The Impact of Insurance Products

BREAD-IGC Virtual Ph.D. Course

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Two classes on insurance

1. Impact of insurance products

2. Demand for insurance products

Today's class*

1. Motivation: risk and insurance
2. Theory: The effect of insurance on consumption and investment
3. Empirical evidence: Agricultural insurance
4. Empirical evidence: Health insurance

** Thanks to Esther Duflo, Greg Lane, and Cynthia Kinnan for sharing slides.*

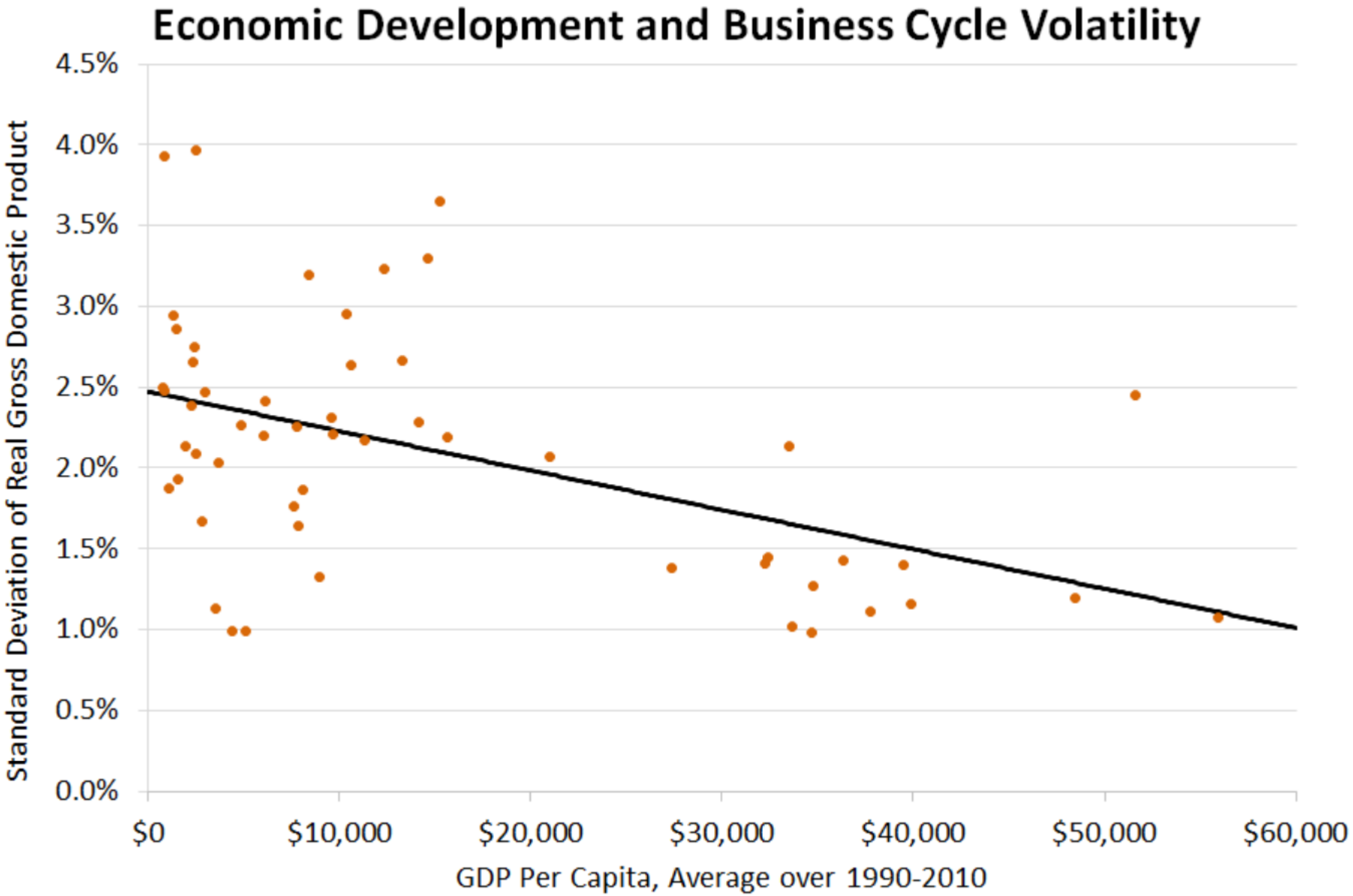
PART 1

Why insurance?

Risk in the lives of the poor

- The poor are exposed to many sources of risk
  - Droughts, floods (rainfed agriculture)
  - Price volatility
  - Health shocks

- These risks imply volatility in production, labor supply, and income



SOURCE: World Bank's World Development Indicators.

