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Credit Rationing in Kenyan Agricultural Households and Uptake of Risk Contingent Credit: Evidence from the Field

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Outline of Talk

Introduction

Context of study

Brief literature review

Methods

Results

Discussion

Introduction

- There is a growing recognition that credit constraints on agricultural households are not solely due to supply-side factors.
- Unlike households that are denied access to credit markets, some may voluntarily chose not to borrow.
- Reasons for and solutions to this voluntary withdrawal have not received the same attention in the literature.
- These demand-side constraints include the non-price terms of the contract such as transaction costs or collateral requirements.
- The policy strategies for alleviation of demand-side constraints differ from those for supply side constraints.
- Risk Contingent Credit is one novel strategy to reduce or eliminate demand-side constraints.

Literature Review, Briefly

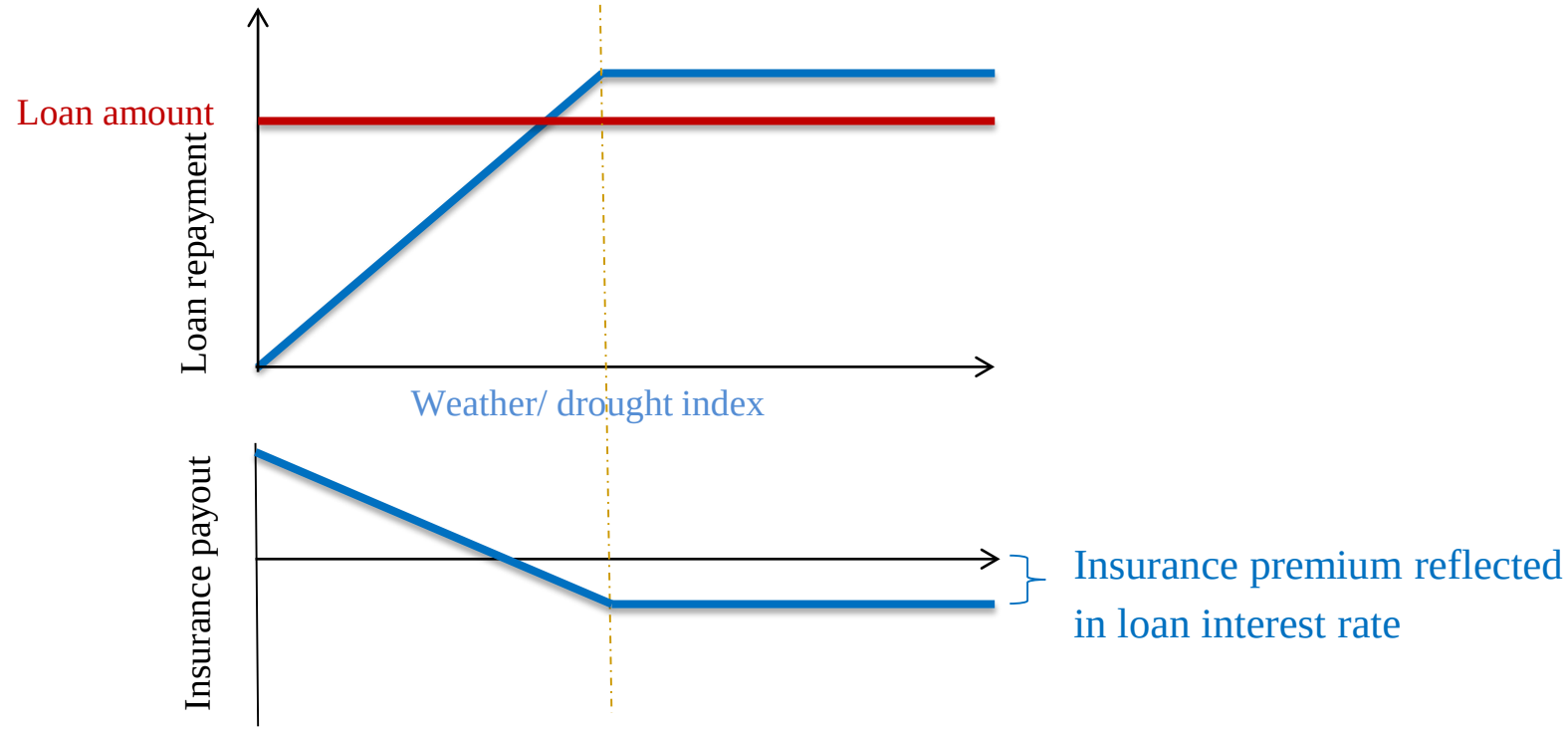
- Boucher et al. 2008 provide first formal treatment of risk rationing in economic and utility-centric context
- Boucher et al. 2009 provide evidence that Direct Elicitation Method can capture motivation for non participation in credit markets.
- Gine and Yang 2008 implement a randomized field experiment to gauge uptake of standard credit vs. a credit and index insurance package, found lower uptake among those offered the package.
- Karlan et al. 2011 implement a randomized field experiment on credit uptake between regular loan and credit embedded with crop price indemnity, find high uptake across both groups.
- Shee and Turvey 2012 provide theoretical underpinning and pricing mechanism for RCC.
- Chui et al. 2014 look at risk rationing and demand for credit in Mexico and China and find differences in elasticity of demand for credit between risk, quantity, and price rationed individuals.
- Karlan et al. 2014 find increasing recognition that relaxing credit constraints without mitigating uninsured risk is not enough to increase agricultural investment and therefore productivity.

Risk Contingent Credit (RCC) Defined

- “A general term we use for any credit instrument that imbeds within its structure a contingent claim which when triggered transfers part or all of the borrower’s liability to the lender or integrator/counterparty.” (Shee and Turvey 2012)
- RCC can theoretically substitute for collateral.
- Posited that RCC opens access to the credit markets for those who have an investment opportunity with expected positive profit, but who voluntarily withdraw from the market due to the negative utility associated with risk of collateral loss.
- Should enhance productivity while providing a safety net should an outside event (e.g. drought) threaten productivity and well-being.

