0971)	(0.149)	(0.171)	(0.185)
Panel F.					
	Saving at least in one method				
Use of Mobile Money Dummy	0.365***	0.334**	0.329	0.265	0.213
	(0.130)	(0.135)	(0.212)	(0.243)	(0.260)
Control Variables					
Negative Shock Dummy	Yes	Yes	Yes	Yes	Yes
Mobile Phone Ownership	Yes	Yes	Yes	Yes	Yes
Population Density & Night Light		Yes	Yes	Yes	Yes
Districts (171 Districts)			Yes	Yes	Yes
Demographic Characteristics				Yes	Yes
Distance to Financial Institutions					Yes
Kleibergen-Paap Rank Wald	75.08	68.71	26.21	20.66	18.11
N	4,127	4,127	4,127	4,127	4,127

Notes: Robust standard errors in parentheses. Notes of Table 3 apply. *** p<0.01, ** p<0.05, * p<0.1.

Table B5. The Second Stage Estimation Results of 2SLS

Estimated Coefficients of Mobile Money Use Dummy on Financial Difficulty

Dependent variable	Financial Difficulty to Pay Regular Expenses				
Variable	(1)	(2)	(3)	(4)	(5)
Panel A.					
Use of Mobile Money Dummy	-0.495***	-0.501***	-0.772***	-0.815***	-0.756**
	(0.155)	(0.160)	(0.250)	(0.288)	(0.299)
Mobie Money × No Negative Shock	0.258	0.255	0.331*	0.354*	0.355*
	(0.172)	(0.173)	(0.187)	(0.188)	(0.186)
No Negative Shock	-0.209**	-0.208**	-0.257**	-0.271**	-0.269**
	(0.0998)	(0.100)	(0.111)	(0.112)	(0.110)
Panel B					
Use of Mobile Money Dummy	-0.370***	-0.377***	-0.643***	-0.678***	-0.631**
	(0.120)	(0.126)	(0.219)	(0.258)	(0.273)
Negative Shock Dummy	-0.0622***	-0.0628***	-0.0683***	-0.0694***	-0.0665***
	(0.0167)	(0.0167)	(0.0196)	(0.0197)	(0.0199)
Control Variables					
Mobile Phone Ownership	Yes	Yes	Yes	Yes	Yes
Population Density& Night Light		Yes	Yes	Yes	Yes
Districts (171 Districts)			Yes	Yes	Yes
Demographic Characteristics				Yes	Yes
Distance to Financial Institutions					Yes
N	4,127	4,127	4,127	4,127	4,127

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

S5.2 Endogeneity of Mobile Phone Ownership

In equation (1), we include the mobile phone ownership dummy as a control variable in x_i. Although the inclusion of this dummy follows the literature (Jack & Suri, 2014; Munyegera & Matsumoto, 2016), it could bias the estimate of β_1 because mobile phone ownership is the outcome variable and controlling for it introduces bias when estimating the causal effect (Angrist & Pischke, 2008). To observe how this occurs, assume that mobile phone ownership is a negative function of our instrumental variable, distance to the areas covered by multiple mobile networks, and a positive function of unobserved characteristics z_{1i}. Assume that z_{1i} is a variable such as unobserved income and familiarity with technology, which is positively correlated with financial activity. When the distance decreases, the probability of using mobile money increases. However, it also positively affects the probability of mobile phone ownership. Thus, a decrease in the instrumental variable (distance) while controlling for mobile phone ownership implies that z_{1i} must decrease and that financial behavior decreases because of the fall in z_{1i}. Thus, the 2SLS estimation while controlling for mobile phone ownership (without the instrumental variable of mobile phone ownership) will downward bias the estimate of β_1, even if we were to use the instrumental variable for mobile money use. On the other hand, if we were to exclude mobile phone ownership from the 2SLS estimation as a control variable in x_i, the coefficient of the mobile money use dummy would capture not only the effect of mobile money use but also the effect of mobile phone ownership since the instrumental variable (mobile network coverage dummy) is also correlated with mobile phone ownership.[1] To address this problem, we run the 2SLS estimation without the mobile phone ownership dummy as one of the control variables and examine how the estimated coefficient of the use of mobile money is sensitive to the inclusion of the mobile phone ownership dummy. Column (1) in Tables C1–C5 shows that the estimated coefficient of mobile money use in the 2SLS estimation does not change without the mobile phone ownership dummy. This implies that the bias induced by including the mobile phone ownership dummy is unlikely to be serious.[2]

[1] One way to solve this problem is to find another instrumental variable correlated with mobile phone ownership but not with financial behavior. However, finding another instrument is difficult.

