Mobile money mitigates the negative effects of weather shocks in Bangladesh: A preliminary result

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Self introduction

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  - 2022, Analyst, Mitsubishi UFJ Research & Consulting

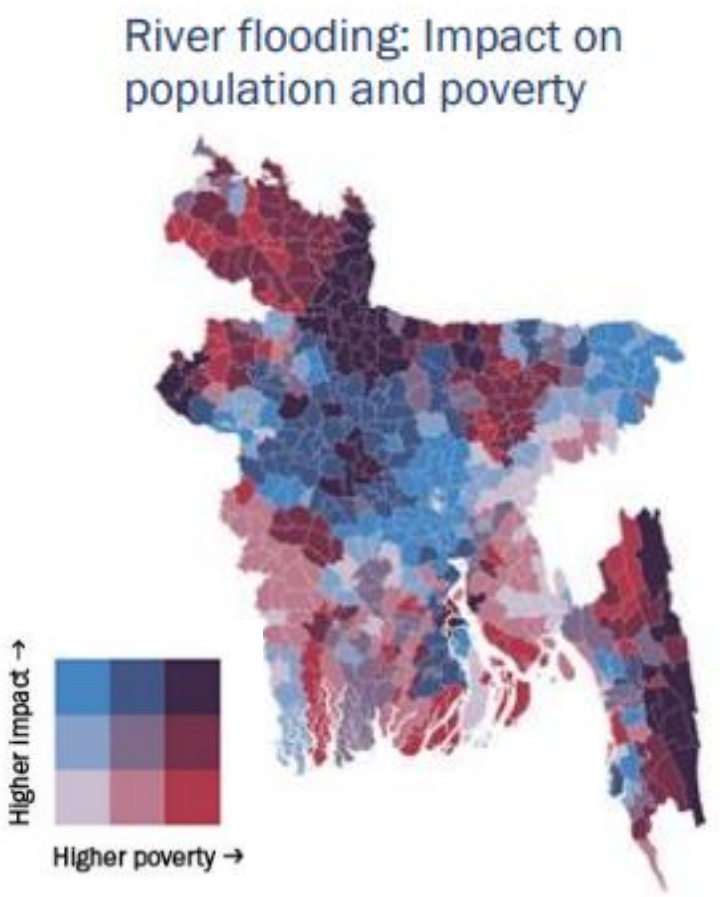
Photo by the author in 2019.

Executive summary

- Negative economic shock: ↓ consumption
- Mobile money (MM) mitigates the negative effects
- Poorer households benefit more from MM
- Heterogeneous mechanism in consumption smoothing

Introduction: weather shocks

- Severe climate events: global climate change
- Smallholder farmers: vulnerable to shocks
  - Farmers in rural and developing economies



Source: World bank (2022)

Bangladesh

- Increasing flood risk (IPCC, 2023)
  - The most vulnerable country (World Bank, 2022)
- 13.13% of GDP: Agriculture (Bangladesh Bureau of Statistics (BBS), 2019)
- 53.82%: farm household among rural households (BBS, 2019)
- 84.42%: smallholder households among farm households (BBS, 2019)