Risk Contingent Credit

- Market based solution to minimize downside agricultural risks and unlocking access to credit, first developed by Shee and Turvey *(Agricultural Economics 2012)*



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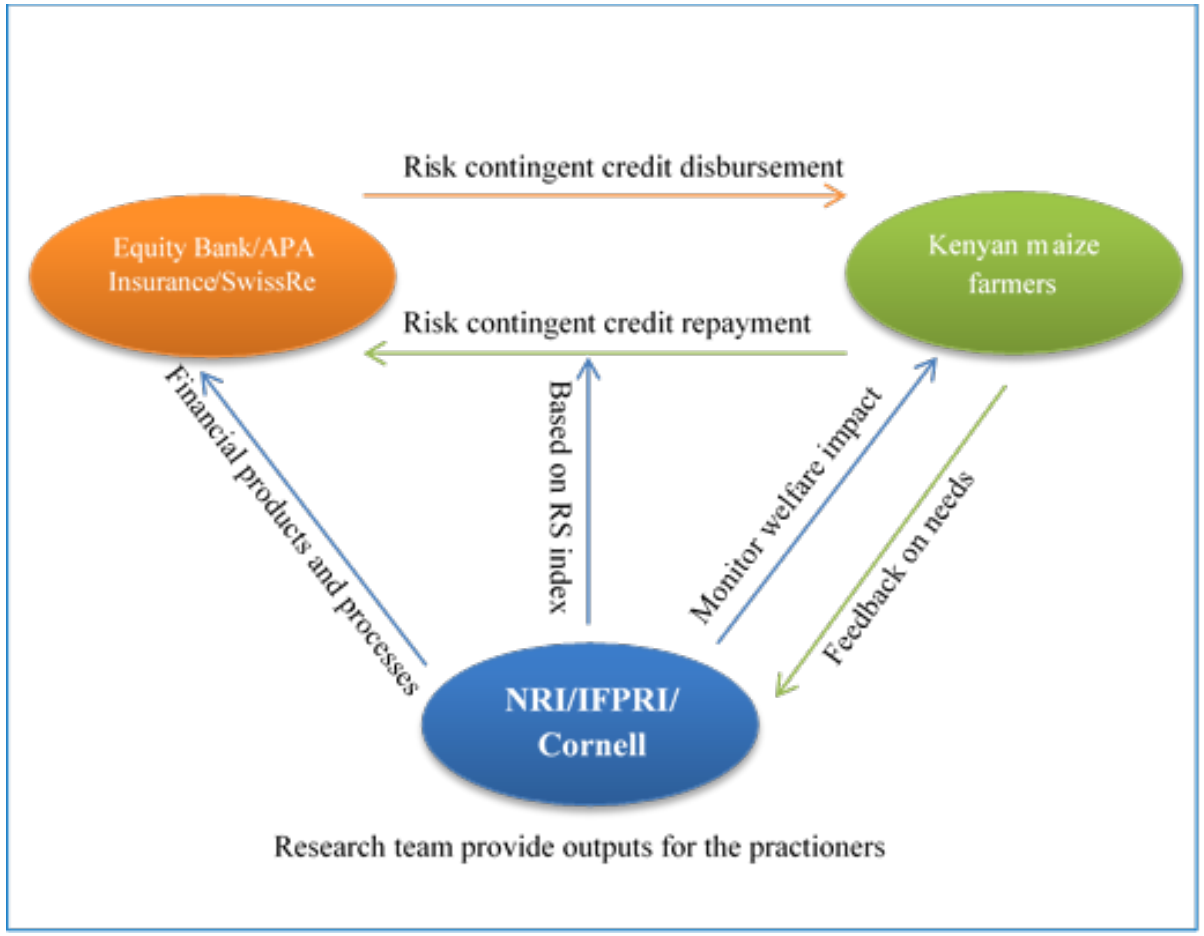
Intervention

- It appears to be the first to develop scientific bundling of rainfall based index insurance and agricultural term loan through actuarially fair pricing
- RCC does not require farmers to pay premiums upfront and out-of-pocket,
- By removing liquidity constraint RCC mechanism can achieve better targeting of poorer farmers
- RCC encourages risk-rationed farmers to take up loans
- Because the insurance component of RCC substitutes for collateral, it is more financially inclusive than conventional credit products