Production risk → consumption risk

- Fluctuations in production and income need not imply fluctuations in consumption

- For the poor, this is more likely to happen

- Why?
  - Incomplete credit markets and barriers to saving hinder risk coping
  - Limits to risk sharing (group insurance)

- More on this later in the course

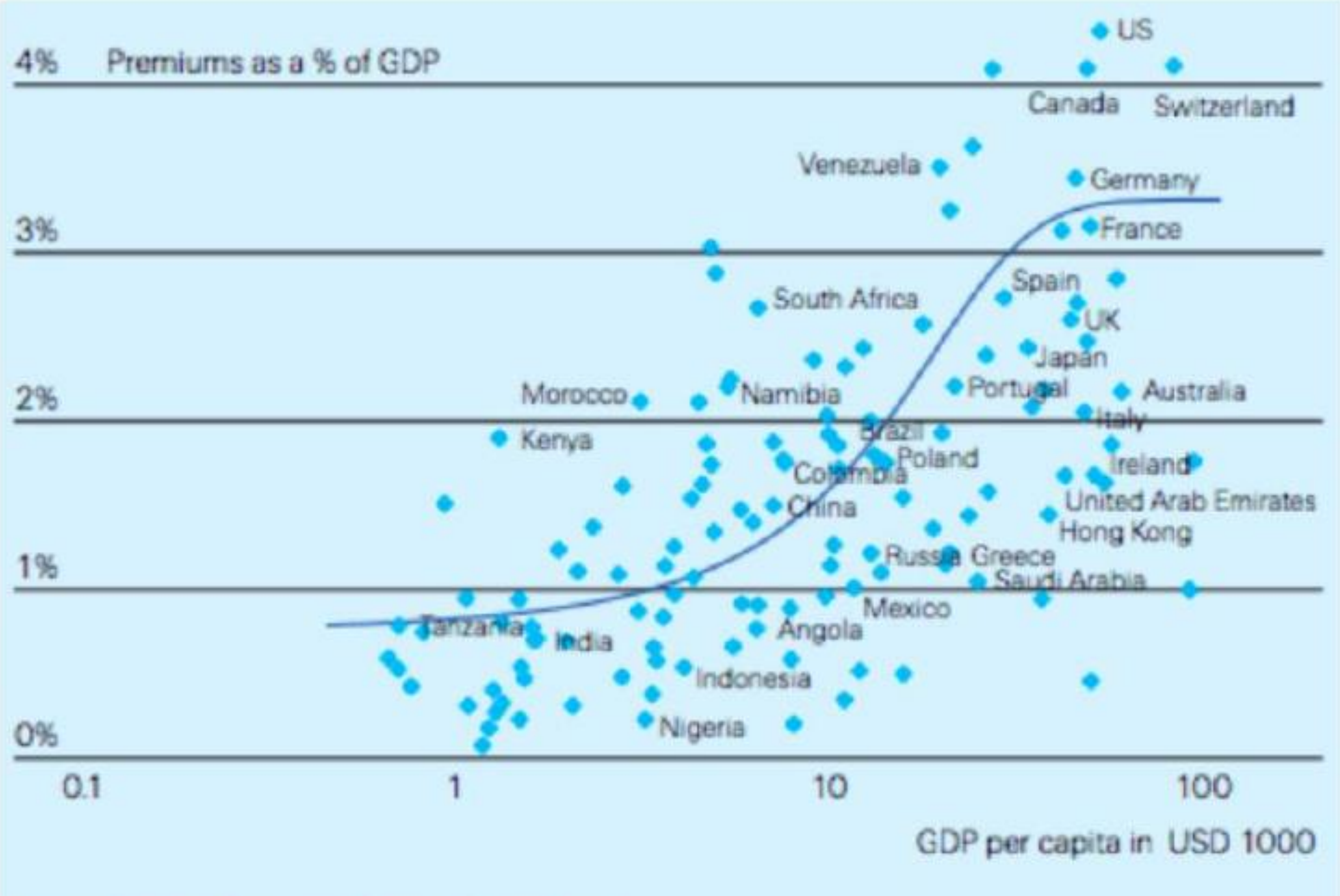
A role for insurance products?

- Given the limits to risk coping and group insurance, "formal" insurance products may be a promising alternative for risk-averse agents

- However, formal insurance penetration is lower in poor countries (Enz, 2000; Gine *et al.*, 2019)

- Reasons for low insurance penetration
  - Asymmetric information: adverse selection, moral hazard
  - Transaction costs
  - Low demand? (Lecture 2)

The insurance S-curve



Source: Swiss Re Economic Research & Consulting.

Microinsurance

- For the last 20 years, a growing body of work has been trying to design insurance products targeting the poor in developing countries
  - Policymakers, private sector, foundations, academics…

- Yearly industry reports by the *Micro Insurance Network*

Agricultural *index* insurance

- One example: Agricultural insurance for smallholder farmers

- Traditional agricultural insurance models may not fit well the poor: high verification costs, moral hazard, etc.