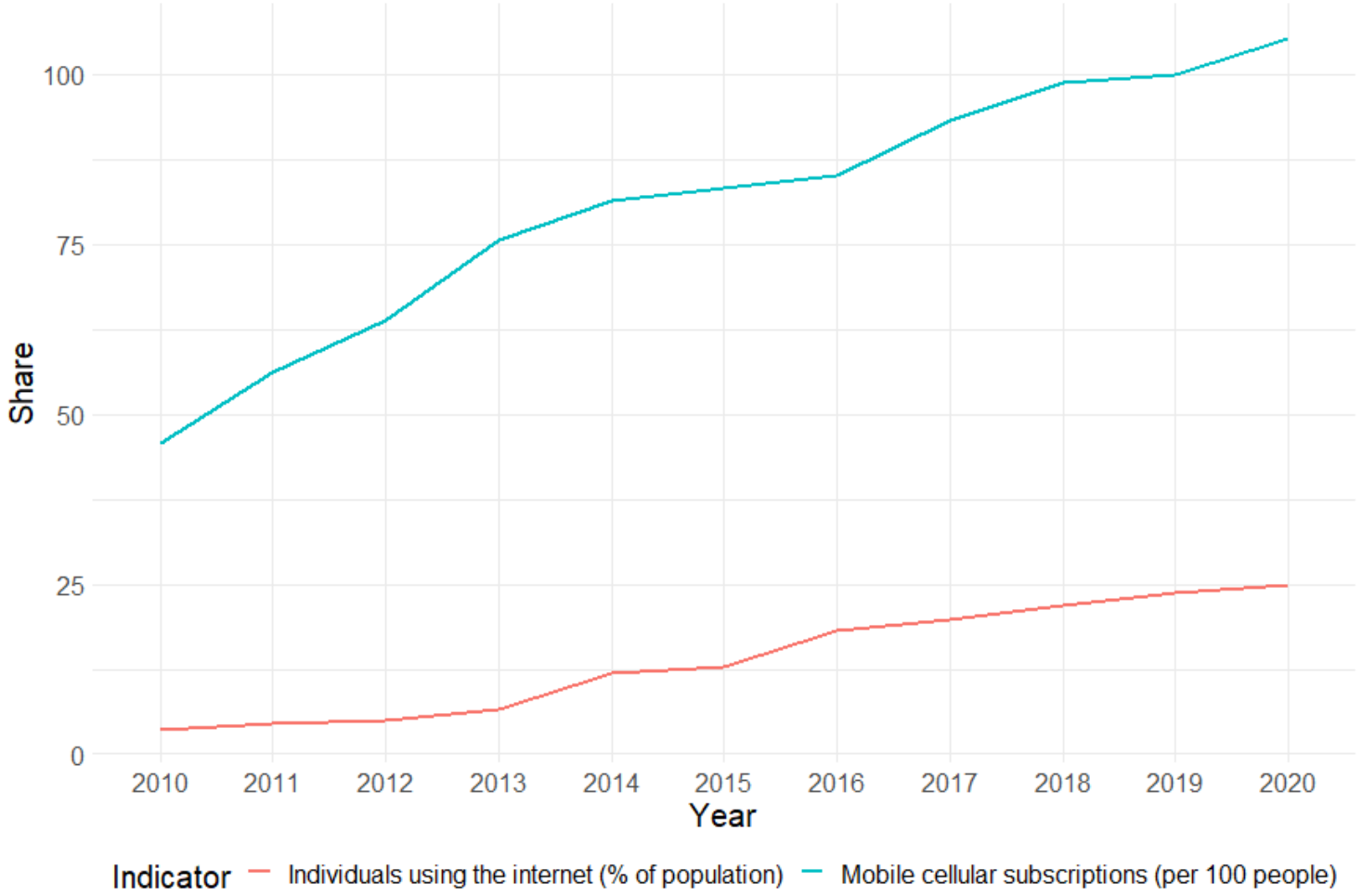
Labor structure in Bangladesh

Source: World Bank. 2023, Calculated and depicted by authors

Consumption smoothing

- Insulating consumption from income fluctuations (Fafchamps et al., 1998)
- MM: enables consumption smoothing of shocks (Jack and Suri, 2014)
- Several mechanisms in response to shocks by MM (Riley, 2018)
  1. Remittance sent by friends and family in other locations
  2. Safe storing fund and quick withdrawal of saving
  3. Borrow more because they are creditworthy (need to be investigated)

Gap between ownership and internet usage



Source: World Bank. 2023, Calculated and depicted by authors

Mobile money in BD

- bKash (major agency)
- Without internet
- Available in local shops
- Easing remittance and payment