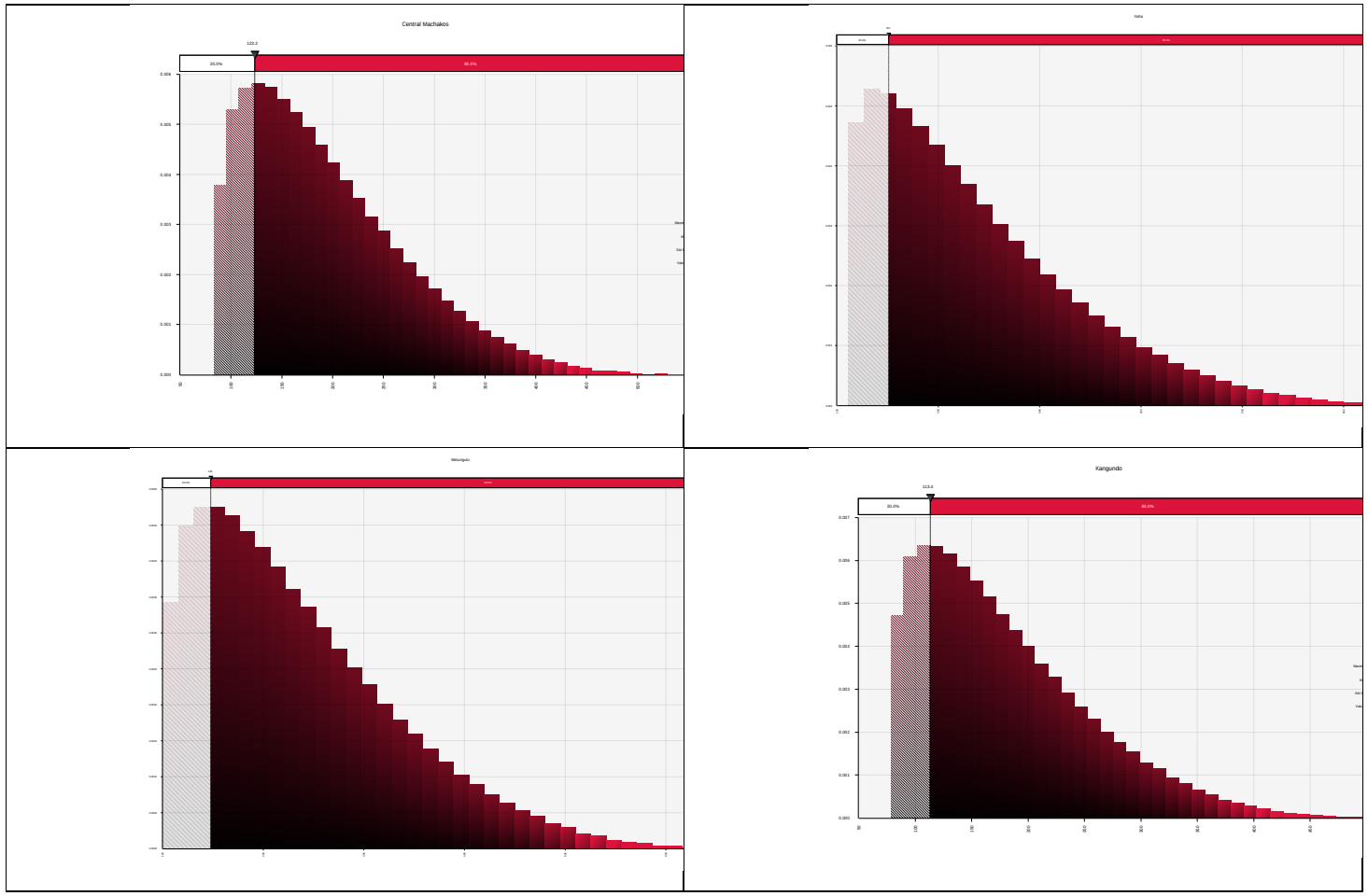


Context: Study Location and Size

- Machakos has hilly terrain and a semi-arid climate where maize is the main food crop produced by smallholder farmers
- To maximize generalizability of results and increase variation in survey population, sample selected from 13 locations dispersed among five sub-counties of Machakos
- Within each location, 15 households were randomly selected from six villages that were also randomly selected.

Sub-County	Location	Households surveyed
Kangundo	Kanzalu	90
	Kakuyuni	90
Kathiani	Mitaboni	90
	Kathiani	90
	Iveti	90
Matungulu	Kyanzavi	90
	Matungulu	90
	Tala	90
Mwala	Mbiuni	90
	Mwala	90
	Masii	90
Yatta	Matuu	90
	Kithimani	90
Total		1170

PERT Estimation of Cumulative Rainfall



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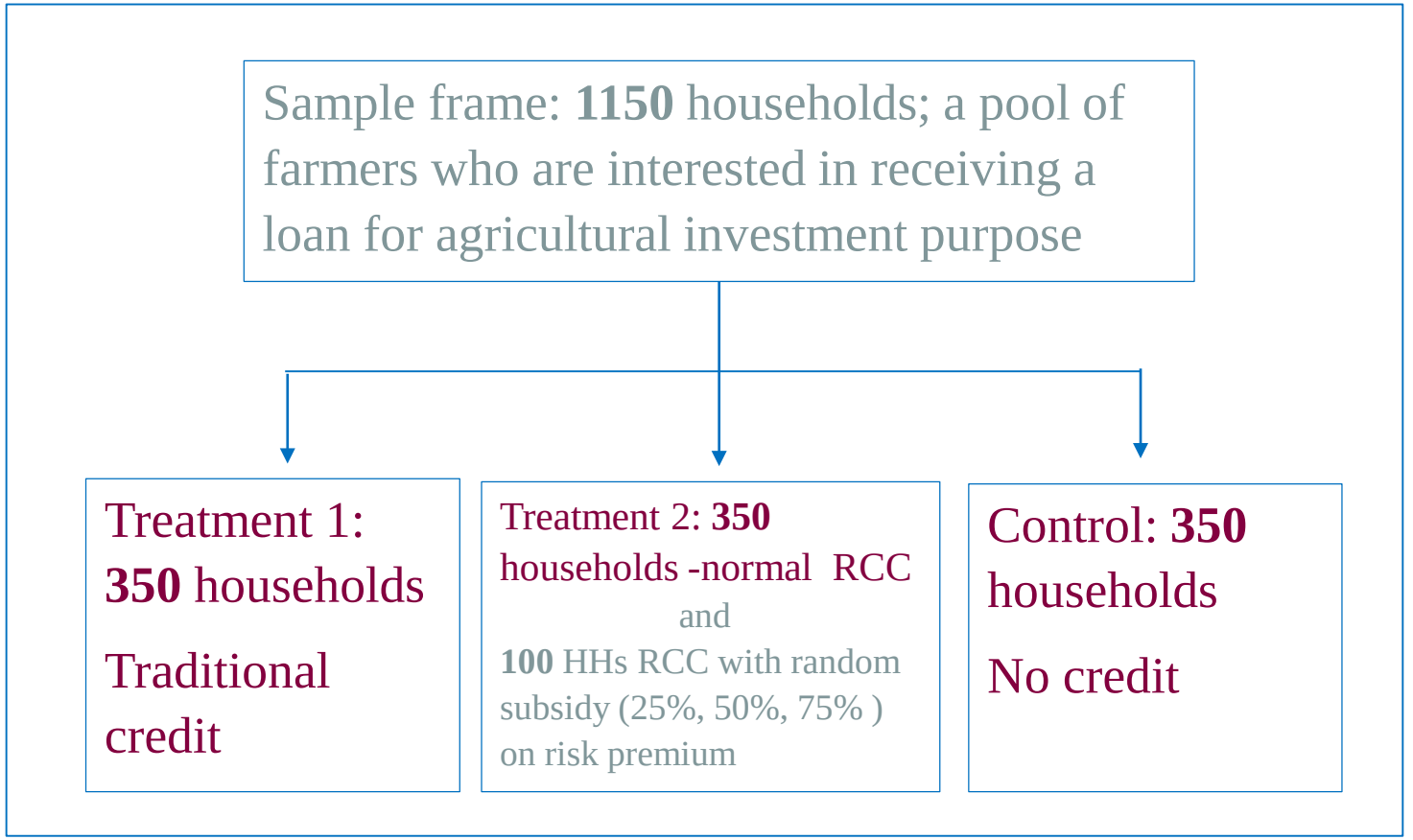
Evaluation design



100 households will be part of a sub-experiment of demand estimation where households will receive random subsidy (25%, 50%, 75%) on risk premium.