[2] Another possible reason behind the similarity between the 2SLS estimates of β_1 with and without the mobile phone ownership dummy is that z_{1i} is actually negatively correlated with financial behavior. The assumption of a positive correlation between z_{1i} and financial behavior is not testable since we

S5.3 Controlling for Income

In Section 5, we included the negative shock dummy to examine the different effects of the use of mobile money. In that analysis, we did not include income as a control variable for two reasons. First, income is the outcome variable if a household that receives remittances through mobile money invested in productive assets and grew its income. Including the outcome variable would thus cause the same problem as including the mobile phone ownership dummy, as discussed in the above subsection. Second, information on income includes information on the negative shock. Thus, the estimated coefficient of the negative shock dummy while controlling for income would bias the estimated coefficients of the negative shock dummy downward.

On the other hand, one might argue that the instrumental variable is correlated with income, and thus not including income in the control variables might bias our estimates. In this case, the effect of the use of mobile money could include the effect of income, and the estimated coefficient would be upwardly biased.

Column (2) in Tables C1–C5 shows the estimated coefficients when we control for income. We find that controlling for the effect of income does not affect the estimated coefficient. This suggests that the bias caused by excluding income from the control variables is not serious.

S5.4 Controlling for Time Distance to Financial Institutions

In Section 4, we included as a control variable the physical distance to several financial institutions such as commercial banks, community banks, and microfinance institutions. Such time distance depends on the ownership of transportation equipment (e.g., bicycle, motorcycle, and car), which is the outcome variable. A household that receives a substantial amount of remittances might purchase a motorcycle. Owing to this endogeneity, we use the physical distance as a control variable. To examine the sensitivity of our analysis by controlling for the time distance, we re-run the regression

cannot observe z_{1i}. However, we can still check whether the observable variables that affect mobile phone ownership positively are correlated with financial behavior following Altonji et al. (2005). When we regress saving or borrowing and mobile phone ownership on the education of respondents and the wage earner dummy, we find that those variables are positively correlated with both mobile phone ownership and financial behavior (saving and borrowing).

by controlling for the time distance instead of the physical distance. To do so, we include the ownership of transportation equipment interacted with the physical distance as the control variables. Column (3) in Tables C1–C5 show the estimation results when transportation equipment and the interaction term with physical distance are included as control variables. We find that the estimated coefficients and standard errors are similar to those in Section 4.

S5.5 Using Different Subsamples

In Section 5, we used households whose distance to the areas covered by multiple mobile networks is less than or equal to 10 km because of the clear first-stage relationship and relatively large sample of this group. One might ask whether our estimates are sensitive to sample selection. In Column (4) of each table in Section S4.2, we use, as the sample, the households whose distance to the areas covered by multiple mobile networks is less than or equal to 7.5 km. The estimated coefficients and standard errors are similar to those obtained in Section 5. In Column (5), we use, as the sample, the households whose distance to the areas covered by multiple mobile networks is less than or equal to 15 km. Again, our estimated coefficients are similar to those obtained in Section 5. This suggests that as long as we choose the distance to the areas covered by multiple mobile networks as small as possible, the households selected are similar and our estimated coefficients change little.

Table C1. First-Stage Estimation Results of 2SLS

Endogenous Variable	Use of Mobile Money Dummy				
	(1)	(2)	(3)	(4)	(5)
Distance from Network Area	-0.00929***	-0.00900***	-0.00912***	-0.00896***	-0.00885***
	(0.00217)	(0.00185)	(0.00186)	(0.00212)	(0.00158)
R-squared	0.387	0.361	0.356	0.356	0.362
Kleibergen-Paap Rank Wald	18.29	23.62	25.92	17.82	31.41
Specifcation					
Not Control Mobile Phone Ownership	Yes				
Control Income		Yes			
Transportation equipment			Yes		
|Distance| ≤ 7.5km				Yes	
|Distance|≤15km					Yes
N	4,127	4,127	4,127	3,867	4,236

Notes: Robust standard errors in parentheses. Column (1)-(5) use the specificaiotn of column (5) in Table 4 except the specification described above. Column (1) in the above table include all control variables in Table 4 except mobile phone owership dummy. Coloum (2) include all control variable in column (5) of Table 4 and income as control variables. Column (3) in the above table includes the tranportation equipment (bicycle, motorcycle and car) ownership dummy and their interaction with the phyiscial distance to financial instituions in addtion to all control variables used in column (5) of Table 4. Column (4) in the above table uses as the sample the housheolds whose shortest distance to the areas with multiple mobile network areas is less than or equal to 7.5km. Column (5) uses as the sample the households whose shortest distance to the areas with multiple mobile networks is less than or equal to 15 km. *** p<0.01, ** p<0.05, * p<0.1.

