Lecture 4: Agriculture and Risk

EC2303: Intermediate Development Economics

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Context for this lecture

- Last week, we saw that investment in productive activities can be constrained by imperfect credit markets (moral hazard, adverse selection).
- Microfinance tries to solve these problems, and succeeds to some extent, but imperfectly.
- Today we'll think about another constraint to productivity in low-income settings: risk.
- We'll see that the poor face a lot of risk. Similarly as for credit, this suggests that insurance should be beneficial for them. Indeed, we'll see that insurance has positive effects on both investment and well-being.
- However, this also suggests that the poor should want to buy insurance, and that insurance products should therefore be available to them. We'll see that this is often not the case, and think about why.
- One answer will be that the insurance premiums need to be paid early, while the benefits only arrive later. Together with liquidity constraints and present bias, and possibly imperfect trust in insurance companies, this can make insurance policies unattractive.

The poor face a lot of risk

Seema Jayachandran, 2006: low-GDP countries have very high wage volatility

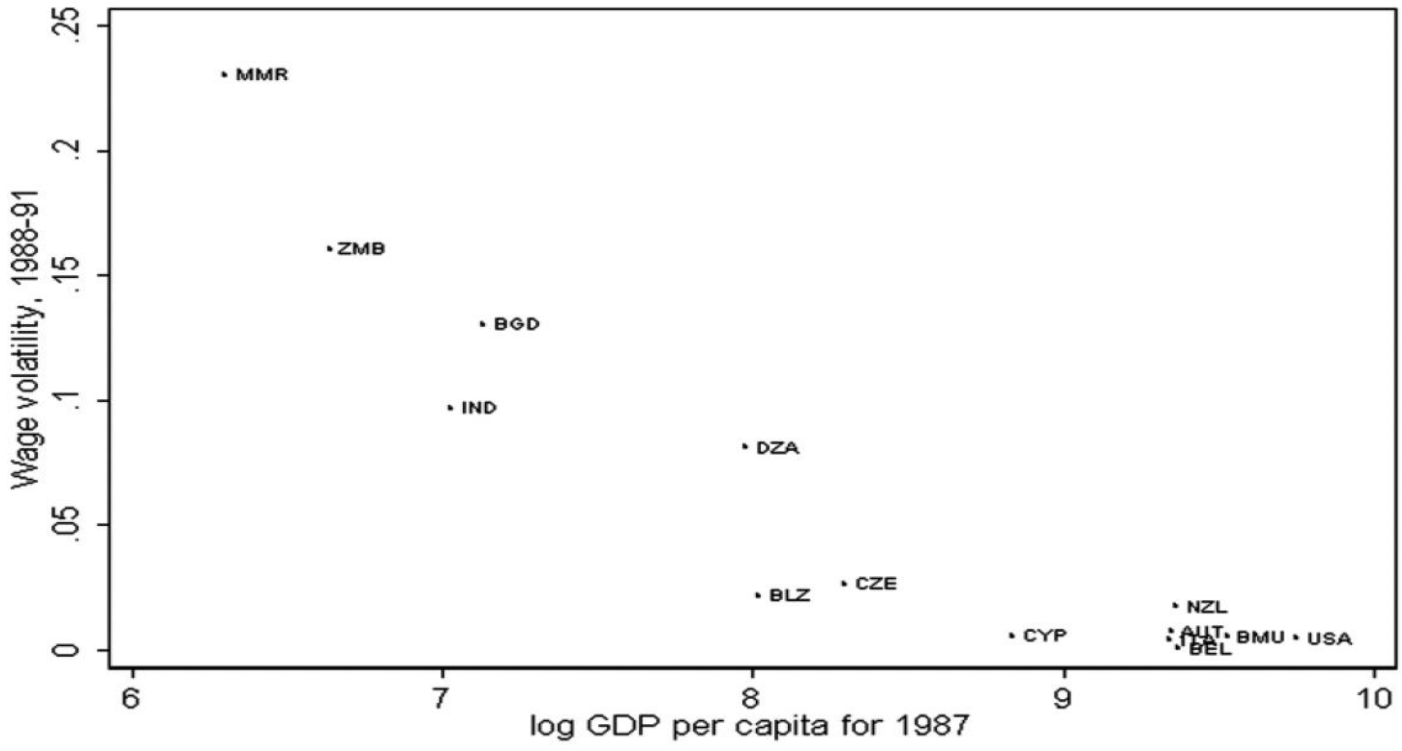


FIG. 1.—Agricultural wage volatility vs. GDP. Wage volatility is calculated from Occupational Wages around the World (OWW) data (Freeman and Oostendorp 2000). It is the standard deviation of log average monthly real wages for a male field crop farmworker, first removing a country-specific linear trend. The log of annual real GDP per capita (in 1996 U.S. dollars) is taken from the Penn World Tables. The sample consists of all countries for which farmworker wage data are available for each of 1988–91 (AUT = Austria, BGD = Bangladesh, BEL = Belgium, BMU = Bermuda, BLZ = Belize, CZE = Czechoslovakia, CYP = Cyprus, DZA = Algeria, IND = India, ITA = Italy, MMR = Myanmar, NZL = New Zealand, USA = United States, and ZMB = Zambia). The OWW data set covers 1981–99; the 1988–91 period yields the largest balanced panel with at least four years per country. The patterns are similar when other subsamples are used.

The poor face a lot of risk

Gilbert & Morgan, 2010: high food price volatility around the world

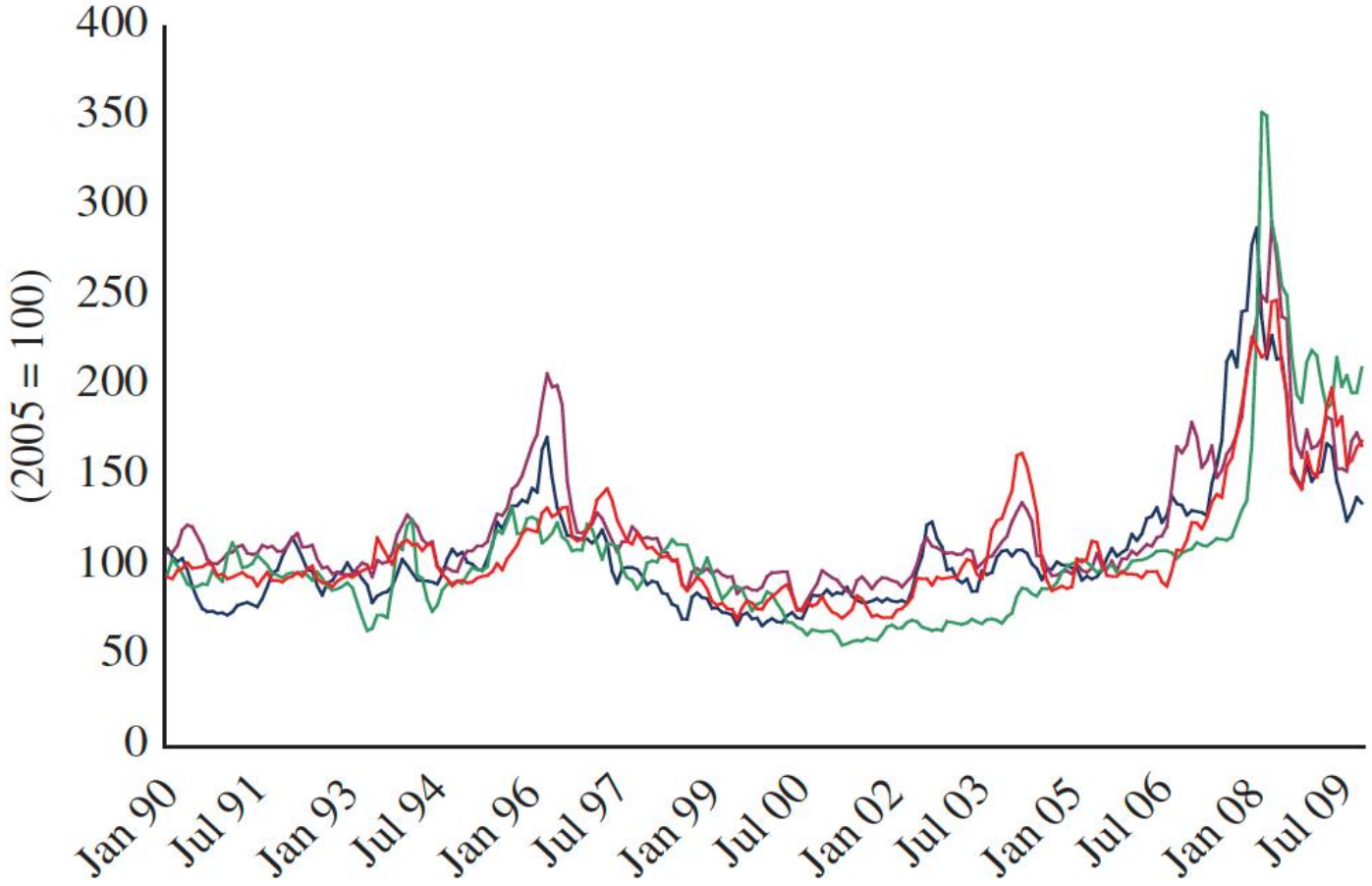


Figure 1. Grains price index numbers (2005 = 100), 1990–2009. Dark grey line, wheat; brown line, maize; green line, rice; red line, soya beans.

