Flexible insurance for heterogeneous farmers

Results from a small scale pilot in Ethiopia

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Outline

Introduction: the problem of weather risk

- Financial instruments that allow households to manage risk improve farmers' welfare when bad events occur and help farmers use their resources in more efficient ways.
- Weather risk is a substantial source of uninsured risk for rural households–covariate nature of shocks make it difficult to manage entirely through risk-sharing networks or asset decumulation.
- How best to increase household's ability to withstand such shocks?

Introduction: can insurance help?

- Weather index based products have made it possible to think about providing insurance against such risks:
  - They are cheaper to provide: they pay on the basis of an independent index so do not require on farm loss assessment which is expensive per unit insured for smallholders
  - They substantially reduced moral hazard and adverse selection: traditionally a big challenge for yield insurance products.
- Yet demand for these products has been quite low and it has been difficult to move beyond pilot provision.
- There are many challenges to establishing sustainable supply and demand for such products.
- In this paper we particularly look at product design: would a different approach to product design make these markets more sustainable?

Securities: a different approach

- Multiple weather securities rather than one unique insurance policy.
- Weather securities are simple insurance policies that pay out a fixed amount if the specified event comes true.
- Events defined on monthly rainfall totals measured at a nearby weather station.

Securities example

	This policy costs 100 Birr and it will pay 500 Birr if the rain recorded at Butajira weather station is less than 116mm in July
	This policy costs 50 Birr and it will pay 500 Birr if the rain recorded at Butajira weather station is less than 97mm in July
	This policy costs 100 Birr and it will pay 500 Birr if the rain recorded at Butajira weather station is less than 114mm in August
	This policy costs 50 Birr and it will pay 500 Birr if the rain recorded at Butajira weather station is less than 96mm in August
	This policy costs 100 Birr and it will pay 500 Birr if the rain recorded at Butajira weather station is less than 79mm in September
	This policy costs 50 Birr and it will pay 500 Birr if the rain recorded at Butajira weather station is less than 61mm in September

Securities: a different approach

- Three characteristics that differentiate them from other indexed approaches:
  - Simple: Each security is simple–a fixed payout for one cut-off.
  - Flexible: Securities can be combined as an individual farmers wishes, i.e. they can be used as building blocks to insure different aspects of risk.
  - Inclusive: Farmers growing many different types of crops, and individuals in other weather-dependent livelihoods (e.g. rural traders) can by the securities that they need.
- Share other challenges of indexed products: particularly basis risk.

Outline

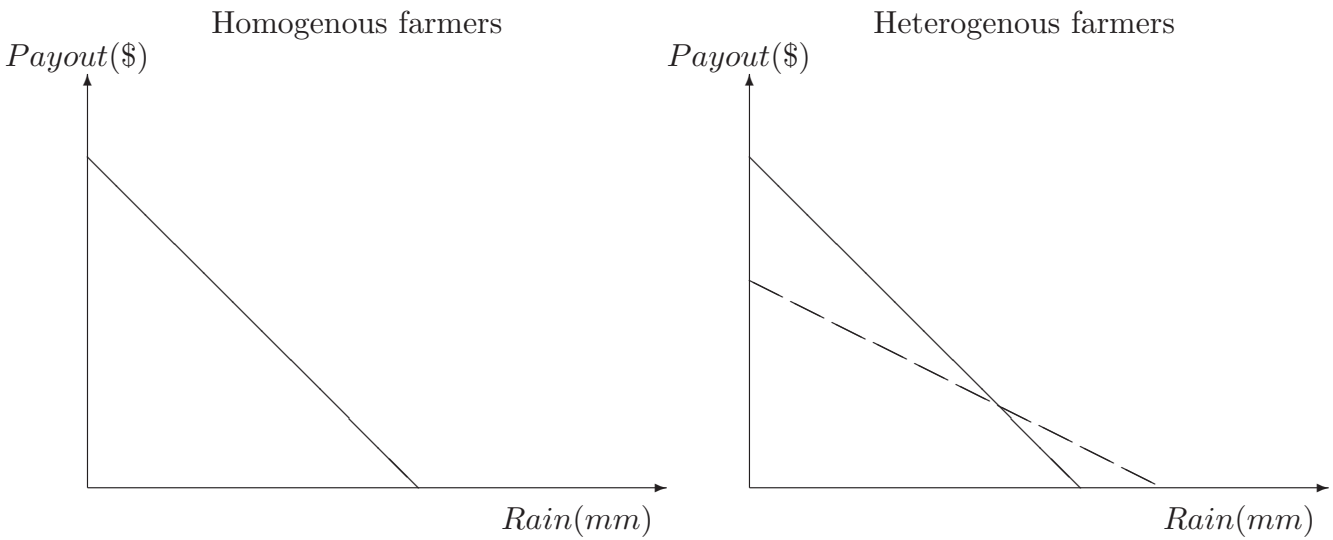
- Conceptual framework that highlights the trade-offs between this and other approaches.
- Empirical evidence on heterogeneity in rainfall needs in one kebele (4-5 villages).
- Results from an experimental game conducted in 2009.
- Results from pilot provision of these securities by Nyala Insurance Company in 2010.