Table C2. The Estimation Results of 2SLS

Estimated Coefficients of Mobile Money Use Dummy on Borrowing

Dependent variable	Borrowing Dummy				
	(1)	(2)	(3)	(4)	(5)
Panel A					
Use of Mobile Money Dummy	-0.0865	0.00216	-0.0460	-0.181	0.0138
	(0.276)	(0.246)	(0.245)	(0.290)	(0.214)
R-squared	0.032	0.051	0.040	0.000	0.052
Kleibergen-Paap Rank Wald	18.29	23.62	23.94	17.82	31.41
Panel B					
Use of Mobile Money Dummy	-0.112	-0.0417	-0.0744	-0.213	-0.00508
	(0.272)	(0.245)	(0.202)	(0.289)	(0.212)
Negative shock dummy	0.190***	0.183***	0.186***	0.192***	0.181***
	(0.0205)	(0.0198)	(0.0186)	(0.0218)	(0.0185)
R-squared	0.055	0.071	0.062	0.019	0.077
Kleibergen-Paap Rank Wald	18.11	23.14	33.98	17.58	31.14
Panel C					
Use of Mobile Money Dummy	0.294	0.222	0.170	0.0276	0.224
	(0.282)	(0.254)	(0.251)	(0.306)	(0.237)
Mobie Money × Negative Shock	-0.627***	-0.510***	-0.508***	-0.409*	-0.350**
	(0.194)	(0.188)	(0.191)	(0.240)	(0.162)
Negative Shock	0.547***	0.474***	0.476***	0.422***	0.376***
	(0.115)	(0.111)	(0.113)	(0.139)	(0.0932)
R-squared	-0.031	0.000	-0.015	-0.025	0.049
Kleibergen-Paap Rank Wald	9.107	10.66	10.62	8.683	15.64
Specifications					
Not Control Mobile Phone Ownership	Yes				
Control Income		Yes			
Transportation equipment			Yes		
|Distance| ≤ 7.5km				Yes	
|Distance|≤15km					Yes
N	4,127	4,127	4,127	3,867	4,236

Notes: Robust standard errors in parentheses. This table is the robustness check of column (5) of Table 5 in section 5. Notes in Table C1 apply. *** p<0.01, ** p<0.05, * p<0.1.

Table C3. The Second Stage Estimation Results of 2SLS
stimated Coefficients of Mobile Money Use, Negative Shock and Their Interaction on Receipt of Remittance

Panel A					
Dependent variable	Receipt of Remittance Dummy				
	(1)	(2)	(3)	(4)	(5)
Use of Mobile Money Dummy	0.843***	0.746***	0.744***	0.705***	0.918***
	(0.233)	(0.211)	(0.186)	(0.259)	(0.204)
Mobie Money × Negative Shock	-0.0579	-0.150	-0.0328	0.0645	-0.178
	(0.168)	(0.160)	(0.165)	(0.203)	(0.141)
Negative Shock	0.0557	0.117	0.0429	-0.00503	0.128
	(0.0997)	(0.0944)	(0.0979)	(0.117)	(0.0809)
Control Variables					
Not Control Mobile Phone Ownership	Yes				
Control Income		Yes			
Transportation equipment			Yes		
|Distance| ≤ 7.5km				Yes	
|Distance|≤15km					Yes
R-squared	0.188	0.244	0.244	0.217	0.193
Kleibergen-Paap Rank Wald	9.107	10.66	10.62	8.683	15.64
N	4,127	4,127	4,127	3,867	4,236

Notes: Robust standard errors in parentheses. This table is the robustness check of column (5) of Table 7 in section 5. Notes in Table C1 apply. *** p<0.01, ** p<0.05, * p<0.1.