A simple model of insurance demand

- Remember our micro-entrepreneur from last week? They have a project that requires one unit of capital and pays return R with probability p, and nothing with probability $1-p$. So the expected earnings are again pR.
  - E.g., the person could be a farmer, and $1-p$ could be the probability of a bad weather event, such as a drought, that destroys their crop.
- Now consider an actuarially fair insurance product that compensates the farmer in case they lose their harvest. Actuarially fair means that the cost of the insurance is equal to the expect cost of the claim.
- The expected cost of the claim is $C = (1-p)R$, so that is the price of the insurance. Importantly, this price needs to be paid regardless of whether the drought happens.
- So if everything goes well (probability p), the farmer earns their return R, and pays the cost of the insurance C. So their income is $R-C$. Substituting the actuarially fair cost of insurance, $R-C$ becomes $R-(1-p)R = pR$.
- If there is a drought, the farmer doesn't earn R; they still pay the cost of the insurance C; but they get compensated by the insurance company to make up for their lost R. So their income is, again, $R-C$, where R is now not what they earned, but the compensation for their lost earnings from the insurance. Again, because the insurance is actuarially fair, we can substitute for C, so their expected total earnings are pR.
- So both with and without insurance, our farmer can expect to earn pR. Why would they want the insurance?

Risk-averse people take up actuarially fair insurance

- Last week we assumed our farmer was risk neutral. However, most people are risk *averse*. So we will adopt this somewhat more realistic assumption now. With risk aversion, our farmer will prefer the insurance.
- (Why didn't we do this already last week? Because we mainly focused on problems that limit the *supply* of credit, so risk aversion of the borrower wasn't so important. But for insurance, low *demand* is a big part of the story, so to understand it we need to get the person's preferences right.)
- What is the farmer's utility without insurance?
  $U_{NoInsurance} = p \cdot u(R) + (1-p) \cdot u(0) = p \cdot u(R)$
- What is the farmer's utility with insurance?
  $U_{Insurance} = p \cdot u(R-C) + (1-p) \cdot u(R-C) = u(R-C) = u(pR)$
- With a linear utility function, $u(x) = x$, notice that these utilities are the same: the person is indifferent between insurance and no insurance. They are *risk-neutral.*
- With a concave utility function, they prefer the insurance. Here's why: concavity is defined as $u(py_1 + (1-p)y_2) > pu(y_1) + (1-p)u(y_2)$. Let's adapt this to our setting: $y_1 = R$, $y_2 = 0$. Then we have:
  $u(pR+0) > pu(R) + 0 \Longrightarrow u(pR) > pu(R)$.
- This means that utility with insurance is larger than without insurance, even though expected earnings are the same! Concave utility implies risk aversion, and risk-averse people will take up actuarially fair insurance.

Benefits of insurance

- Karlan et al., 2014: Increased agricultural investment with crop insurance
- Haushofer et al., 2020: Lower levels of self-reported stress and stress hormones (cortisol) with health insurance

	Intent-to-treat		
	(1) Insurance	(2) UCT	(3) Difference *p*-value
Log avg. cortisol level	−0.14**	−0.02	0.04**
	(0.06)	(0.07)	
Log avg. cortisol less 100	−0.15**	−0.07	0.16
	(0.06)	(0.06)	
Log avg. cortisol (.99 Wins.)	−0.14**	−0.03	0.05**
	(0.06)	(0.06)	
Joint *p*-value	0.06*	0.17	0.16

Why is insurance take-up low?

Casaburi & Willis, 2018

- But: insurance takeup is often extremely low (e.g. Ahmed et al., 2017; Giné et al., 2008; Dercon et al., 2014: all under 5%). Why?
- One possibility: premium has to be paid now, but benefits don't arrive until later! Can we test experimentally if this matters?
- Lorenzo Casaburi & Jack Willis worked with a large sugar factory in Western Kenya, and the small-holder farmers that deliver their sugarcane to it.
  - Largest sugar company in East Africa, founded in 1971
  - $\sim$ 80,000 farmers grow sugarcane for the company under contract
- Sugarcane is the main cash crop in the region.
  - It's an important source of income for many farmers: $> 1/4$ of total income for 80% of farmers, $> 1/2$ for 38%
  - Long crop cycle ($\sim$16 months), so harvest is important, and crop failures are very damaging.