- *Index Insurance*: delinking payouts from the assessment of individual losses
  - Examples: area yield (not individual yield); rainfall; satellite-based measures of crop health (normalized difference vegetation index)

- Review papers: Carter et al., ARRE 2017; Cole and Xiong, ARE 2018

PART 2

The effect of insurance on consumption and investment: A simple model

A Theory of Intertemporal Choices

- In previous courses, you have studied consumption and production choices as independent problems

- In practice, for many poor households, the two decisions are intertwined
  - e.g., a small entrepreneur must decide how much money to allocate to business and/or household consumption

- A simple framework of intertemporal choices (***Karlan et al., 2014, Appendix***)
  - Agent must decide how much to consume/save
  - Agent must decide how much to invest (and thus, produce)

Setup (1)

- The agent lives two periods (t=1,2)

- In t=1, the agent is endowed with some pre-existing wealth (*Y)* and decides how much to consume, to invest in production (i.e., buy inputs), and to save/borrow

- In t=2, there are two states of the world: Good or Bad
  - Probability of state G is π_G; Probability of state B is $\pi_B = 1 - \pi_G$; assume π_G "sufficiently large"

- The agent can invest in a **risky input** x_r or a **hedging input** x_h

$$f_{G(x_r,x_h)} = A_G f(x_r); \quad f_{B(x_r,x_h)} = A_B f(x_h);$$
$$A_G > A_B;$$
$$f' > 0, \qquad f'' < 0$$

Setup (2)

- Utility

$$U = u(c^1) + \delta \sum_{s \in S} \pi_s u(c_s^2)\,,$$

  - where $S = \{G, B\}$
  - we assume $u'(c^t) > 0, u''(c^t) < 0$

- Budget constraint in period 1 (assume input prices equal to one):

$$c^1 = Y - x_r - x_h - a$$

  - Y: pre-existing wealth
  - a : saving (if >0) or borrowing (if <0)
  -

Individual Choices and Markets

- We study the consumption/saving/investment decisions under three scenarios:
  - **Complete credit and insurance markets**
  - **Missing credit markets**
  - **Missing insurance markets**

Complete Markets: Credit Markets

- Agents can transfer money across time at gross return, $R=1+r$
  - i.e., no restrictions on saving or borrowing
  - R does not depend on the state of the world in t=2

- Later we model restrictions to borrowing

Complete Markets: Insurance Markets

- The producer is in a **perfect risk-sharing arrangement**:
  - In the good state of the world, she pays into the risk-sharing pool
  - In the bad state of the world, she draws from the risk-sharing pool

- Therefore, she always receives the *expected value* of her investment, with no uncertainty

$$p * \left(\pi_G A_G f(x_r) + \pi_B A_B f(x_h)\right) \quad \textit{[p is the output price]}$$

Optimization with Complete Markets

$$Max_{a,x_r,x_h}\, u(c_1) + \delta u(c_2)$$

subject to:

$$c_1 = Y - x_r - x_h - a;$$

$$c_2 = p * (\pi_G A_G f(x_r) + \pi_B A_h f(x_h)) + R * a$$

- We can rewrite this as:

$$Max_{a,x_r,x_h}\, u(Y - x_r - x_h - a) + \delta u(p\pi_G A_G f(x_r) + p\pi_B A_h f(x_h) + R * a)$$

Saving/Consumption with Complete Markets

- Take the first order condition w.r.t a

- We obtain the **Euler Equation**

$$u'(c_1) = \delta R u'(c_2)$$

- What happens if $u'(c_1) > \delta R u'(c_2)$?

Investment decision with complete markets

- Take the first order condition w.r.t x_r $(or\ x_h)$ and plug in the Euler Equation

- We obtain the standard investment optimum condition: (expected) marginal productivity equalized to the cost of capital

$$\pi_G A_G p \frac{\partial f(x)}{\partial x_r} = \pi_B A_B p \frac{\partial f(x)}{\partial x_h} = R$$

- Does the discount factor δ enter the investment choice?

Separation

- With complete markets, **the production and the consumption decisions are separable**
  - I maximize the size of the pie
  - And then I decide how much to consume today and tomorrow

- This is an important result: wealth or impatience and other utility parameters do not enter the investment choice

Incomplete credit markets

- Assume incomplete credit markets: $a \geq 0$

- In other words, individuals in period 1 cannot borrow
  - (Later in the course, what if they cannot *save*?)

- Let's look at the consumption and investment choices for those agents for which this constraint binds.
  - Who are these people?

Optimum with credit constraints

- For constrained agents, consumption in period 1 is "too low" (i.e., u' is "too high")

$$u'(c^1) > \delta R\, u'(c^2)$$

- Constrained agents now face a tradeoff between consumption and investment.
- Euler equation becomes:

$$u'(c^1) = \delta \boldsymbol{\pi_G A_G p \frac{\partial f(x_r)}{\partial x_r}} u'(c^2)$$

  - Thus, expected marginal productivity is larger than R

$$\pi_G A_G p \frac{\partial f(x_r)}{\partial x_r} = \pi_B A_B p \frac{\partial f(x_h)}{\partial x_h} = \frac{u'(c^1)}{\delta u'(c^2)} > R$$

- **Separation fails:** investment now depends on wealth and utility parameters

Who are the “constrained” agents?