Outline

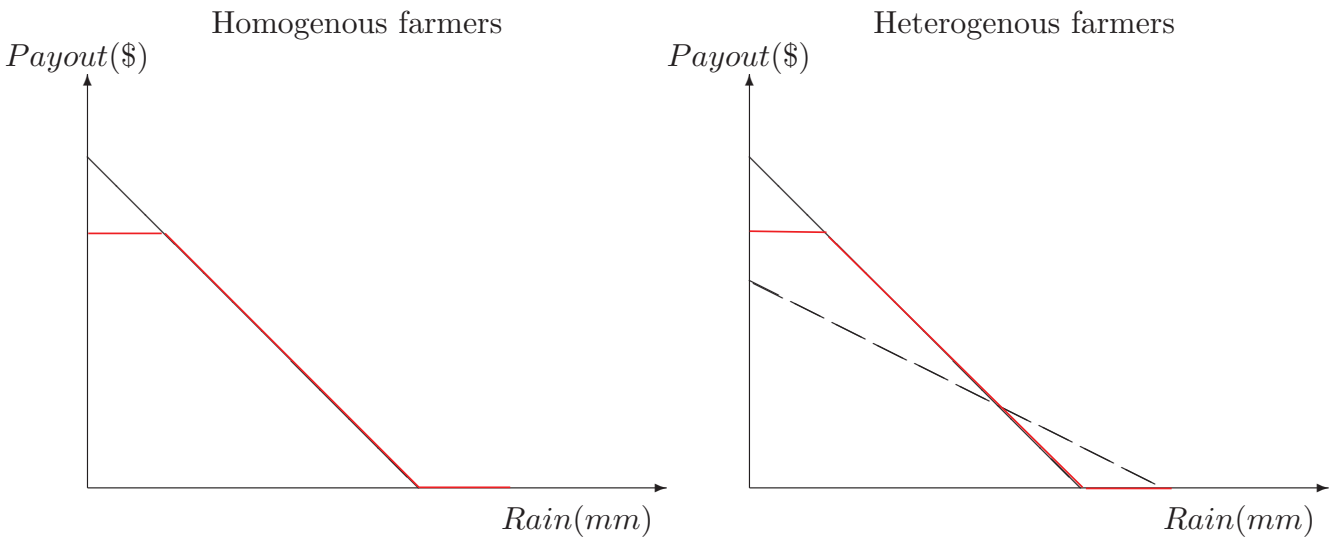
Conceptual framework

- Standard crop index insurance contracts:
  - Different payoffs in many states of the world based on the average water requirements of the average (or ideal) farmer.
  - One payoff profile for all farmers. But we know farmers are heterogeneous in productivity and production practices (Suri 2006), especially small-scale farmers.