Experimental setting

Casaburi & Willias, 2018

- The contracts between the company and the farmers stipulate that the farmers must sell to the company, and the company must buy from the farmer.
  - Company harvests the crop and pays the farmer by weight
  - The contract covers 3+ crop cycles (4+ years)
- "Interlinking": As is common in contract farming, credit is interlinked with the contract:
  - The company provides input to the farmers on credit (e.g. fertilizer)
  - The costs for this input, plus interest, are later deducted from the harvest.
- The core idea of this study: This same mechanism can be used to sell crop insurance to the farmers! The strong relationship between them and the factory makes it possible for them to pay later.

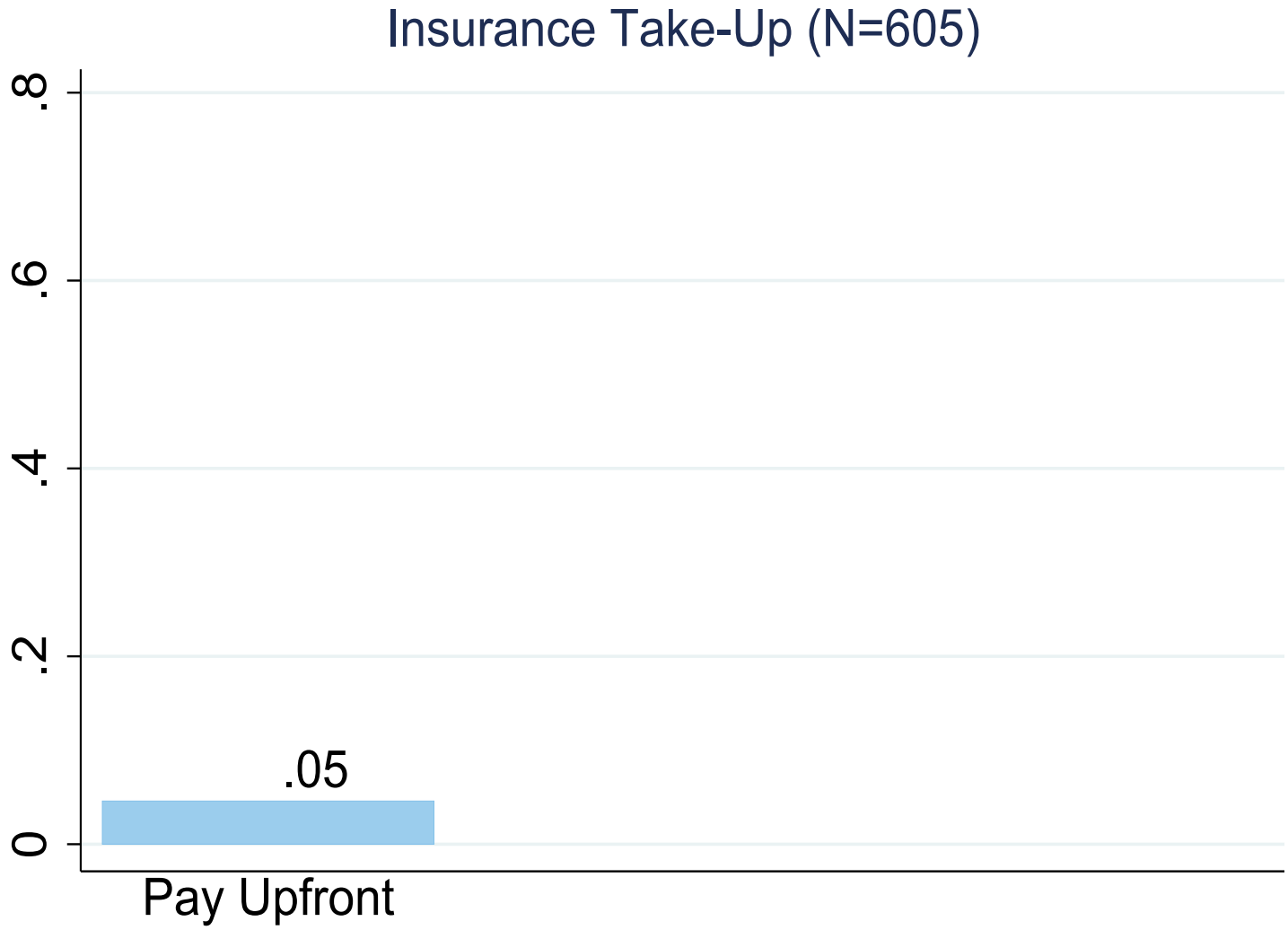
Experimental setting

Casaburi & Willias, 2018

- 605 farmers are offered crop insurance. It's partly an index insurance: it pays when the yield of the field is lower than predicted by a set of variables (e.g. plot size & location).
