Role of risk-reducing innovations for technology adoption: Toward a portfolio approach

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1. Uninsured risk is a major hurdle to technology adoption

- Agriculture is **risky** due to weather and diseases, and risks are largely **covariate**, making them difficult to co-insure locally
- Farmers are particularly **risk averse** due to poverty, food insecurity, lack of information, lack of trust
- Risk, risk-aversion, and lack of access to risk-reducing instruments induce **self-insurance** that constrains adoption:
  - **Coping with shocks** (ex-post) through asset decapitalization and migration decreases technology adoption
  - **Managing risks** (ex-ante) through less investment in higher return-higher risk technologies and crops

- **Objectives** and **outline** of this presentation:
  - **Discuss results for three specific innovations** to reduce uninsured risks that constrain adoption (ATAI/AMA-Basis results using field experiments):
    - Risk-reducing technology
    - Index insurance
    - Emergency loans
  - Show how these innovations complement each other in a **portfolio approach** to risk reduction

2. Risk-reducing technology to induce the adoption of other risky technologies: Case of flood tolerant rice in Odisha

Randomized controlled trial: Seed minikit recipient in Odisha

1. Research objective and approach

- **New technology for risk-reduction**
  - "Swarna-Sub1" = Swarna + Sub1 locus that conveys flood tolerance to rice
  - Reduces downside yield risk under flooding
- **Objective**
  - Analyze the impact of use of flood tolerant rice variety on adoption of other technologies
- **Approach**
  - **Randomized allocation** of seed minikits to villages and farmers within treatment villages

Step 1: Yield tolerance value of resilient technology

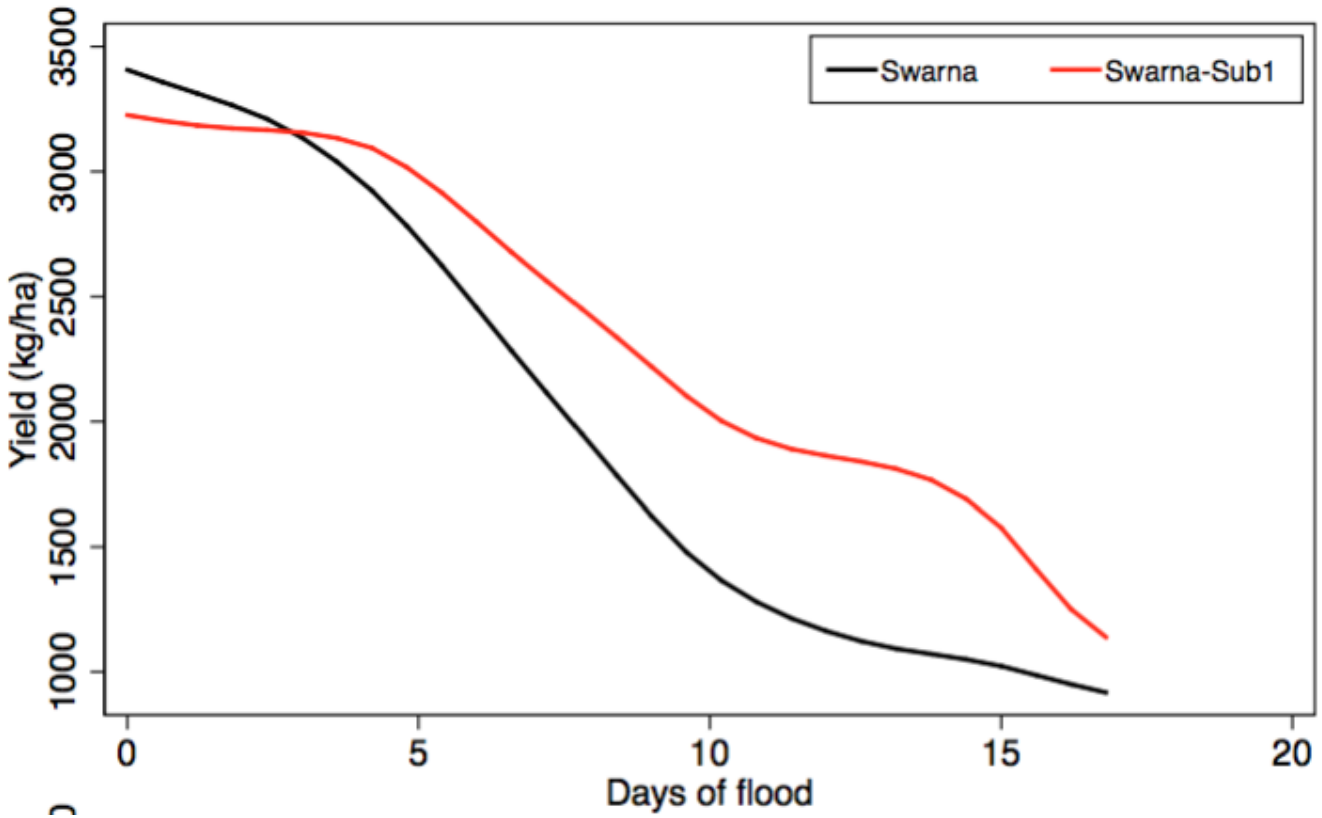
What is the plot-level ex-post shock-coping value of Sub1 in farmers' fields?