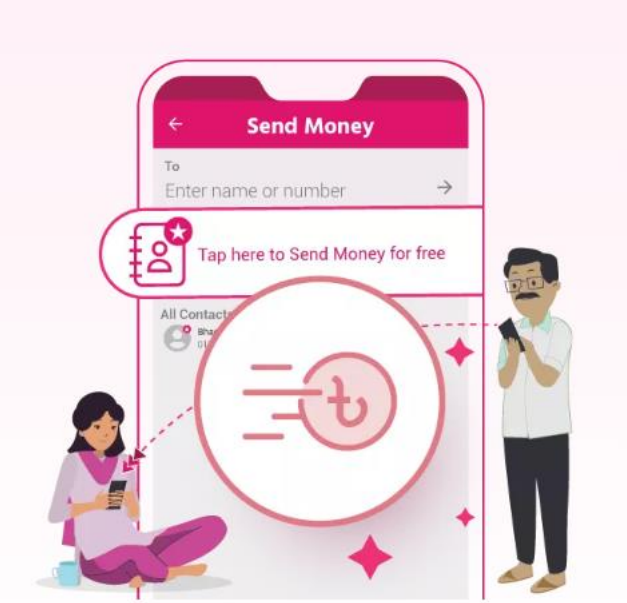
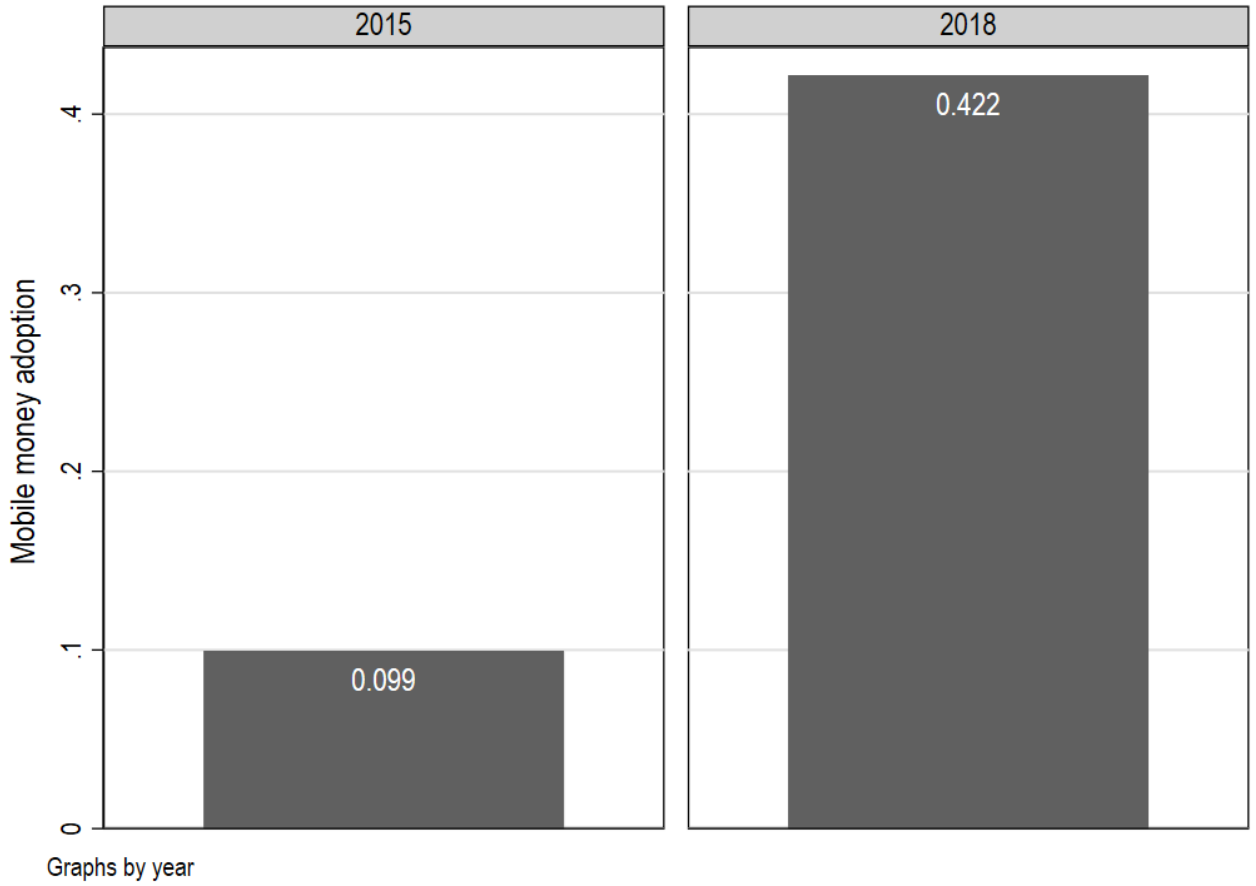


Photo credit: bKash (2023)