- Constrained agents are those that would like to consume more today, but they cannot do so

- One or more of the following characteristics:
  - Impatient
  - Low predetermined wealth
  - High(er) expected production (and consumption) in future period

Incomplete Insurance Markets

- Now, we allow credit, but we shut down insurance markets

- Therefore, individuals may have different consumption in period 2 depending on the state of the world (good or bad)

$$c_G^2 = pA_G f(x_r) + Ra \text{ with probability } \pi_G$$
$$c_B^2 = pA_B f(x_h) + Ra \text{ with probability } \pi_B$$

Consumption Optimum with Incomplete Insurance

- **Consumption:** marginal utility in t=1 equation to *expected* marginal utility in t=2

$$u'(c^1) = \delta R(\pi_B u'(c_B^2) + \pi_G u'(c_G^2)\ )$$

- **Investment:** underinvestment in the risky input

$$p\pi_G A_G \frac{\partial f(x)}{\partial x_r} = R\left[\pi_b \frac{u'(c_B^2)}{u'(c_g^2)} + \pi_G\right] > R$$

… and overinvestment in the hedging input

→ Risk preferences shape investment strategies

Theory: summing up

- You should be clear on the two different problems an individual faces
  - Consumption/Saving problem
  - Investment/Production problem
- Key concepts: **Euler Equation** and **Separation**
  - Work out solutions algebraically (e.g., $u(c) = \log(c)$ and $f(x) = x^{\alpha}$)
- Make sure to understand difference between incomplete credit markets and incomplete insurance markets
- The framework also derives predictions for the impact of cash grants and insurance products under various missing-market scenarios (later)

PART 3

Empirical evidence: agricultural insurance

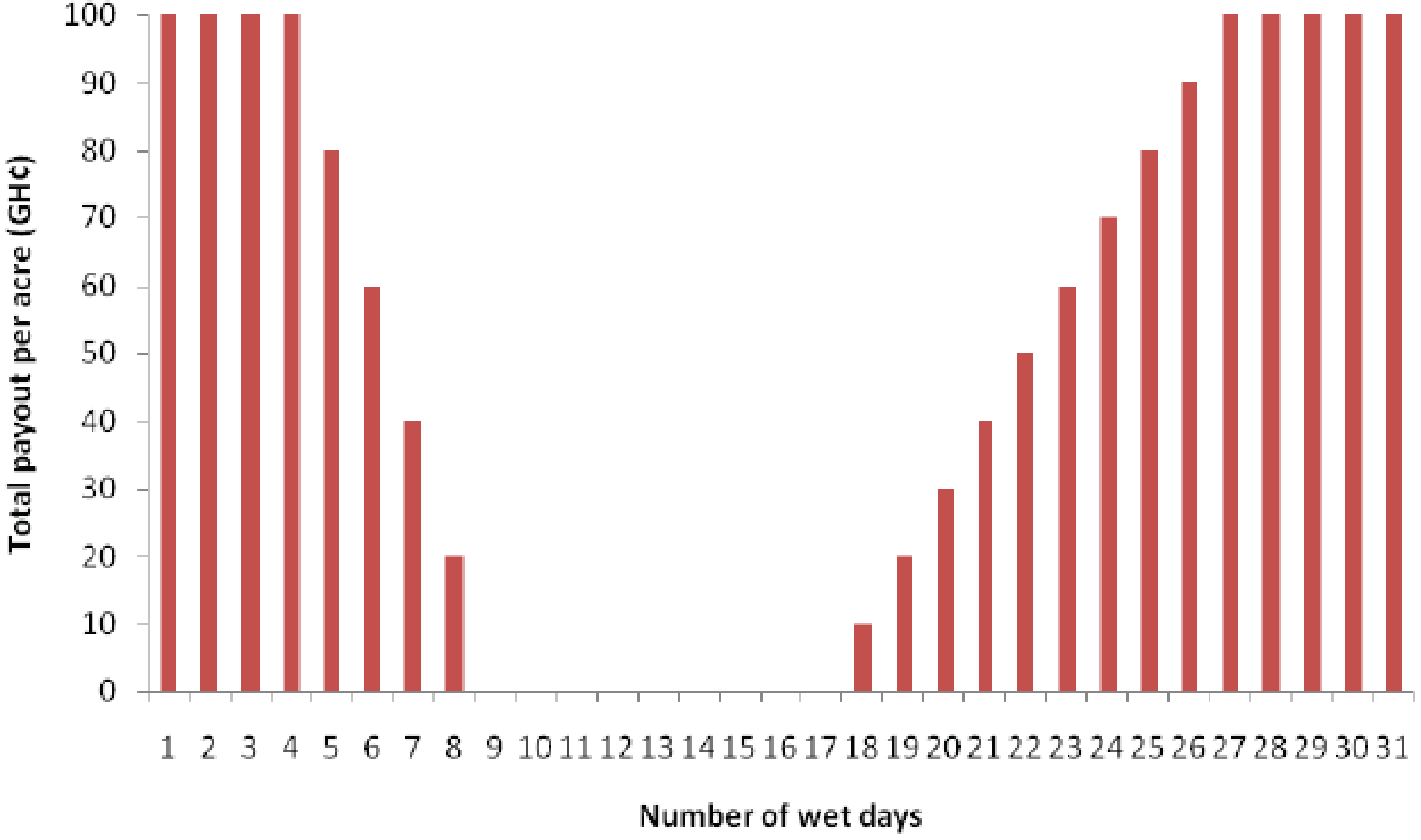
Karlan *et al.* (2014): Credit and insurance in Ghana