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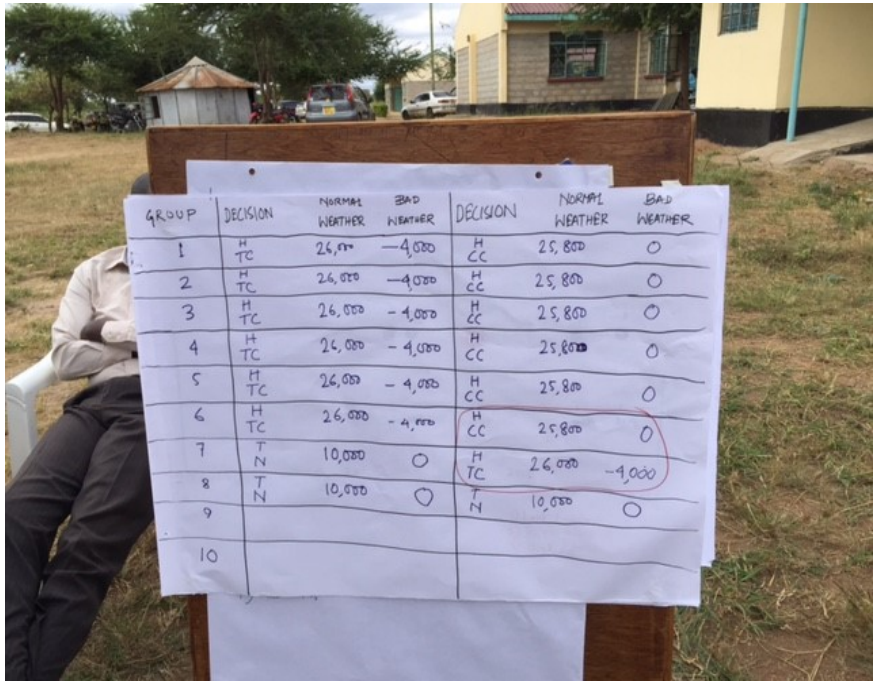
Communication through a participatory RCC game

Published in *Shee et al. Agricultural Finance Review 2015*



GROUP	DECISION	NORMAL WEATHER	BAD WEATHER	DECISION	NORMAL WEATHER	BAD WEATHER
1	H TC	26,000	−4,000	H CC	25,800	0
2	H TC	26,000	−4,000	H CC	25,800	0
3	H TC	26,000	−4,000	H CC	25,800	0
4	H TC	26,000	−4,000	H CC	25,800	0
5	H TC	26,000	−4,000	H CC	25,800	0
6	H TC	26,000	−4,000	H CC	25,800	0
7	T N	10,000	0	H TC	26,000	−4,000
8	T N	10,000	0	T N	10,000	0
9						
10						

Randomized Control Framework: Farmers were asked to select chips from an urn

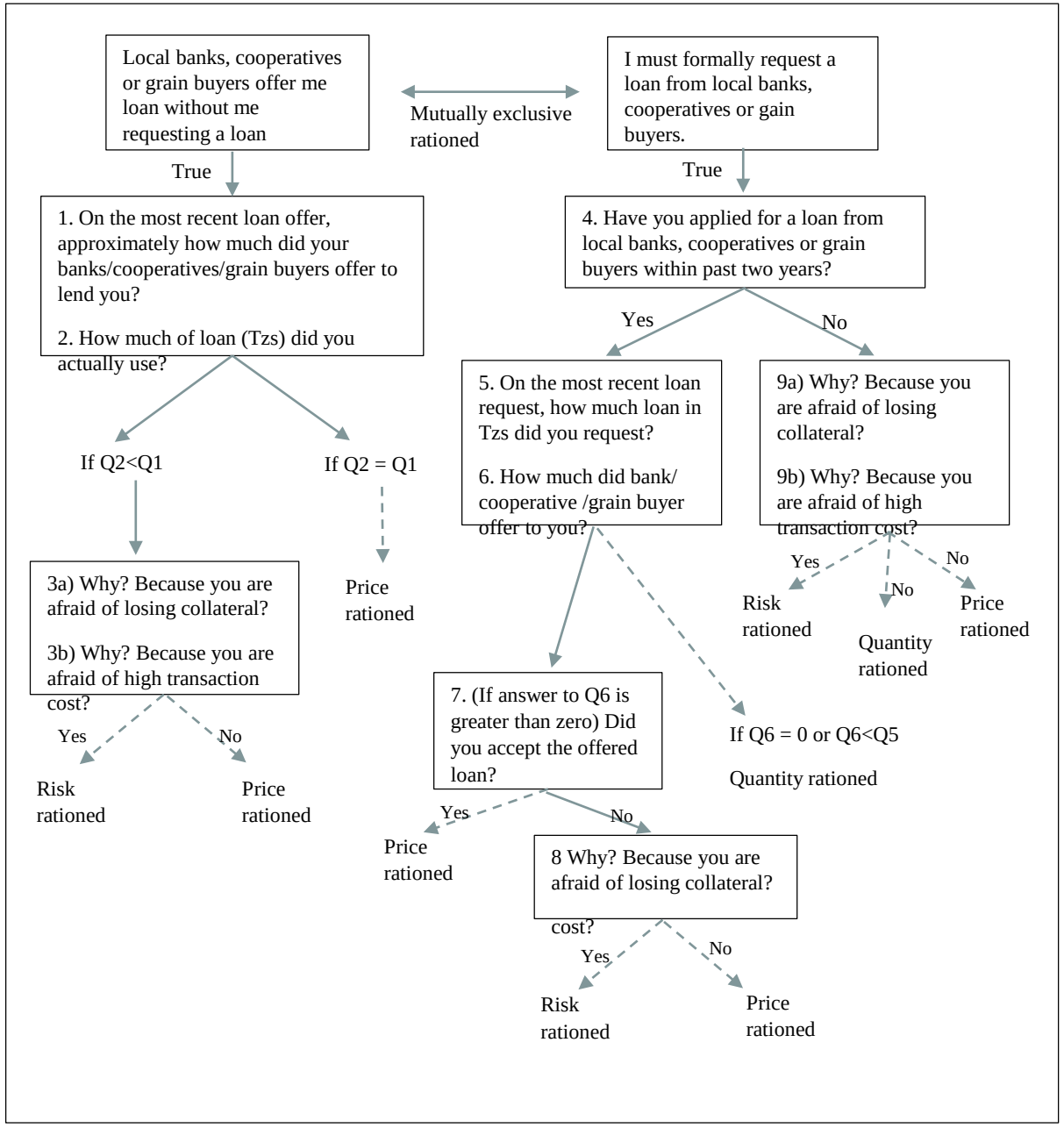
Chips in urn included balanced selection of target groups