Conceptual framework

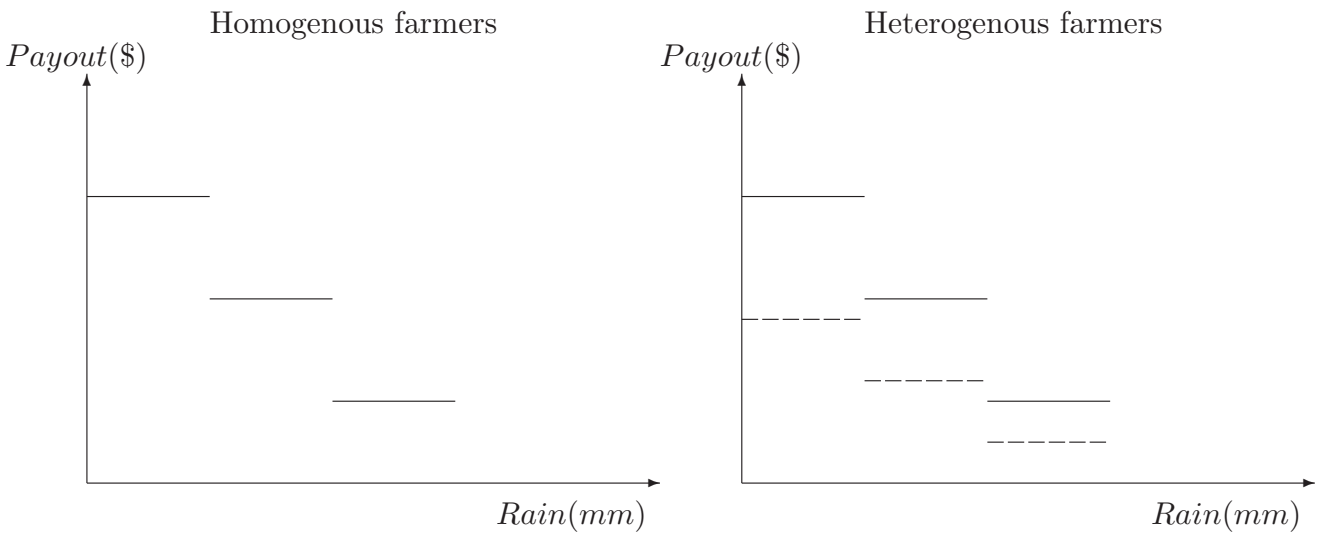


Conceptual framework



Conceptual framework

- Weather securities:
  - Flexible in providing different payoff profiles across different farmers
  - But limited in the number of payoffs across all states (there is a limit to the number of securities that can be provided).



Conceptual framework

- Trade-off between the two depends on:
  - The degree of heterogeneity across farmers rainfall needs in a locale (empirical question)
  - The disutility imposed by a flat payout structure for a limited number of cut-offs (in part dependent on shape of utility function)

Outline

How much heterogeneity of rainfall risk is there?

- In 2009 we started working in one kebele (a collection of 4-5 villages) in Silte woreda in southern Ethiopia.
- Focus group discussions revealed clear differences in crops grown by farmers in different parts of the kebele and their rainfall needs
  - Wheat and maize farmers were particularly concerned about the amount of rain in August
  - Barley farmers particularly concerned about the amount of rain in September
- Also differences in rainfall needs for the same crop depending on the farmer's type of soil and specific production practices (timing of planting, land preparation etc)
- Qualitative evidence of different rainfall risk $\rightarrow$ test this with quantitative data on perceptions of rain in the last 5 years.

Collecting data on historical rainfall risk

- When was the last year in which you received sufficient Kiremt rains (from June to September) for your crops?
- When was the last year in which the Kiremt rains failed?
- If [card showing 6 drops of rain] was the Kiremt rains received in [year rain was sufficient] and [card showing 1 drop of rain] was the rainfall received in [year rain failed], how would you describe the Kiremt rains in the other years in the last 5 years (for as many as you can remember)?