Mobile money adoption over time



Source: BIHS2015, 2018/19

Research questions

1. Does MM mitigate the negative effects of weather shocks?
2. Who benefit more from MM?
3. How does the mechanism work?

Relevance

Contribution

- Flood risk in South Asia
  - Merged with historical climate data
- Heterogeneous analysis
  - Poorer households benefit more from MM
  - (Gender perspectives)
- Further mechanism rather than remittance

Data

Bangladesh Integrated Household Survey

- 2015 and 2018/19
- International Food Policy Research Institute
- 6500 households (in baseline)
- Nationally representative rural households

Bangladesh meteorology department

- 64 districts
- Monthly rainfall and temperature for 1991-2018

Key variables

- MM adoption
  - 1 if a household uses MM
- Negative economic shock by climate events
  - 1 if a household experience
- Consumption
  - Monthly per capita (food/non-food) consumption expenditure (deflated to 2011)
- Remittance
  - Annual remittance value (square root) (deflated to real USD value in 2011)

74.15 BDT = 1 USD in 2011

Key variables

- Coefficient of Variation
  - $C_v = \sigma/\mu$: σ variance of rainfall (temperature), μ average of rainfall (temperature)
- Poverty indicator (Foster-Greer-Throbecke) (Foster et al., 1984)

$$d_i^{\alpha} = \left(\frac{z - x_i}{z}\right)^{\alpha}$$

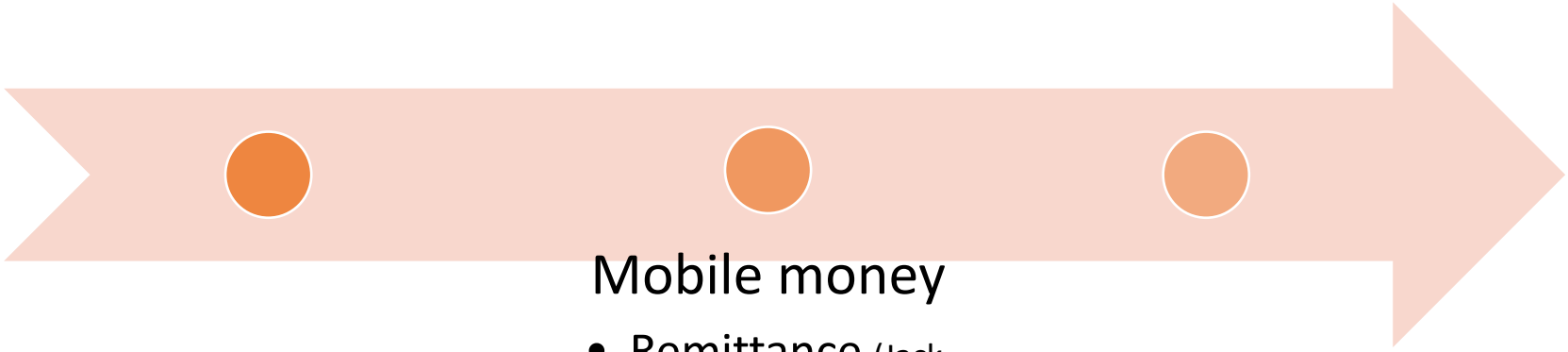
x_i: Household Income

z: $1.90 per person per day

Conceptual framework

Negative economic shocks

Consumption smoothing



Mobile money

- Remittance (Jack and Suri, 2014)
- Saving (Benami and Carter, 2021)
- Borrowing (Riley, 2018)

Empirical strategy: IV-DiD

$$MM_{it} = 1\{\xi X_{it} + \eta_i + \omega_{dt} + \tau_{it} > 0\}$$

MM_{it}: mobile money

X_{it}: covariate

η_i: household fixed effect

ω_{dt}: division-year specific unobservable characteristics

τ_{it}: error term

$$Y_{it} = \alpha_i + \gamma Shock_{it} + \mu MM_{it} + \beta MM_{it} \times Shock_{it} + \theta X_{it} + \zeta r_{it} + \eta_i + \omega_{dt} + \gamma_v + \epsilon_{\mathrm{it}}$$