- 27 Control
- 27 Normal credit
- 27 Risk-contingent credit
- 3 each 25%, 50%, 75% subsidy

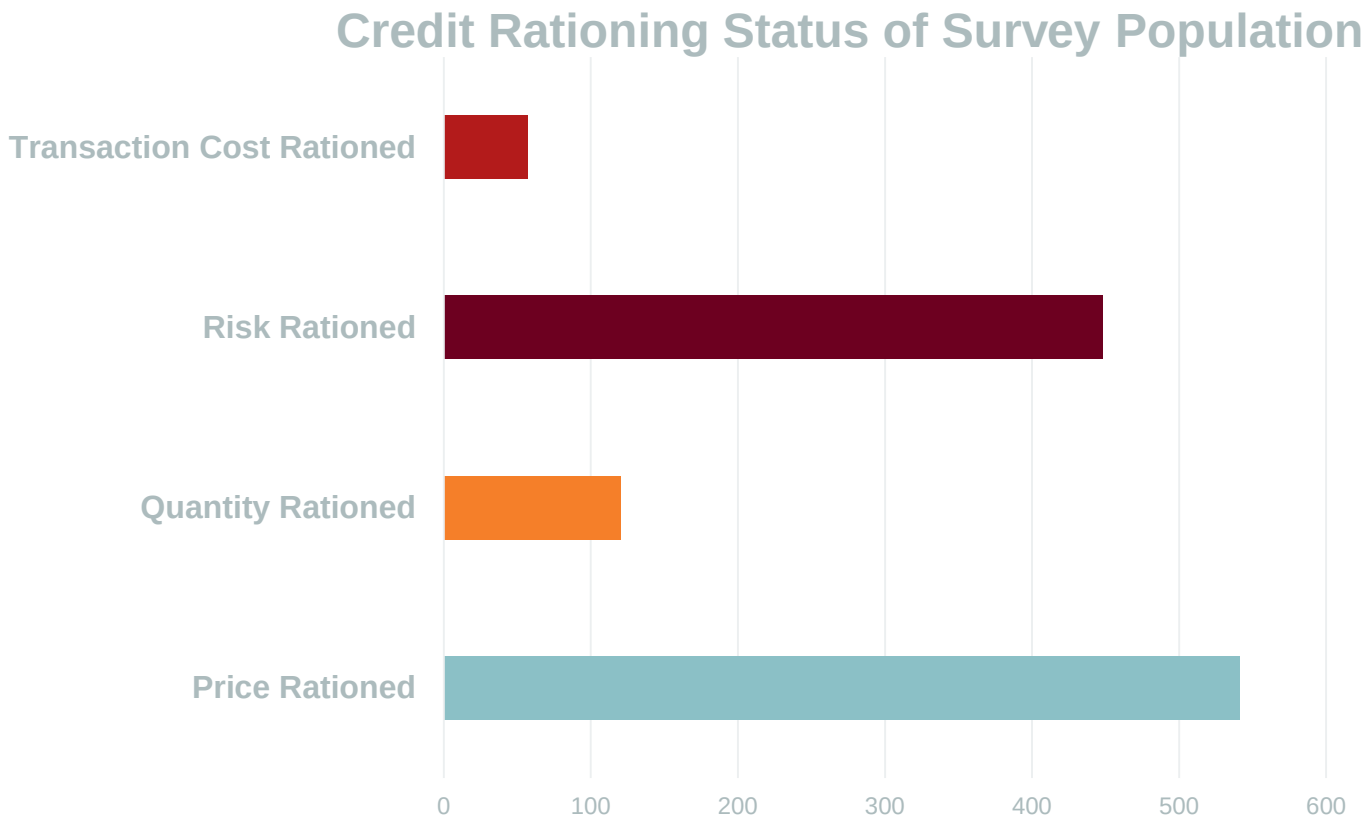
Credit Ration Statuses Defined

- Price - unconstrained households, either borrowers who are satisfied with the loan amount at the price offered or non-borrowers, who voluntarily chose not to enter credit markets even when faced with fair market prices and transaction costs.
- Quantity - households that have had a loan application rejected, been offered a loan of an amount less than applied for, or have not applied for a loan due to belief that they would be rejected. Positive *notional* demand for credit, but faces zero supply.
- Transaction Cost - households that face zero effective demand due to the size of the transaction costs associated with the loan, such as high opportunity costs, distance/time to local bank branch, or amount of paperwork required.
- Risk - households that show lower effective demand due to the risk-sharing rules of the contract, usually dealing with collection of collateral in the event of default. The collateral requirement forces the household to bear a minimum amount of risk and the inclusion of this risk in their expected utility calculation drives the borrower's expected utility below their reservation utility, even though the loan would raise expected consumption.

Methods: Direct Elicitation Method



Survey Credit Rationing Breakdown



Socioeconomic Variables used in Analysis

- These variables all rely on self reported data. While it would be useful to have third party certified data, in the case of credit rationing, the subjective feelings of households are more relevant.