  - Index insurance solves the moral hazard problem: payouts don't depend on your effort. (So this is perhaps not a *perfect* index insurance because it still depends on yield, which might depend on effort.)
- The insurance is offered at actuarially fair prices, or with a discount. The actuarially fair premium is USD 18 on average, which corresponds to about 3% expected revenue.
- If the pays out, it covers 20% of expected revenue.
- Treatment groups:
  1. Offer insurance at actuarially fair price, paid now
  2. Offer insurance with a 30% discount, paid now
  3. Offer insurance at actuarially fair price, paid at harvest time.
- What is take-up when payment is delayed?

Impact of delayed payment on take-up

Casaburi & Willis, 2018



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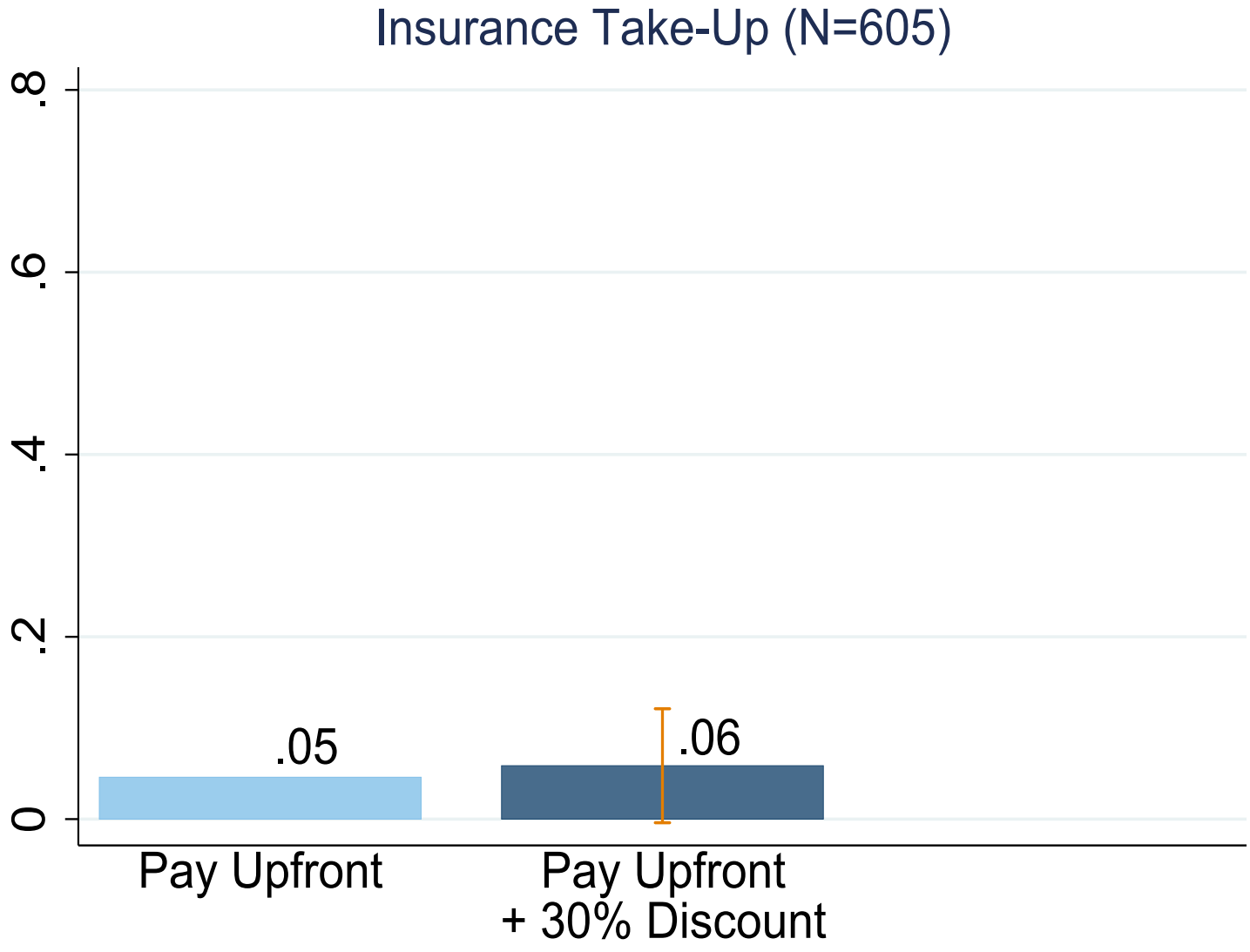
Casaburi & Willis, 2018