Y_{it}: outcome variables

r_{it}: residual from the first equation

ϵ_{it}: error term

Identification strategy: control function

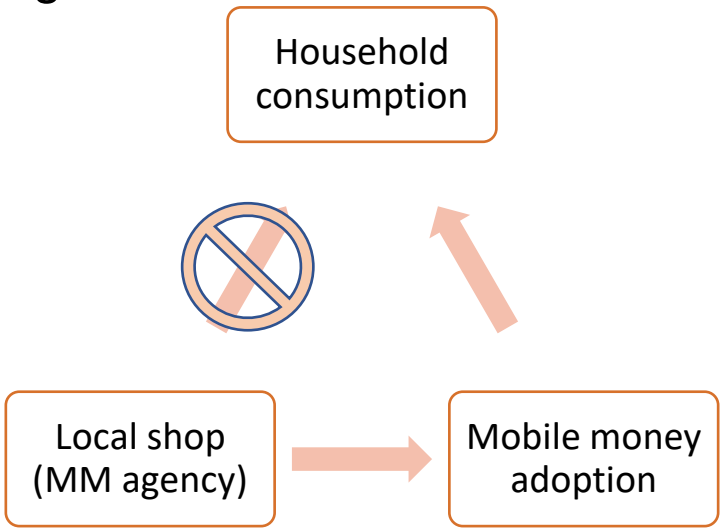
Control function: two-stage residual inclusion (Terza et al., 2008)

Mobile money

- Instrumented by distance to local shop (MM agency)

Negative economic shock by flood or cyclone

- Assuming exogenous



Weather shocks undermine welfare

	(1) Per capita expenditure	(2) Per capita food expenditure	(3) Per capita non-food expenditure	(4) Per capita expenditure	(5) Per capita food expenditure	(6) Per capita non-food expenditure
	OLS	OLS	OLS	OLS-FE	OLS-FE	OLS-FE
Shock	-0.058*	-0.027	-0.091**	-0.015	-0.025	0.006
	(0.030)	(0.037)	(0.042)	(0.028)	(0.037)	(0.036)
Household FE	No	No	No	Yes	Yes	Yes
Division FE	No	No	No	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes
Control variables	No	No	No	Yes	Yes	Yes
Observation	10,038	10,038	10,038	9,858	9,858	9,858

Note: Robust standard errors clustered by households in parenthesis * p<0.1, ** p<0.05, *** p<0.01. Estimated by OLS-FE

MM mitigates the negative effects (IV-DiD)

	(1) Per capita expenditure	(2) Per capita food expenditure	(3) Per capita non-food expenditure
Mobile money	-0.004	-0.016	0.011
	(0.016)	(0.016)	(0.021)
Shock	-0.028	-0.040	-0.016
	(0.056)	(0.073)	(0.073)
MM*Shock	0.147*	0.107	0.206**
	(0.082)	(0.096)	(0.099)
Household FE	Yes	Yes	Yes
Division FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Division*Year	Yes	Yes	Yes
Control variables	Yes	Yes	Yes
Observations	9,750	9,750	9,750

Note: Bootstrapped standard errors clustered by households in parenthesis * p<0.1, ** p<0.05, *** p<0.01. Estimated by IV-FE

Who benefit more from MM?

	(1) Per capita expenditure Poor	(2) Per capita expenditure Non-Poor
Mobile money	0.016	0.011
	(0.012)	(0.009)
Shock	0.016	-0.067*
	(0.037)	(0.035)
MM*Shock	0.111***	0.075
	(0.035)	(0.053)
Division FE	Yes	Yes
Year FE	Yes	Yes
Division*Year	Yes	Yes
Control variables	Yes	Yes
Observations	1,239	9,913

Note: Bootstrapped standard errors clustered by households in parenthesis * p<0.1, ** p<0.05, *** p<0.01. Estimated by IV-FE

How to smooth the consumption: remittance (IV-DiD)

	(1) Poor	(2) Non-poor
Mobile money	4.952	36.295***
	(22.298)	(8.259)
Shock	45.933	3.912
	(71.452)	(39.799)
MM*Shock	250.356*	-90.777
	(142.051)	(57.505)
Division dummy	Yes	Yes
Year dummy	Yes	Yes
Division*Year	Yes	Yes
Control variables	Yes	Yes
Observation	1,239	9,913

Note: Standard errors * p<0.1, ** p<0.05, *** p<0.01. Estimated by IV-Tobit. Outcome variables are transformed into square root.