Variable	Description
Age	The age of the head of household
Education	Highest level of education for head of household
Female	Binary variable =1 if head of household is female
Household Adults	Number of adults living in household
Household Size	Number of people living in household
Total Acres	Total acres a household farms
Maize per Acre	Production of maize in rainy season per acre
Plots	Number of different plots farmed
Ownership	Percentage of plots farmed the household owns

Variable	Description
Average Distance	Average distance from household to plots they farm
Productive	Subjective productive asset (animals used in agricultural production) value. Scaled by 10,000 for ease of interpretation
Livestock Income	Value of income from livestock sales over last 12 months. Scaled by 10,000 for ease of interpretation
Percent Food	The percentage of household expenses spent on food
Subjective Welfare	Subjective score on scale of 1-5 of economic standing
Risk Aversion	Outcome of risk game on scale of 1-5, 1 being risk averse, 5 being risk seeking

Variable Means and Standard Deviations by Ration Status

	Price rationed		Quantity rationed		Risk rationed		Transaction cost rationed		Total	
age	55.5	13.2	55.7	12.9	56.8	13.4	58.2	12.3	56.2	13.2
education	9.3	3.8	8.7	3.8	7.9	3.8	7.9	3.7	8.6	3.8
female	0.2	0.4	0.2	0.4	0.3	0.4	0.2	0.4	0.2	0.4
hh_adults	3.6	1.6	3.6	1.6	3.5	1.7	4.1	1.8	3.6	1.6
hh_size	5.7	2.3	5.9	2.3	5.7	2.4	6.3	2.7	5.7	2.3
total_acres	4.8	10.5	3.7	5.6	3.1	3.7	3.4	3.0	4.0	7.8
maize_per acre	270.8	262.7	235.6	292.7	238.8	202.8	221.6	171.3	252.5	241.3
plots	2.0	1.1	1.8	1.0	1.9	1.1	2.0	1.3	2.0	1.1
ownership	0.9	0.2	0.9	0.2	0.9	0.2	0.9	0.2	0.9	0.2
ave_dist	1.6	0.6	1.6	0.6	1.6	0.6	1.6	0.6	1.6	0.6
productive assets	10.3	15.4	7.2	8.0	6.8	7.2	9.5	10.2	8.6	12.0
l_income	1.9	8.5	1.0	2.6	0.8	2.7	0.4	0.9	1.4	6.1
percent food	0.5	0.2	0.5	0.2	0.5	0.2	0.5	0.2	0.5	0.2
sub_welfare	2.9	0.6	2.7	0.7	2.7	0.6	2.6	0.6	2.8	0.6
risk aversion	2.5	1.2	2.5	1.2	2.4	1.1	2.4	1.2	2.4	1.2

Methods, Determinants of Credit Rationing Status Analysis

- Use a single multinomial logit to simultaneously estimate coefficients:

$$Y_{ij} = C + \beta_j' X_i + \varepsilon_{ij}$$

- Y_{ij} is a categorical variable that represents the propensity of household *i* to be in rationing category *j*. β_j is a vector of parameters associated with *j*th rationing category and X_i is a vector of household *i*'s socioeconomic characteristics.
- Robust standard errors clustered on the village level to account for unmeasured correlations among those households in the same village.
- Hypothesis: $H_0 : \beta_j = 0 \quad H_1 : \beta_j \neq 0$
- Drop price rationed group to normalize comparative results of other rationed groups and answer question:

Relative to those households that interact with credit markets in an optimal way (from a systems perspective), is this ration group significantly more correlated with the variable in question, X_i?

Methods, Determinants of Credit Rationing Status Analysis

- For robustness and ease of coefficient interpretation, also run bivariate logit and linear probability models in form:

$$Y_i = C + \beta' X_i + \varepsilon_i$$

- Y_i is a binary variable that represents whether household *i* is in specified rationing category. β is a vector of parameters and X_i is a vector of household *i*'s socioeconomic characteristics.
- Robust standard errors clustered on the village level to account for unmeasured correlations among those households in the same village.
- Hypothesis: $H_0 : \beta_j = 0 \quad H_1 : \beta_j \neq 0$
- All three models tell a consistent story, so will present linear probability coefficients for ease of interpretation.
  - Coefficients are direct marginal effects

Results, Determinants of Credit Rationing Status Analysis

- Displaying bivariate linear probability results →

VARIABLES	price	quantity	risk	trans
age	-0.001	0.000	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.000)
education	0.012**	-0.000	-0.011	-0.001
	(0.005)	(0.002)	(0.007)	(0.002)
female	-0.028	-0.045*	0.064	0.009
	(0.038)	(0.023)	(0.042)	(0.023)
hh_adults	0.011	-0.013	-0.006	0.009
	(0.012)	(0.014)	(0.019)	(0.006)
hh_size	-0.015	0.009	0.005	0.001
	(0.009)	(0.009)	(0.012)	(0.004)
total_acres	0.003	0.001	-0.003*	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)
maize_per_acre	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
plots	-0.006	-0.011	0.014	0.003
	(0.017)	(0.008)	(0.014)	(0.005)
ownership	0.140	0.004	-0.079	-0.065
	(0.090)	(0.040)	(0.080)	(0.052)
ave_dist	0.031	0.002	-0.025	-0.008
	(0.039)	(0.014)	(0.031)	(0.012)
productive	0.003**	-0.001	-0.003**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
l_income	0.004**	0.000	-0.002	-0.002
	(0.001)	(0.001)	(0.002)	(0.001)
percent_food	-0.078	-0.076	0.138*	0.017
	(0.065)	(0.066)	(0.071)	(0.052)
sub_welfare	0.067**	-0.028	-0.020	-0.019
	(0.027)	(0.016)	(0.018)	(0.014)
ra	0.002	0.004	-0.005	-0.002
	(0.011)	(0.008)	(0.009)	(0.003)
Constant	0.115	0.233*	0.532***	0.120
	(0.167)	(0.107)	(0.105)	(0.080)
Observations	1,144	1,144	1,144	1,144
R-squared	0.059	0.013	0.041	0.016
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Multinomial Logit Results

VARIABLES	price	Quantity_rationed	Risk_rationed	transaction_cost
age		0.007	0.008	0.010
		(0.006)	(0.006)	(0.011)
education		-0.028	-0.056**	-0.042
		(0.026)	(0.028)	(0.045)
female		-0.425	0.198	0.212
		(0.308)	(0.184)	(0.470)
hh_adults		-0.164	-0.048	0.147*
		(0.140)	(0.074)	(0.089)
hh_size		0.134	0.060	0.041
		(0.082)	(0.056)	(0.069)
total_acres		-0.002	-0.041**	-0.088**
		(0.016)	(0.018)	(0.037)
maize_per_acre		-0.000	-0.000	-0.000
		(0.001)	(0.000)	(0.001)
plots		-0.112	0.063	0.164
		(0.113)	(0.084)	(0.141)
ownership		-0.295	-0.514	-1.392**
		(0.442)	(0.425)	(0.593)
ave_dist		-0.026	-0.127	-0.276
		(0.188)	(0.176)	(0.331)
productive		-0.027**	-0.019**	0.032**
		(0.012)	(0.009)	(0.013)
l_income		-0.002	-0.027	-0.285***
		(0.021)	(0.032)	(0.055)
percent_food		-0.660	0.428*	0.397
		(0.767)	(0.252)	(1.074)
sub_welfare		-0.423**	-0.202*	-0.554***
		(0.194)	(0.107)	(0.215)
ra		0.032	-0.023	-0.050
		(0.095)	(0.046)	(0.072)
Constant		0.577	1.011	-0.077
		(1.282)	(0.639)	(1.525)
Observations	1,144	1,144	1,144	1,144
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