Table C4. The Second Stage Estimation Results of 2SLS

Estimated Coefficients of Mobile Money Use Dummy on Varioius Saving Methods

	Dependent variable				
	(1)	(2)	(3)	(4)	(5)
Panel A.					
	Less Liquid Saving				
Use of Mobile Money Dummy	-0.454**	-0.359**	-0.396**	-0.377*	-0.315**
	(0.206)	(0.175)	(0.175)	(0.196)	(0.149)
Panel B.					
	Saving in Cash				
Use of Mobile Money Dummy	-0.0633	-0.0145	-0.0475	-0.0130	-0.0937
	(0.226)	(0.207)	(0.204)	(0.240)	(0.180)
Panel C.					
	Saving in Mobile Money Account				
Use of Mobile Money Dummy	0.592***	0.604***	0.618***	0.661***	0.485***
	(0.204)	(0.193)	(0.192)	(0.227)	(0.153)
Panel D.					
	Saving in Saving Groups with MM Technology				
Use of Mobile Money Dummy	0.229**	0.214**	0.220**	0.208*	0.132
	(0.109)	(0.102)	(0.102)	(0.118)	(0.0845)
Panel E.					
	Saving in Saving Groups without MM Technology				
Use of Mobile Money Dummy	0.141	0.0982	0.0792	0.0997	0.184
	(0.185)	(0.173)	(0.171)	(0.197)	(0.145)
Panel F.					
	Saving at least in one method				
Use of Mobile Money Dummy	0.213	0.355	0.326	0.276	0.195
	(0.260)	(0.243)	(0.240)	(0.280)	(0.209)
Control Variables					
Negative Shock Dummy	Yes	Yes	Yes	Yes	Yes
Not Control Mobile Phone Ownership	Yes				
Control Income		Yes			
Transportation equipment			Yes		
|Distance| ≤ 7.5km				Yes	
|Distance|≤15km					Yes
Kleibergen-Paap Rank Wald	75.08	68.71	26.21	18.11	20.66
N	4,127	4,127	4,127	3,867	4,236

Notes: Robust standard errors in parentheses. This table is the robustness check of column (5) of Table 8 in section 5. Notes in Table C1 apply. *** p<0.01, ** p<0.05, * p<0.1.

Table C5. The Second Stage Estimation Results of 2SLS

Estimated Coefficients of Mobile Money Use Dummy on Financial Difficulty

Dependent variable	Financial Difficulty to Pay Regular Expenses				
Variable	(1)	(2)	(3)	(4)	(5)
Panel A.					
Use of Mobile Money Dummy	-0.756**	-0.617**	-0.627**	-0.595**	-0.371*
	(0.299)	(0.266)	(0.266)	(0.288)	(0.202)
Mobie Money × No Negative Shock	0.355*	0.278	0.278	0.373*	0.106
	(0.186)	(0.176)	(0.178)	(0.214)	(0.145)
No Negative Shock	-0.269**	-0.222**	-0.221**	-0.273**	-0.115
	(0.110)	(0.104)	(0.105)	(0.123)	(0.0829)
Panel B					
Use of Mobile Money Dummy	-0.631**	-0.483**	-0.489**	-0.441*	-0.335*
	(0.273)	(0.232)	(0.229)	(0.259)	(0.192)
Negative Shock Dummy	-0.0665***	-0.0631***	-0.0619***	-0.0629***	-0.0554***
	(0.0199)	(0.0186)	(0.0182)	(0.0195)	(0.0167)
Control Variables					
Not Control Mobile Phone Ownership	Yes				
Control Income		Yes			
Transportation equipment			Yes		
|Distance| ≤ 7.5km				Yes	
|Distance|≤15km					Yes
N	4,127	4,127	4,127	3,867	4,236

Notes: Robust standard errors in parentheses. This table is the robustness check of column (5) of Table 9 in section 5. Notes in Table C1 apply. *** p<0.01, ** p<0.05, * p<0.1.

S5.6 Controlling for Social Networks and Community

Recently, several studies have pointed out the importance of social networks when adopting mobile money (Okello Candiya Bongomin et al., 2018; Okello Candiya Bongomin & Munene, 2021). Given such studies, one might have another concern for our estimation results: the shortest distance to the border of the areas covered by multiple mobile networks might be correlated with some of the characteristics of communities. More specifically, communities in which people have a strong tendency to help each other might be correlated with the shortest distance to the border of the areas with multiple mobile networks. If so, our 2SLS estimates measure not only the effect of the use of mobile money but also the effect of such communities. To examine such a possibility, we first construct a variable that measures the degree to which people in communities help each other. Then, we include this constructed index as an additional control variable in the regression.[3] Table D1 in Appendix D shows our 2SLS estimation results when we include the community index as an additional control variable. The estimated coefficient of the interaction term of the use of mobile money and adverse shock dummy changes from 0.50 to 0.49 when we include the community index. Thus, the estimated coefficient of the interaction term of the negative shock and mobile money dummy is virtually the same, even when controlling for the tendency of each community to help its members. Thus, it is improbable that the effect of community characteristics drives our results.