How to smooth the consumption: saving (IV-DiD)

	(2) Poor	(3) Non-poor
Mobile money	-2.781	9.550**
	(11.761)	(4.807)
Shock	60.342*	26.748
	(35.541)	(21.662)
MM*Shock	-704.670	-82.128**
	(1.9e+05)	(32.293)
Division dummy	Yes	Yes
Year dummy	Yes	Yes
Division*Year	Yes	Yes
Control variables	Yes	Yes
Observation	1,239	9,913

Note: Standard errors * p<0.1, ** p<0.05, *** p<0.01. Estimated by IV-Tobit. Outcome variables are transformed into square root.

Channel analysis

	(1) Per capita expenditure Poor	(2) Per capita expenditure Non-poor	(3) Per capita food expenditure Poor	(4) Per capita food expenditure Non-poor	(5) Per capita non-food expenditure Poor	(6) Per capita non-food expenditure Non-poor
Shock	0.025	-0.003	-0.013	-0.016	0.065	0.016
	(0.027)	(0.022)	(0.044)	(0.026)	(0.058)	(0.031)
Remittance	0.002*		-0.001		0.007***	
	(0.001)		(0.002)		(0.002)	
Saving		0.003***		0.002***		0.004***
		(0.001)		(0.001)		(0.001)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Division FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Division*Year	Yes	Yes	Yes	Yes	Yes	Yes
Observation	1,252	9,967	1,252	9,967	1,252	9,967

Note: Robust standard errors clustered by households in parenthesis * p<0.1, ** p<0.05, *** p<0.01. Estimated by OLS-FE. Saving and remittance are transformed into logarithm,

Conclusion (and policy implication)

1. Does MM mitigate the negative effects of weather shocks?
   - Yes
2. Who benefit more from MM?
   - Poor households
3. How does the mechanism work?
   - Remittance for the poor
   - Saving for the non-poor

Next…

- Mechanism of the effect: asset, borrowing
- Disaggregating domestic and international remittance
- Additional heterogeneous analysis: gender, migrant
- Robustness checks

Thank you!

- Any comments?
- Further comments to: Masanori_Matsuura@ide.go.jp
- More information: https://masanorimatsuura.github.io/

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Appendix: summary statistics

	Obs	Mean	SD	Obs	Mean	SD
	MM user			MM non-user		
Per capita expenditure	2,968	3429.136	1818.264	8,367	3008.099	1811.681
Per capita food expenditure	2,968	1761.852	902.856	8,367	1691.378	989.881
Per capita non-food expenditure	2,968	1667.284	1201.934	8,367	1316.721	1102.347
Shock by flood or cyclone	2,968	0.017	0.127	9,038	0.020	0.139
Flood shock in Kharif	2,968	0.001	0.037	9,038	0.002	0.042
Flood shock in Rabi	2,968	0.549	0.498	9,038	0.304	0.460
Local shop access (MM agency) (minutes)	2,955	6.318	5.391	8,299	6.941	5.913
Periodic bazaar access (minute)	2,947	13.394	8.445	8,277	15.105	9.406
Female household head	2,968	0.186	0.389	8,368	0.202	0.402
Age of HH	2,968	46.381	12.682	8,368	47.041	13.824
Schooling year of HH	2,967	4.657	4.300	8,364	3.128	3.783
Number of adults	2,968	3.778	1.865	9,038	2.934	1.701
Number of children	2,968	1.958	1.230	9,038	1.639	1.296
Asset index	2,968	0.690	1.923	8,368	-0.575	1.879

Appendix: summary statistics

	Obs	Mean	SD	Obs	Mean	SD
	MM user			MM non-user		
Temperature shock in Kharif	2,968	0.003	0.007	9,038	0.009	0.008
Temperature shock in Rabi	2,968	0.001	0.015	9,038	0.003	0.013
Rainfall CoV in Kharif	2,968	0.088	0.009	9,038	0.088	0.008
Rainfall CoV in Rabi	2,968	0.466	0.037	9,038	0.473	0.047
Temperature CoV in Kharif	2,968	0.047	0.008	9,038	0.047	0.008
Temperature CoV in Rabi	2,968	0.110	0.011	9,038	0.110	0.011