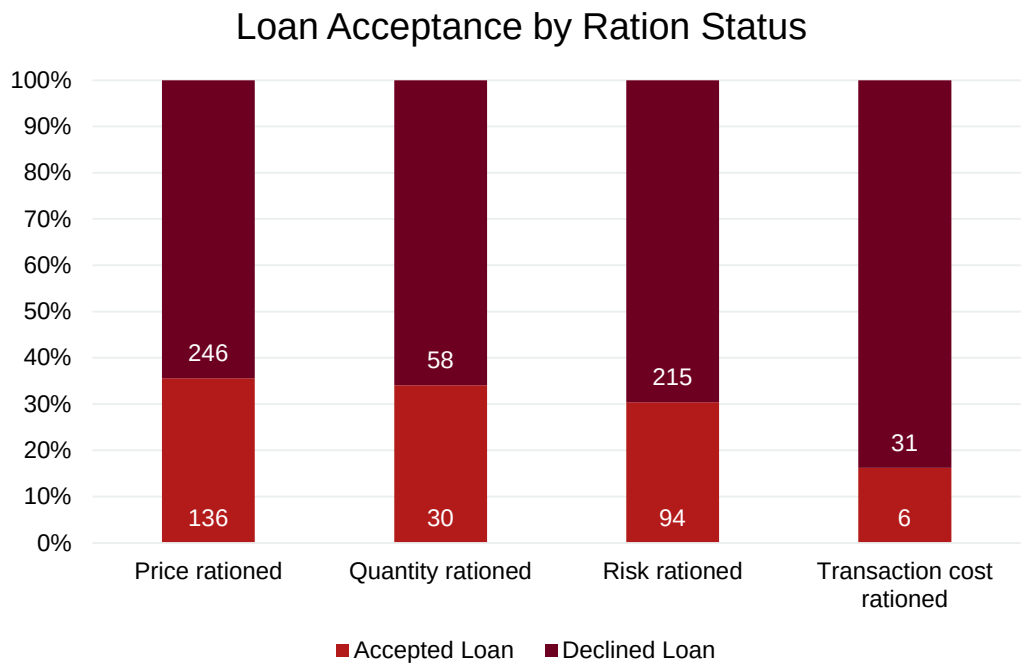
Methods, Credit Uptake Analysis

- First, we drop the control group since they did not have an opportunity to access credit.
- Then use a logit regression with standard errors clustered on village level

$$Y_i = C + \beta_j' X_i + \gamma_j{}' A_i + \vartheta_j Z_i + \varepsilon_i$$

- Where $Y_i$is a binary variable stating whether household *i* accepted a loan, X_i is a vector of binary ration status variables, A_i is a vector of binary uptake variables for different credit products and Z_i is a vector of socioeconomic variables to absorb noise.
- Do not include price rationed in X_i or the normal credit offering in A_i such that results are relative to these groups.
- Hypothesis – since no priors, null hypothesis is no effect for all variables

Results, Credit Uptake Analysis



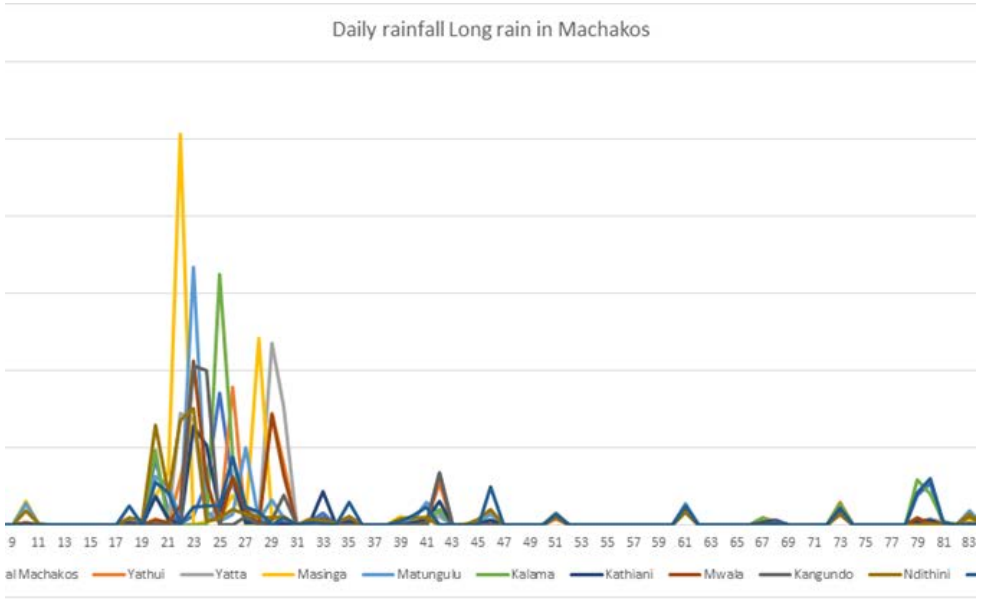
	Accepted	Declined	Percentage Accepted
Normal credit	107	243	31%
RCC	123	227	35%
RCC 25% subsidy	15	25	38%
RCC 50% subsidy	12	24	33%
RCC 75% subside	9	30	23%

In Gine and Yang 2008, uptake of normal credit was 33%, while 20% for credit and insurance bundle

Uptake logit results normalized over price rationed and normal credit offer

VARIABLES	uptake
risk	-0.166
	(0.501)
quantity	-0.036
	(0.880)
trans	-1.055***
	(0.005)
rcc	0.243
	(0.218)
rcc75	-0.401
	(0.359)
rcc50	0.208
	(0.576)
rcc25	0.402
	(0.207)
age	-0.004
	(0.626)
education	0.015
	(0.653)
female	-0.205
	(0.310)
hh_adults	0.058
	(0.450)
hh_size	-0.022
	(0.531)
total_acres	-0.017
	(0.287)
productive	0.005
	(0.385)
percent_food	-0.608
	(0.124)
sub_welfare	0.122
	(0.303)
Constant	-0.704
	(0.360)
Observations	816
Robust pval in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Epilogue: What Happened?