- RCT with farmers in 4 groups: control, capital grants, free rainfall insurance, grants + insurance

- Capital grants:
  - Provide sufficient support to purchase Ministry recommended inputs package
  - $85 per acre to max of 10 acres

- Rainfall insurance:
  - Index insurance based on number of wet days
  - Free insurance up to 15 acres (1st year) then subsidized premia (IV strategy using price subsidies as an instrument for insurance take up)

Triggers and payouts



Theory predictions

FIGURE 1 SUMMARY OF IMPLICATIONS OF MARKET IMPERFECTIONS

	Market Environment		Predicted Change in Investment					
	Perfect Capital Markets	Perfect Risk Markets	Capital Grant Treatment Only		Insurance Grant Treatment Only		Capital & Insurance Grant Treatment	
			Risky Asset	Hedging Asset	Risky Asset	Hedging Asset	Risky Asset	Hedging Asset
1	Yes	Yes	0	0	0	0	0	0
2	No	Yes	++	++	-	-	+	+
3	Yes	No	+ [36]	- [37]	++	- -	++	- -
4	No	No	+	+	-	-	?	?

[36] Small and positive via wealth effect, if DARA; zero if CARA.

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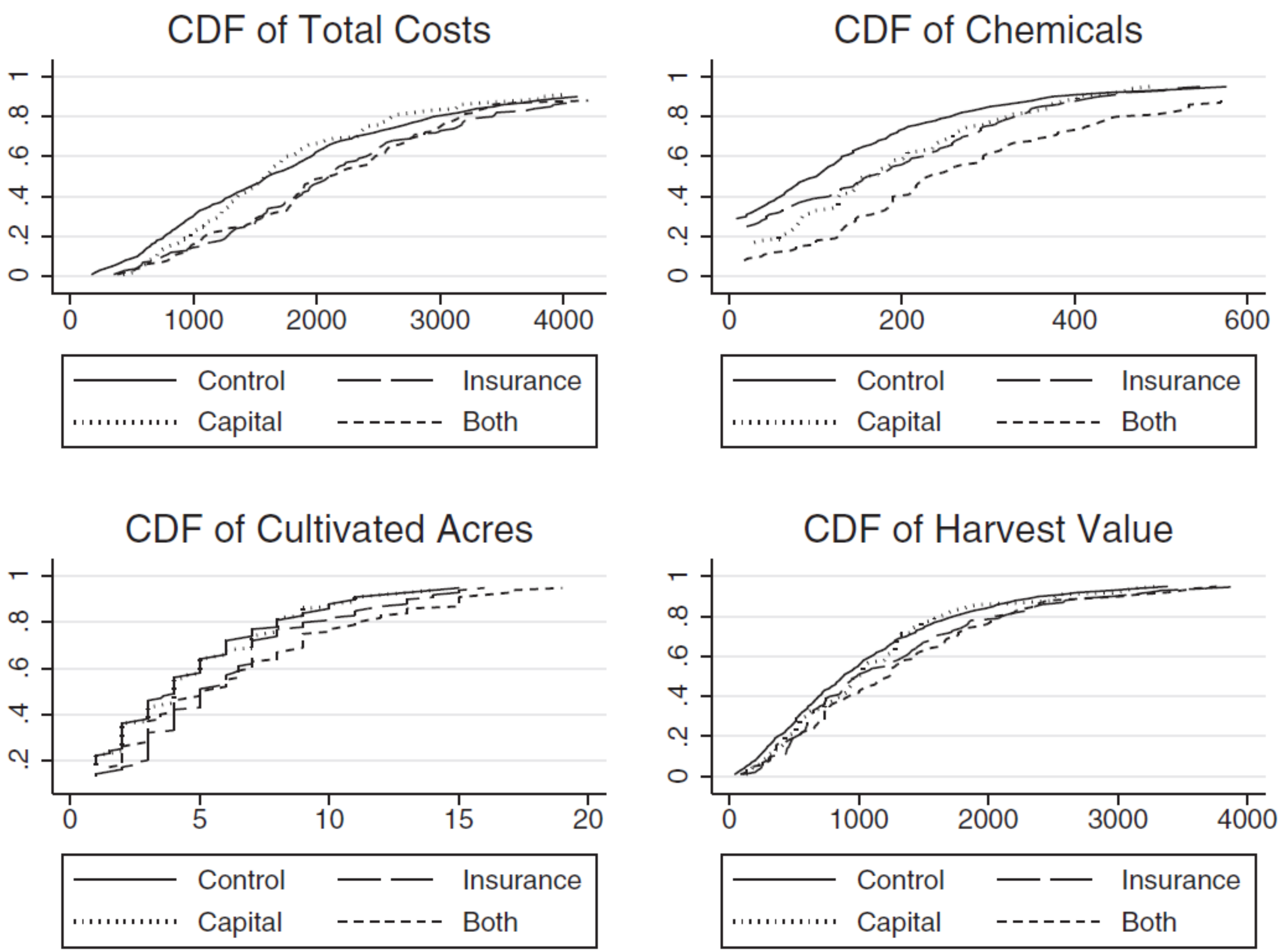
Results: Graphical evidence