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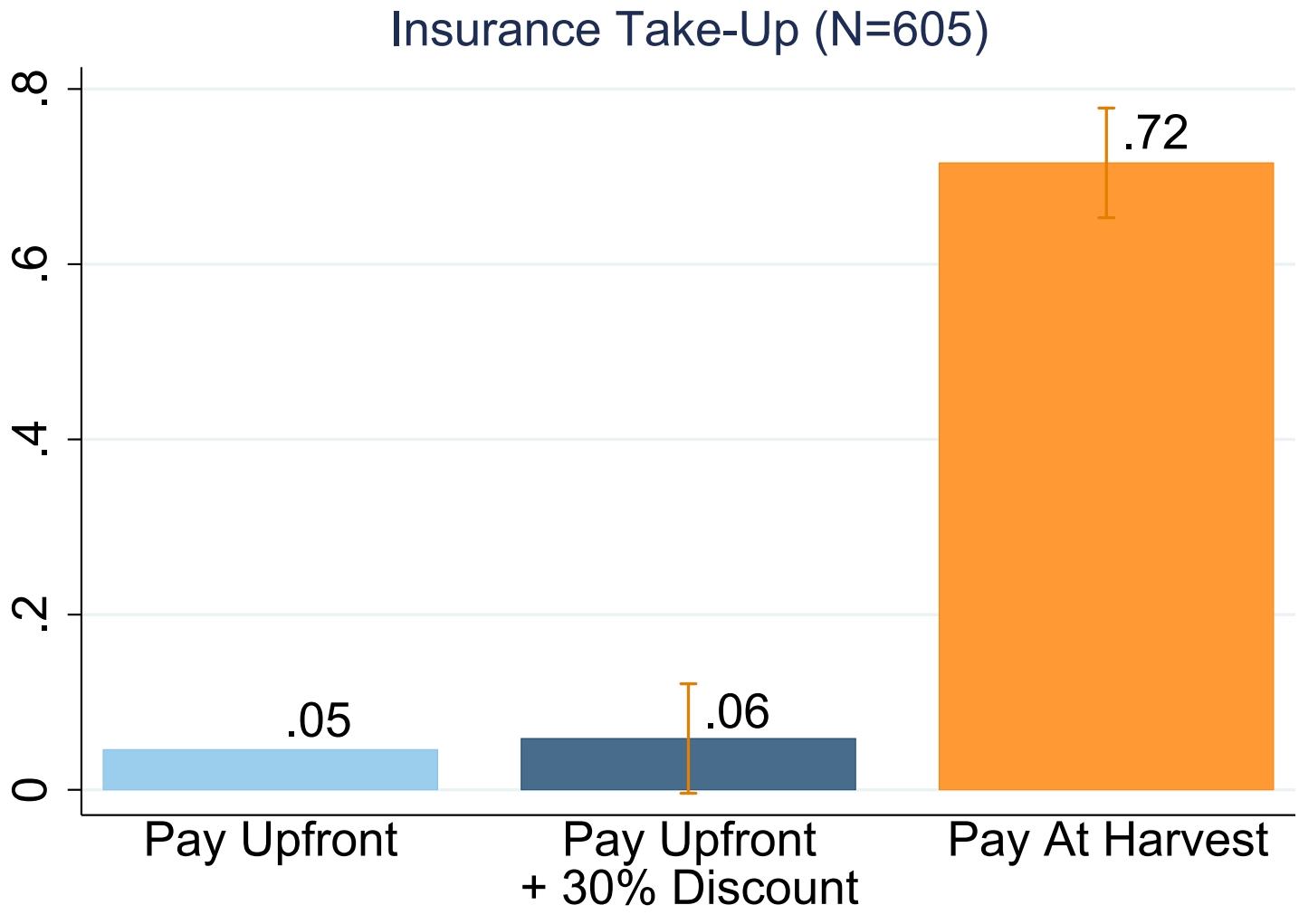


Potential mechanisms

Casaburi & Willis, 2018

What explains the increase in demand when payment happens at harvest?