- Rainfall in Machakos failed
  - Intra-season basis risk
  - Dry in October
  - Abundant rain in November
  - Extensive drought December/January
- BUT the rainfall insurance did not trigger
- For RCC it was decided to pay 50% indemnities from reserve funds as if from insurer
  - Deception (?)
- Facing an ethical dilemma on conventional loans
  - RCT protocol/integrity says farmers pay
  - But farmers in situation by chance!
  - Do we provide relief? (probably)
- Will redesign RCC for 2018/2019
  - Multiple event risk

Discussion

- Inconclusive evidence on increased uptake due to RCC.
- Regression results suggest that the intervention successfully moved the quantity rationed and risk rationed onto the demand curve, but that the type of credit product offered did not have an effect on uptake of loan.
- Reasons could include, pent up demand across all rationing groups due to lack of access to credit previously.
- The follow up survey, and results of RCT will help lead to more conclusive answers.
  - Particularly interesting will be the size of loans accepted across rationing groups and repayment rate.
- More work needs to be done to determine optimal point in microfinance value chain for insurance to be implemented.

Thank you

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Appendix 3: Uptake logit results normalized over price rationed and normal credit offer with rcc_all instead of rcc

VARIABLES	uptake
risk	-0.166
	(0.501)
quantity	-0.036
	(0.880)
trans	-1.055***
	(0.005)
rcc_all	0.243
	(0.218)
rcc75	-0.644
	(0.192)
rcc50	-0.036
	(0.929)
rcc25	0.159
	(0.591)
age	-0.004
	(0.626)
education	0.015
	(0.653)
female	-0.205
	(0.310)
hh_adults	0.058
	(0.450)
hh_size	-0.022
	(0.531)
total_acres	-0.017
	(0.287)
productive	0.005
	(0.385)
percent_food	-0.608
	(0.124)
sub_welfare	0.122
	(0.303)
Constant	-0.704
	(0.360)
Observations	816

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 4: Uptake logit results with transaction cost omitted, normal omitted and using rcc_all

VARIABLES	uptake
risk	0.890**
	(0.015)
quantity	1.019***
	(0.002)
price	1.055***
	(0.005)
o.trans	-
rcc_all	0.243
	(0.218)
rcc75	-0.644
	(0.192)
rcc50	-0.036
	(0.929)
rcc25	0.159
	(0.591)
age	-0.004
	(0.626)
education	0.015
	(0.653)
female	-0.205
	(0.310)
hh_adults	0.058
	(0.450)
hh_size	-0.022
	(0.531)
total_acres	-0.017
	(0.287)
productive	0.005
	(0.385)
percent_food	-0.608
	(0.124)
sub_welfare	0.122
	(0.303)
Constant	-1.759**
	(0.011)
Observations	816

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 5: Uptake logit results with transaction cost omitted but including

VARIABLES	uptake
risk	0.897**
	(0.014)
quantity	1.019***
	(0.002)
price	1.055***
	(0.005)
o.trans	-
normal	12.247***
	(0.000)
rcc_all	12.485***
	(0.000)
rcc75	-0.645
	(0.192)
rcc50	-0.034
	(0.933)
rcc25	0.160
	(0.589)
age	-0.004
	(0.626)
education	0.016
	(0.648)
female	-0.206
	(0.307)
hh_adults	0.057
	(0.451)
hh_size	-0.022
	(0.547)
total_acres	-0.016
	(0.278)
productive	0.005
	(0.384)
percent_food	-0.627
	(0.116)
sub_welfare	0.121
	(0.306)
Constant	-13.999***
	(0.000)
Observations	816

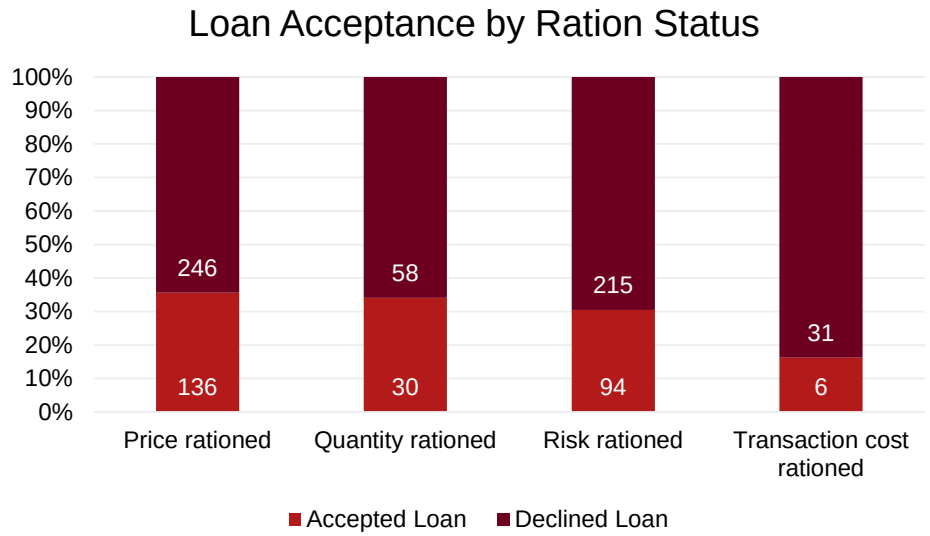
Robust pval in parentheses

Context: Survey Population Statistics

- Graphics for:
- Female headed households, education levels, household size, maize/acre, subjective welfare, age

Results, Credit Uptake Analysis

- Tables
- % of those offered each that accepted
- The reg results suggest that there is pent up demand across rationing groups, this suggests that RCC, or other structures that open greater access to credit, will be received with high demand from farmers.
- Lack of subsidy effect also points to this highly inelastic demand for credit
  - Price doesn't have an effect on uptake of RCC



	Accepted	Declined	Percentage Accepted
Normal credit	107	243	31%
RCC	123	227	35%
RCC 25% subsidy	15	25	38%
RCC 50% subsidy	12	24	33%
RCC 75% subside	9	30	23%