Results: Investment and Harvest

TABLE IV

IMPACT ON INVESTMENT AND HARVEST (INSTRUMENTAL VARIABLES)

Dependent variable:	(1) Land preparation costs	(2) # of Acres cultivated	(3) Value of chemicals used	(4) Wages paid to hired labor	(5) Opportunity cost of family labor	(6) Total costs	(7) Value of harvest
Insured	25.53**	1.02**	37.90**	83.54	98.16	266.15**	104.27
	(12.064)	(0.420)	(14.854)	(59.623)	(84.349)	(134.229)	(81.198)
Insured * capital grant treatment	15.77	0.26	66.44***	39.76	−52.65	72.14	129.24
	(13.040)	(0.445)	(15.674)	(65.040)	(86.100)	(138.640)	(81.389)
Capital crant treatment	15.36	0.09	55.63***	75.61	−130.56	2.44	64.82
	(13.361)	(0.480)	(17.274)	(68.914)	(92.217)	(148.553)	(89.764)
Constant	169.38***	8.12***	171.70***	201.88***	1,394.58***	2,033.11***	1,417.52***
	(10.603)	(0.399)	(13.804)	(45.383)	(84.786)	(124.294)	(90.635)
Observations	2,320	2,320	2,320	2,320	2,320	2,320	2,320
R-squared	0.017	0.143	0.041	0.005	0.006	0.009	0.012
Mean for control	189.1	5.921	158.3	327.9	1,302	2,058	1,177
Chi^2 test of insured and insured + capital grant treatment	8.889	7.125	36.15	3.136	0.239	5.091	6.618
p-value	.003	.008	.000	.077	.625	.024	.010

Notes. Robust standard errors in parentheses. "Insured" instrumented by full set of prices (Table III, column (1) presents first-stage regressions). Total costs (column (6)) includes sum of chemicals, land preparatory costs (e.g., equipment rental but not labor), hired labor, and family labor (valued at gender/community/year-specific wages). Harvest value includes own-produced consumption, valued at community-specific market value. All specifications include controls for full set of sample frame and year interactions. $^{***}p < .01$, $^{**}p < .05$, $^{*}p < .1$.

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Results: Reallocation of investment

TABLE V

Reallocation of Investments (Instrumental Variables)

Dependent variable:	(1) Value of harvest	(2) Proportion of land planted with maize	(3) Average weekly orchard income	(4) Household has nonfarm income generating activity (binary)	(5) # of HH members working in nonfarm income generating activity	(6) Average weekly enterprise income
Insured	−1,069.13*	0.09***	−1.59*	−0.06*	−0.11*	−8.64
	(596.208)	(0.031)	(0.876)	(0.033)	(0.061)	(7.151)
Insured * capital grant treatment	1,324.48	0.04	0.65	0.07**	0.16**	3.77
	(821.152)	(0.029)	(0.776)	(0.033)	(0.062)	(9.126)
Capital grant treatment	−879.77	0.12***	−0.19	−0.04	−0.08	−2.83
	(642.233)	(0.034)	(0.926)	(0.038)	(0.066)	(4.530)
Insured * total rainfall	156.82**					
	(76.291)					
Insured * capital grant treatment * total rainfall	−155.36					
	(105.649)					
Capital grant treatment * total rainfall	124.95					
	(83.589)					
Total rainfall (hundreds of millimeters)	2,247.39***					
	(624.545)					
Total rainfall squared	−146.65***					
	(40.970)					
Constant	−7,154.76***	0.23***	2.42***	0.17***	0.22***	5.79
	(2,375.086)	(0.016)	(0.613)	(0.027)	(0.038)	(4.363)
Observations	2,320	2,782	2,316	2,320	2,320	2,350
R-squared	0.021	0.090	0.001	0.007	0.010	0.007
Chi^2 test of joint effect of insurance and insurance + capital	0.138	15.52	0.906	0.132	0.388	0.449
p-value	.710	8.16e-05	.341	.717	.534	.503
Mean for control	1177	0.309	2.587	0.261	0.405	6.604

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REALLOCATION OF INVESTMENTS (INSTRUMENTAL VARIABLES)