Analysis of heterogeneity of rainfall risk

- Combine this data with data on production choices and plot characteristics to see if this explains variation in perceptions.
- We find systematic variation in perceptions based on crop type, soil characteristics and production practices.

Analysis of heterogeneity of rainfall risk

Table 1: Weather perceptions in one kebele: year and crop variations

	(1)	(2)			(3)	
	Year only	Year and Crop+			Year and Barley Only+	
		Year	Barley	Wheat	Maize	Year	Barley
2004			-1.530**	-0.110	-1.190		-1.281**
			(0.759)	(0.482)	(1.297)		(0.646)
2005	-1.002***	-1.665***	1.996***	0.559	1.739	-1.278***	1.388**
	(0.147)	(0.307)	(0.755)	(0.472)	(1.280)	(0.173)	(0.643)
2006	0.658***	0.485	0.154	-0.510	0.452	0.491***	0.366
	(0.146)	(0.298)	(0.719)	(0.456)	(1.252)	(0.170)	(0.627)
2007	-3.775***	-4.188***	2.103***	-0.249	-0.065	-4.147***	2.248***
	(0.146)	(0.297)	(0.716)	(0.454)	(1.249)	(0.170)	(0.626)
2008	-0.530***	-0.507*	-0.839	-0.258	-2.577**	-0.634***	-0.314
	(0.146)	(0.297)	(0.716)	(0.454)	(1.249)	(0.170)	(0.626)
Constant							
Observations	1167	1163			1163		
Adj. R-squared	0.494	0.504			0.505		

Notes: +Each cell entry represents the coefficient of the crop interacted with the year dummy, all interactions were included in the same regression with the year dummies.
* Indicates significant at 10%, ** at 5% and *** and 1% levels of significance.

Analysis of heterogeneity of rainfall risk

Table 2: Weather perceptions in one kebele: including plot and production characteristics

	(2)				(3)					
	Including soil characteristics				Including soil and production characteristics					
	Year	Barley	Not Lem	Soil Cons.	Year	Barley	Not Lem	Soil Cons.	Extension	Fertilizer
2004		-1.269**	0.179	-0.498**		-1.190*	0.145	-0.512**	0.813***	0.210
		(0.632)	(0.232)	(0.226)		(0.653)	(0.230)	(0.225)	(0.208)	(0.220)
2005	-0.756**	1.109*	1.323***	-0.441**	0.066	1.257*	1.348***	-0.413*	-0.105	-0.236
	(0.332)	(0.628)	(0.229)	(0.224)	(0.396)	(0.648)	(0.227)	(0.222)	(0.206)	(0.216)
2006	0.295	0.296	0.431*	-0.059	0.827**	0.196	0.414*	-0.078	0.049	0.145
	(0.328)	(0.611)	(0.223)	(0.221)	(0.391)	(0.630)	(0.222)	(0.220)	(0.201)	(0.211)
2007	-4.842***	2.228***	-0.106	0.279	-3.987***	1.959***	-0.094	0.268	-0.482**	0.202
	(0.326)	(0.610)	(0.222)	(0.220)	(0.388)	(0.623)	(0.220)	(0.218)	(0.199)	(0.202)
2008	-0.544*	-0.074	-0.537**	-1.098***	-0.376	-0.021	-0.584***	-1.129***	0.621***	0.173
	(0.326)	(0.610)	(0.222)	(0.220)	(0.387)	(0.620)	(0.221)	(0.218)	(0.199)	(0.199)
Constant										
Observations	1163				1163					
Adj. R-squared	0.533				0.544					

Notes: +Each cell entry represents the coefficient of the crop interacted with the year dummy, all interactions were included in the same regression with the year dummies.
* Indicates significant at 10%, ** at 5% and *** and 1% levels of significance.