1. Liquidity constraints? People may not have the money to pay immediately, but have money at harvest
2. Time preferences / present bias? People may not like having to pay the premium immediately when the benefits only materialize later

Evidence for liquidity constraints – 1

Casaburi & Willis, 2018

The increase in take-up when payment is delayed is smaller amongst those farmers who have high income:

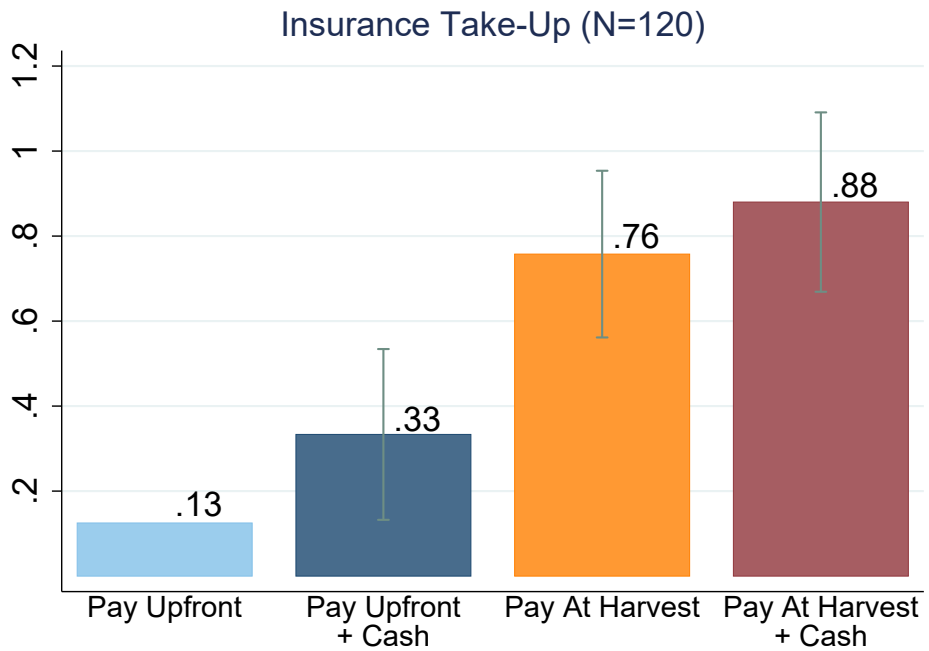
	Land Cultivated	Own Cow(s)	Previous Yield	Plot Size	Portion Income from Cane	Savings for Sh1,000	Savings for Sh5,000
X*Pay At Harvest	-0.065**	-0.139*	-0.079**	-0.001	0.053*	-0.174**	-0.131
	[0.033]	[0.078]	[0.031]	[0.031]	[0.028]	[0.069]	[0.097]
X	-0.000	0.066	0.015	-0.022	-0.004	0.006	-0.016
	[0.017]	[0.044]	[0.020]	[0.019]	[0.016]	[0.043]	[0.059]
Pay At Harvest	0.706***	0.822***	0.673***	0.672***	0.540***	0.764***	0.725***
	[0.029]	[0.068]	[0.028]	[0.028]	[0.096]	[0.035]	[0.031]
Mean Y Control	0.052	0.052	0.052	0.052	0.052	0.052	0.052
Mean X	0	0.791	0	0	3.311	0.300	0.120
S.D. X	1	0.407	1	1	1.126	0.459	0.326
Observations	562	569	605	605	569	566	565

Put differently, the effect is especially large amongst poor farmers. This suggests that liquidity constraints may play a role in limiting take-up under the regular payment scheme.

Evidence for liquidity constraints – 2

Casaburi & Willis, 2018

Mechanism experiment: Provide farmers with money to buy the insurance, either immediately or at harvest. If take-up increases, liquidity constraints may be important.



The increase in take-up suggests that liquidity constraints are important in limiting take-up under the regular payment scheme. But they don't explain the entire effect of late payment.