[3]The questionnaire of the FinScope dataset asked for agree/disagree responses to the following three statements: "You have people in the community that you can turn to for help if you need to"; "People in your community have a strong sense of involvement in the community"; and "People in your community rely on each other for support." We count the number of agrees for each respondent and standardize it so that the mean becomes zero and the standard deviation becomes one. We use this standardized value as the control variable.

Table D1. Estimation Results of the 2SLS Estimation

Estimated Coefficients of the Mobile Money Use Dummy on Borrowing by Including Community Mutual Help Index as an Additional Control Variable

Dependent variable	Borrowing Dummy				
	(1)	(2)	(3)	(4)	(5)
Use of mobile money dummy	0.0898	0.0680	0.211	0.184	0.209
	(0.152)	(0.157)	(0.180)	(0.214)	(0.249)
Mobile money × negative shock	-0.455**	-0.457**	-0.488***	-0.477**	-0.487***
	(0.194)	(0.195)	(0.187)	(0.186)	(0.187)
Negative shock	0.465***	0.466***	0.469***	0.458***	0.462***
	(0.114)	(0.115)	(0.110)	(0.109)	(0.111)
Community mutual help	0.0265***	0.0269***	0.0268***	0.0215**	0.0212**
	(0.00857)	(0.00867)	(0.00884)	(0.00836)	(0.00860)
R-squared	-0.043	-0.052	-0.015	0.003	0.006
Kleibergen-Paap Rank Wald	25.63	24.72	21.19	15.53	11.05
Control variables					
Mobile phone ownership	Yes	Yes	Yes	Yes	Yes
Population density and night light		Yes	Yes	Yes	Yes
Region (31 regions)			Yes	Yes	Yes
Demographic characteristics				Yes	Yes
Distance to financial institutions					Yes
N	4,127	4,127	4,127	4,127	4,127

Notes: Robust standard errors in parentheses. Notes in Table 3 apply. Community Mutal Help Index is a variable that measures the degree in which the community in which each respondent reside help each other. This variable is constructed so that the mean of this variable is zero and its standard deviation is one. *** p<0.01, ** p<0.05, * p<0.1.

S5.7 Effect of the Use of Mobile Money on the Payment Method

Although this study focuses on financial behavior, mobile money can affect the payment method used. For example, using a field experiment, Aker et al. (2016) analyze the effect of utilizing mobile money as the payment method of the welfare system on consumption behavior. In Table E1, we examine whether the use of mobile money increases its use as a payment method for a type of good or service. We find that mobile money is increasingly being used as a payment method for food and utilities.

Table E1. Estimation Results of the 2SLS Estimation
Estimated Coefficients of the Use of Mobile Money Dummy on Using Mobile Money as a Payment Method for Different type of Goods and Services

Category	(1) For Food	(2) For School Fee	(3) For Medical Bill	(4) For Rent	(5) For Utility
Mobile money Dummy	0.271*	-0.0156	-0.00441	0.0489	0.270**
	(0.145)	(0.0544)	(0.00450)	(0.0379)	(0.134)
R-squared	0.162	0.011	-0.005	-0.059	0.133
Kleibergen-Paap Rank Wald	24.01	24.01	24.01	24.01	24.01
Control variables					
Mobile phone ownership	Yes	Yes	Yes	Yes	Yes
Population density and night light	Yes	Yes	Yes	Yes	Yes
Region (31 regions)	Yes	Yes	Yes	Yes	Yes
Demographic characteristics	Yes	Yes	Yes	Yes	Yes
Distance to financial institutions	Yes	Yes	Yes	Yes	Yes
N	4,127	4,127	4,127	4,127	4,127

Notes: Robust standard errors in parentheses. Notes in Table 3 apply. For each column, the dependent variable is the use of mobile money as a payment method for the category of goods or services shown under the category raw. For example, in column (1), the depedent variable is the use of mobile money dummy as a payment method for food. *** p<0.01, ** p<0.05, * p<0.1.

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