Outline

An experimental game

- Given this heterogeneity, take a securities approach.
- Tested this in an experimental game in 2009 in this kebele
- Two securities for each of the main months of the rainy season: July, August and September
- Identified a severe-loss and moderate-loss cut-off level for these months. The cutoff was for the rainfall recorded in mm in a weather station located some 20km away.
- Each security paid 100 Birr (US$9) and was priced at expected value.

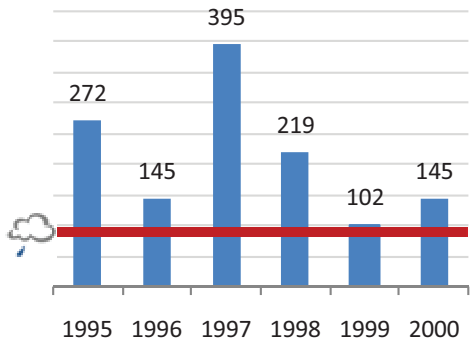
Example

100

This ticket will pay **100 Birr** if the amount of rain that falls at Butajira weather station

- from **Sane 24th, 2001 to Hamle 24th, 2001**
- is less than **100mm**

DMJ1XXX



This ticket would have paid in:
1965
1969
1974
1975
1987
1988
1992

A real-time experimental game

- Village meeting: random assignment to 3 groups: (i) participate through a group (their iddir), (ii) participate as an individual, (iii) not participate.
- Endowment: all participants randomly allocated an endowment of cash that they could use to purchase securities.
- Training session: those participating as individuals and leaders of groups were trained on the securities. Leaders of groups were asked to communicate the concept to group members and to purchase on behalf of their members.
- Purchase days: securities were bought during two purchase days, remaining money not spent was given out in cash at end of 2nd day.
- Payout day: in October payments made for securities that came true.
- Follow-up survey

Results of experiment

- Understanding was high: securities were simple enough such that key features could effectively be communicated by those trained to those not in the meeting.
  - Little difference in understanding between individuals trained directly and individuals trained by their group leaders in a subsequent interactions.
- Total endowment was a strong predictor of the amount of insurance purchased.
  - Liquidity does seem to constrain demand: 97% of households said they would purchase securities if given money again to purchase, 67% said they would purchase if they had to pay out of their own pocket. In reality few purchased in the next year.

Understanding

Table 7: Characteristics of understanding: regressing the understanding score on nature of participation

	(1)	(2)	(3)	(4)	(5)
Participated as an individual	2.110***	2.104***	1.797***	1.853***	
	(0.497)	(0.498)	(0.484)	(0.468)	
Participated as a group and were trained	4.028***	4.394***	3.397***	3.561***	1.787***
	(0.443)	(0.701)	(0.479)	(0.466)	(0.556)
Participated as a group and were not trained	1.698***	2.040***	1.749***		
	(0.319)	(0.628)	(0.313)		
Group held meeting & they attended all meetings last year				2.920***	1.036**
				(0.389)	(0.465)
Group held meeting & they missed a meeting last year				1.551***	-0.170
				(0.486)	(0.564)
Group did not hold a meeting				1.633***	-0.211
				(0.309)	(0.403)
Sample	Full	Full	Full	Full	Not control
Characteristics included	No	Iddir f.e.	Yes	Yes	Yes
Observations	406	406	401	401	361
Adjusted R-squared	0.166	0.165	0.225	0.276	0.233

Notes: * Indicates significant at 10%, ** at 5% and *** and 1% levels of significance.

Total purchases

Table 10: Regressions on the amount of insurance purchased

	(1) Amount spent	(2) Amount spent (incl. characteristics)
Endowment	0.205*	0.288**
	(0.105)	(0.112)
Number of people in group	15.252***	14.710***
	(4.387)	(4.470)
Constant	-7.416	7.127
	(27.131)	(58.853)
Observations	35	34
Adjusted R-squared	0.879	0.881

Notes: * Indicates significant at 10%, ** at 5% and *** and 1% levels of significance.