Why present bias reduces insurance demand

- How might present bias (or discounting in general) affect take-up of insurance? Let's add a present bias parameter $\beta < 1$ to all delayed outcomes.
- Utility without insurance is now:
  $U_{NoInsurance} = p \cdot \beta \cdot u(R) + (1-p) \cdot \beta \cdot u(0) = p\beta u(R)$
- What is the farmer's utility with insurance?
  With insurance, the farmer pays the premium C immediately. Their income R only arrives at harvest time. Similarly, in case of drought, they don't get the insurance payout until harvest time. The payout amount is *not* paid with interest. So the farmer's utility is:
  $U_{Insurance} = p\,[u(-C) + \beta u(R)] + (1-p)\,[u(-C) + \beta u(R)] = u(-C) + \beta u(R)$
- Can this utility ever be smaller than the utility without insurance? This would imply $u(-C) + \beta u(R) < p\beta u(R)$.
- Rearranging: $(1-p)\beta u(R) < -u(-C)$
- Note that both the LHS and the RHS are positive, and that β only shows up on the LHS. So if we make β small enough, we can always make this inequality true.
- When that's the case, even a risk-averse farmer doesn't buy insurance: they dislike paying the premium immediately when the benefits only arrive later.

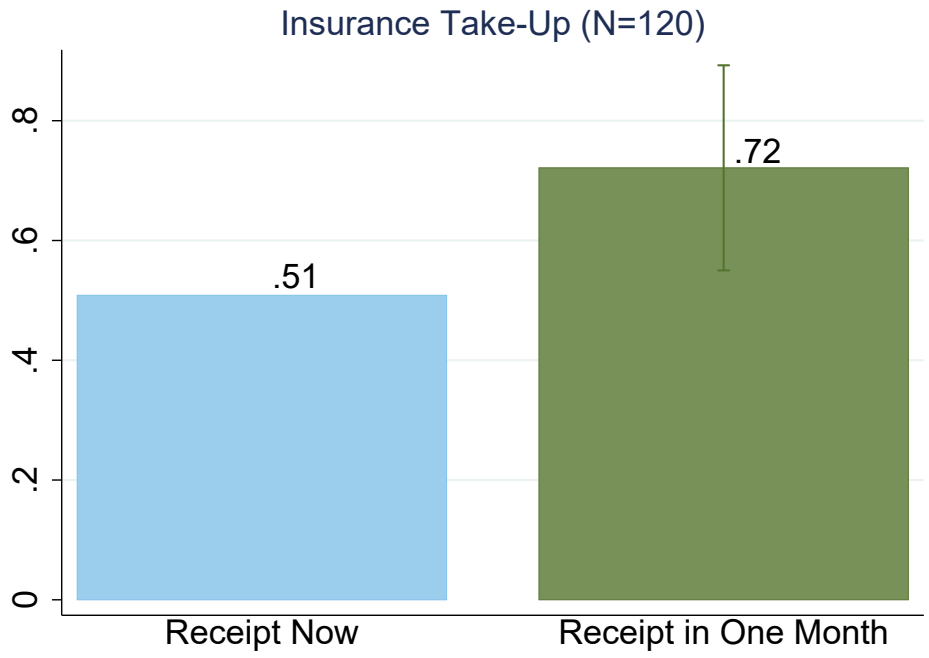
How to test for the importance of present bias

Casaburi & Willis, 2018

- Mechanism experiment: 120 farmers choose between receiving free insurance, or receiving the value of the premium in cash.
  - Group 1: Make a choice now; receive their chosen outcome immediately (cash or insurance)
  - Group 2: Make a choice now; receive their chosen outcome (+ interest) in 1 month
- How does this shed light on the role of present bias? Note first that people are making an *intertemporal choice* between a "sooner" and a "later" outcome: the cash can be used immediately after receiving it; the value of the insurance only materializes later.
- *Present bias* is a technical term that refers to a greater preference for "sooner" relative to "later" outcomes when the "sooner" outcome is received *immediately*
  - In this case: present bias implies a greater preference for cash over insurance when the cash is received immediately (Group 1), relative to when it is received in 1 month.
  - Put differently, with present bias, demand for insurance should be lower when the alternative (money) is available immediately.

Evidence for present bias

Casaburi & Willis, 2018



With present bias, demand for insurance should be lower when the alternative (money) can be received *now*. This is what we observe. This suggests that farmers are indeed present-biased, and this limits their demand for insurance.

Summary

- The poor face a lot of risk
- Risk-averse individuals should prefer actuarially fair insurance.
- Insurance has positive effects on investment and well-being
- In practice, take-up is very low.
- One reason for this is that premium payment in most cases is immediate, while the benefits are delayed.
- After the break, we'll talk about Karlan et al. (2014): Does insurance have positive effects on investment?

Next week

- STATA lab: Mon 20/9, 15:00–17:00, on Zoom. I will send a link the day before. Both SU and RSE students are welcome!
- In lecture, we'll talk about another possible source of poverty traps: nutrition.
- Lecture 5: Thu 23/9 10:00–12:00 (!), Auditorium 4, Södra huset hus B