Dependent variable:	(1) Value of harvest	(2) Proportion of land planted with maize	(3) Average weekly orchard income	(4) Household has nonfarm income generating activity (binary)	(5) # of HH members working in nonfarm income generating activity	(6) Average weekly enterprise income
Insured	−1,069.13*	0.09***	−1.59*	−0.06*	−0.11*	−8.64
	(596.208)	(0.031)	(0.876)	(0.033)	(0.061)	(7.151)
Insured * capital grant treatment	1,324.48	0.04	0.65	0.07**	0.16**	3.77
	(821.152)	(0.029)	(0.776)	(0.033)	(0.062)	(9.126)
Capital grant treatment	−879.77	0.12***	−0.19	−0.04	−0.08	−2.83
	(642.233)	(0.034)	(0.926)	(0.038)	(0.066)	(4.530)
Insured * total rainfall	156.82**					
	(76.291)					
Insured * capital grant treatment * total rainfall	−155.36					
	(105.649)					
Capital grant treatment * total rainfall	124.95					
	(83.589)					
Total rainfall (hundreds of millimeters)	2,247.39***					
	(624.545)					
Total rainfall squared	−146.65***					
	(40.970)					
Constant	−7,154.76***	0.23***	2.42***	0.17***	0.22***	5.79
	(2,375.086)	(0.016)	(0.613)	(0.027)	(0.038)	(4.363)
Observations	2,320	2,782	2,316	2,320	2,320	2,350
R-squared	0.021	0.090	0.001	0.007	0.010	0.007
Chi^2 test of joint effect of insurance and insurance+capital	0.138	15.52	0.906	0.132	0.388	0.449
p-value	.710	8.16e-05	.341	.717	.534	.503
Mean for control	1177	0.309	2.587	0.261	0.405	6.604

Results: Reallocation of investment

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Intepreting the results (1): External Validity

- We are all aware of the problem of external validity: results in one place may not be relevant in other places

- However, Rosenzweig and Udry (2020) makes a more nuanced point: the impact of an intervention *in a given setting* depends on the state of the world in that period
  - Obvious example from agriculture: in response to insurance, a farmer makes more risky investments. Whether or not the impact on profits is positive depends on rain realization
  - Other examples: returns to education depend on macroeconomic conditions; firm profits depend on prevailing prices, health interventions returns depend on prevailing infection rates

- Implications:
  - Understand how important year-to-year variation is in your study setting
  - Multiple-year evaluations. If single year: is it a "normal" year?
  - Learn about variation of impact by state using heterogeneity by space (caveats in the paper)

Interpreting the results (2): risk aversion

- Other studies find a large effect of (free/subsidized) insurance provision on investment
  - Mobarak and Rosenzweig (2013), Cai et al. (2012), Carter et al. (2014), Cole et al. (2016)
  - But not all of them (e.g., Udry *et al.*, 2019)

- The results suggest a very high level of risk aversion
  - Implausibly high?
  - If risk aversion is so high, we would expect high levels of savings (precautionary savings, buffer stock savings…), which we don't
  - We may need to extend the standard model, e.g., present-biased farmers (see Kremer, Rao, Schilbach, 2019)

Investment response to other risk-management tools

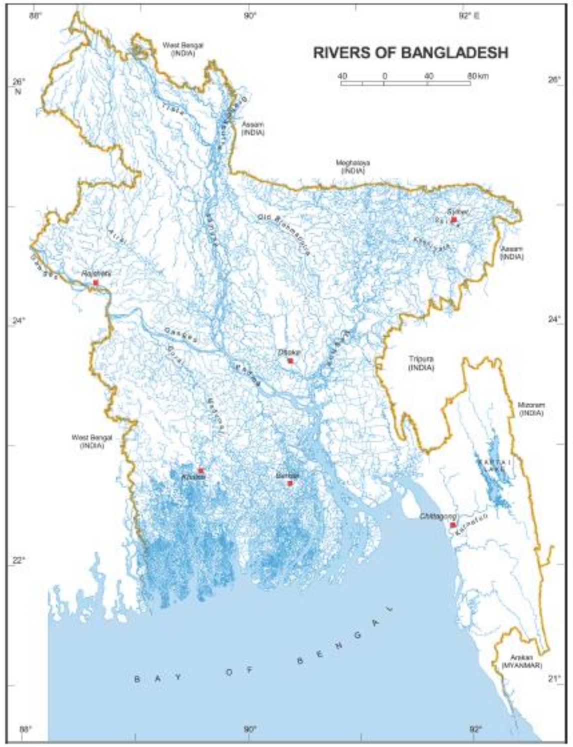
- Flood-tolerant crops (Emerick *et al.*, 2016, India)
- Access to weather forecasting (Rosenzweig and Udry, 2019, India)
- Emergency credit lines (Lane, 2020, Bangladesh)

Lane (2020): Credit Lines as Insurance

- While insurance seems to have positive effects, demand remains low (NEXT CLASS)

- An alternative: **emergency loans**
  - Pre-approved households are made aware that they are guaranteed access to a certain amount of credit if a flood occurs (branch-level index)
  - Removes uncertainty about credit availability

- RCT in partnership with BRAC (branch-level randomization)



Treatment effects

1. **Ex-ante outcomes:** Guaranteed access may increase investment levels, because they know they are protected in the event of a flood

2. **Ex-post outcomes:** Among treated households, production levels should be more sensitive to flood shocks, but not consumption

Treatment effects: ex-ante outcomes

Table 1: Land Farmed

	(1) Own land	(2) Rented land	(3) Sharecrop land	(4) Total land	(5) Any Cult.
Treatment	0.000	0.063***	-0.004	0.058**	0.044*
	(0.013)	(0.016)	(0.004)	(0.026)	(0.024)
Controls	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes
Mean Dep. Var	0.13	0.20	0.02	0.35	0.46
Observations	4744	4740	4743	4739	4745