Results of experiment

- Individuals in groups bought as a group which resulted in a few separate purchases observed, so analysis is mainly hypothesis generating.
- The choices of which securities to buy reflect differences in risk:
  - Individuals with poor soil quality were more likely to purchase securities for the beginning of the season
  - Those receiving extension were more likely to purchase more securities and more for September.

Outline

Pilot provision in 2010

- In 2010 we worked with Nyala Insurance Company (NISCO) and the University of Oxford to sell securities as insurance products to farmers.
- NISCO provided weather securities for the months of June, July, August and September in this and other nearby kebeles.
- Two securities for each month (extreme and moderate risk), each paying out 500 Birr
- Priced at their expected value.
- Premium paid from farmers' own pocket.
- Survey carried out for 480 farmers in villages in which insurance was sold.

Lessons from the pilot

- Insurance purchases were high (42% of those trained and 27% of households on average). Much higher than in other pilots: is this as a result of product design or greater risk in Ethiopia, or lower prices?
- Purchases reflected differences in price risk:
  - Barley farmers more likely to buy in September and less likely to buy in July and August.
  - Farmers with poor soil quality were again more likely to buy insurance for the beginning of the season. Also more likely to buy in September.
  - Use of fertilizer influenced which months were purchased.

Amount purchased

Table 8: Purchases of securities

Security	Number purchased	Proportion of farmers purchasing	Total
June (50 Birr)	43	9%	2,150 Birr
June (100 Birr)	8	2%	800 Birr
July (50 Birr)	16	3%	800 Birr
July (100 Birr)	5	1%	500 Birr
August (50 Birr)	32	7%	1,600 Birr
August (100 Birr)	9	2%	900 Birr
September (50 Birr)	31	6%	1,550 Birr
September (100 Birr)	4	1%	400 Birr
Total	*148*	*27%*	*8,700 Birr*

Pattern of purchases

Table 14: Security choices in 2010 (SUR estimation)

	Purchased June	Purchased July	Purchased August	Purchased September
Proportion of barley	-0.477	-1.086	-1.250	1.770**
	(0.942)	(0.743)	(0.917)	(0.844)
Proportion of wheat	0.190	-0.312*	0.009	-0.101
	(0.210)	(0.166)	(0.205)	(0.188)
Proportion of maize	0.239	-0.283	-0.003	-0.193
	(0.239)	(0.188)	(0.232)	(0.214)
Proportion of land not lem	0.195*	0.007	-0.152	-0.081
	(0.110)	(0.086)	(0.107)	(0.098)
Undertakes soil conservation	-0.024	-0.072	-0.238**	0.197**
	(0.098)	(0.078)	(0.096)	(0.088)
Number of extension visits	-0.010	-0.004	0.002	0.019*
	(0.011)	(0.009)	(0.011)	(0.010)
Uses DAP	0.222	0.061	0.199	-0.299*
	(0.175)	(0.138)	(0.170)	(0.157)
Uses urea	-0.380***	0.060	0.018	0.225*
	(0.131)	(0.103)	(0.127)	(0.117)
Sample	insurance purchasers	insurance purchasers	insurance purchasers	insurance purchasers
Fixed effects	district	district	district	district
Observations	118	118	118	118
Adjusted R-squared	0.136	0.099	0.115	0.184

Conclusions and future work

- Securities show promise.
  - Take-up rates were high in an area with considerable diversity in crops planted.
  - Evidence consistent with farmers purchasing according to heterogeneity in rainfall risk.
- Particularly useful in environments where formal insurance products are new (simple to understand) and heterogeneity in rainfall risk is high.
- However, they carry non-negligible basis risk. How to handle?
  - Sell through groups, so that groups can help insure within group variation: the other presentation in this session shows that when the product was sold as a group product (something that could be shared) sales were much higher. Future work: understand why and how sharing rules established.
  - Combine with contingent credit and reserves, so that groups can self-insure against downside basis risk.