Table 2: Ex-Ante Investments

	(1) Fert. Applied	(2) Pest. Applied	(3) Input Cost per Acre	(4) Non-Ag Invest
Treatment	6.51	0.26	2.06	12.13*
	(5.30)	(0.17)	(2.17)	(6.64)
Controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Mean Dep. Var	140.47	1.58	65.85	38.69
Observations	2183	2140	2017	4745

Treatment effects: ex-post outcomes

Panel A: Ex-Post Outcomes by Treatment

	(1) Log Cons PerCap	(2) Crop Prod. (Kg)	(3) Log Income	(4) Bus. Stock Value
Treatment	0.080**	47.896*	-0.019	205.693*
	(0.031)	(28.093)	(0.029)	(111.556)
Mean Dep. Var	5.93	275.22	10.77	864.89
Observations	4743	4745	4531	799
Controls	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Week Interviewed FE	Yes	No	No	No

Panel B: Ex-Post Outcomes by Treatment and Flood Realization

	(1) Log Cons PerCap	(2) Crop Prod. (Kg)	(3) Log Income	(4) Bus. Stock Value
Treatment	0.047	97.088**	-0.016	182.041
	(0.045)	(41.030)	(0.044)	(174.600)
Flood X Treatment	0.061	-88.492*	-0.005	44.445
	(0.062)	(51.942)	(0.064)	(231.634)
Flood	-0.051	5.509	0.049	-68.940
	(0.058)	(37.383)	(0.059)	(193.055)
Mean Dep. Var	5.93	275.22	10.77	864.89
Observations	4743	4745	4531	799
Treat + Flood X Treat	0.01	0.81	0.61	0.13
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PART 4

Empirical evidence: health insurance

Health Behavior: stylized facts

- Dupas (2011) reviews health behavior in developing countries:
  1. High levels of *curative* health expenditures
  2. Low levels of *preventive* health expenditures

- For instance, in India, 62% of health expenditures were paid by households out-of-pocket (vs. 11% in the U.S.)

- One way to shift expense from ex-post to ex-ante would be to enhance access to *health insurance* for the poor

Why could health insurance help?

- Outcomes that could be affected by health insurance:

    - Healthcare utilization
    - Health outcomes
    - Financial outcomes (e.g., saving, borrowing, etc.)
    - Psychological wellbeing

Experimental evidence – U.S.

- The Oregon Experiment (U.S.): 2008 lottery targeting low-income adults to access Medicaid

- Overview of the medium-term effects (Finkelstein *et al., 2019):*
  - Increases in healthcare use
  - Improvements in self-reported health and depression
  - No statistically significant impact on mortality and physical health
  - Reduction in the risk of large out-of-pocket medical expenditures
  - No significant impact on employment or income

- Finkelstein *et al. (2019)* develop a framework to estimate the welfare effects of Medicaid and estimate willingness to pay for the program

Experimental evidence - developing countries

- A small body of work uses field experiments to evaluate the impact of health insurance in developing countries
  - Thornton et al. (2010, Nicaragua), Levine et al. (2016, Cambodia), Chemin et al. (2021, Kenya), **Malani et al. (2021, India)**

- In 2008, India launched national, public hospital insurance (RSBY) for poor households (59M targeted). In 2018, the program was expanded to cover 500M people, including households above poverty line

- Malani et al. (2021) conducts an evaluation of expanding RSBY to above-poverty-line households (2013-2017)

Malani et al. (2021) - Design

- Largest experimental evaluation of health insurance in developing countries

- Four treatment groups
  A. Free insurance
  B. Opportunity to buy insurance at full price+ unconditional cash transfer
  C. Opportunity to buy insurance at full price
  D. Control

- Village-level variation in the fraction of households with insurance access
  - This design allows to estimate within-village *spillover* effects

- Data collection for 3.5 years

Results: take up and utilization

- All treatments generate significant enrollment in insurance, even when the household has to pay the full price (take-up in group C was 60%)

- The treatments increased the *use* of insurance over the study
  - 13% in free-insurance group vs 8% in control group

Results: health outcomes

- The paper investigates treatment effects on many health outcomes
  - Self-reported health, chronic disease, quality of life, mental health, childbirth, biomarkers, mortality. Multiple outcomes for each of these groups.

- How to deal with a large number of outcomes?
  - Adjust inference for multiple hypothesis testing
  - Combining multiple outcomes in one health index (z-score of individual outcomes)

- Overall, 0.5% of outcomes were significant after dealing for multiple hypothesis testing and there was no significant effect on summary health index
  - Caveat: power; not a precise zero

Results: health outcomes

- The limited effects on health outcomes in the India RCT are consistent with evidence from other studies in developing countries

- One possible explanation is that, even when health insurance is provided for free, few people end up using it
  - Lack of understanding about what the insurance could cover
  - Lack of information on how to use the insurance card, etc.

We will talk about barriers to insurance demand and insurance use in the next class