Measured by yield resilience effect in bad years

Observations

Large floods in year 1: Identify **shock-coping** value by flood duration

Shock-coping value by flood duration



Yield by duration of flooding: Swarna vs. Swarna-Sub1

Superior technology: No yield penalty with no flooding

Yield advantage: 45% at 13-day flood

Step 2: Households behavioral response to risk reduction and technology adoption

- **What is the (ex-ante) risk-management** effect on technology adoption/input use and cultivation practices?
- **No floods in year 2**: Measure **crowding-in** of other inputs and cultivation practices due to risk reduction effect of technology
- **Impact on behavior** toward technology adoption
  - 15% less use of **traditional** varieties
  - 11% increase in (early) **fertilizer** expenditures
  - 33% increase in use of labor-intensive **transplanting**

Conclusion

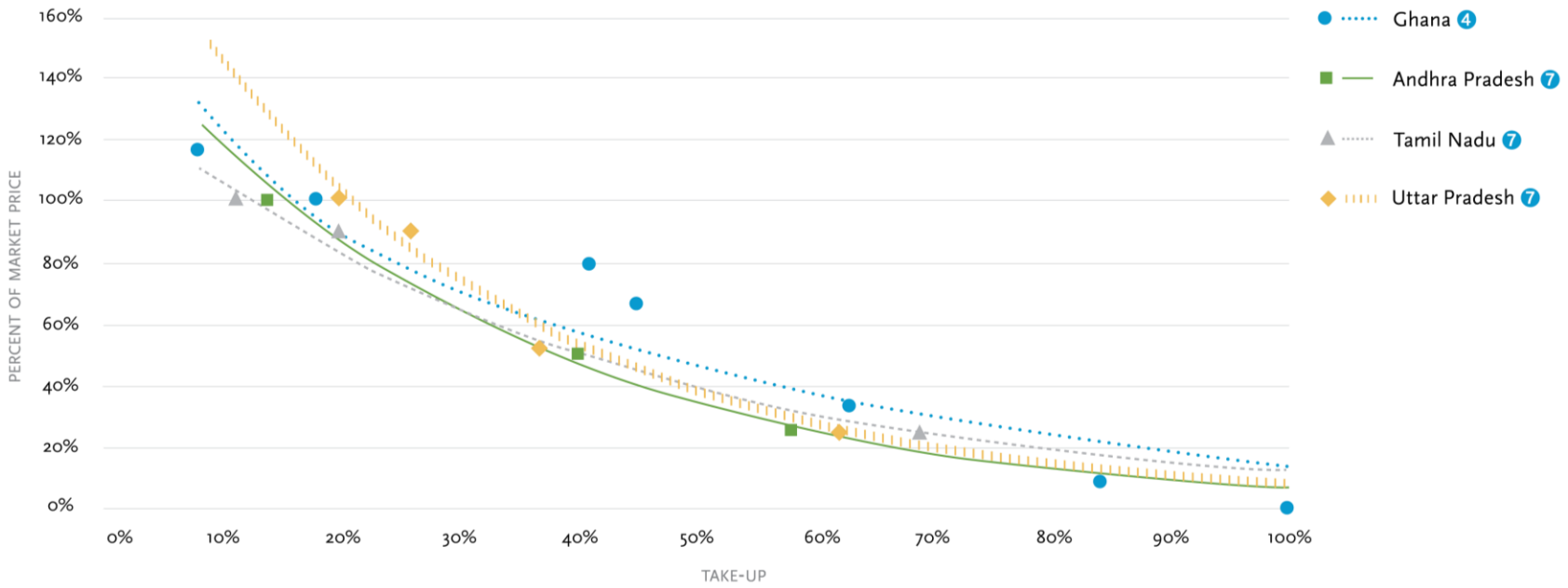
- Use of risk-reducing technology can induce the **adoption of other risky technological improvements** (fertilizers, more costly planting) for moderate risks
- But **leaves uncovered**
  - **Full protection against small risks**: need credit and savings
  - **Protection against large shocks**: need insurance
- Need build **complementarities** between risk-reducing technology and financial instruments for risk-reduction

3. Index insurance for risk reduction: How to make it work?

1. **Weather index insurance (WII) is an appealing way of offering risk-reduction to smallholder farmers** (Carter et al.)
   - Payouts triggered by an observable **indicator/index** falling below a threshold. Indicator can be:
     - **Weather** events (rainfall, temperature) measured at meteorological stations
     - Average **small area yields** measured by crop cuttings or aerial/satellite observations
   - Payouts are not based on **actual individual damages** as assessed by an insurance adjuster

- **Presumed advantages**
  - Allows **quick**, **automatic, and transparent** disbursement
    - Avoids **lengthy and conflictual claims** process
    - Eliminates **misbehavior** by client: no room for Moral Hazard and Adverse Selection
    - **Cheap** to implement for large numbers of smallholder farmers
  - **Ex-post** protection from shocks (insurance payouts) can induce **ex-ante** investment effects (including **technology adoption**)

2. However, index insurance has met with low uptake unless heavily subsidized by government



Take-up of index insurance as a % of the market price: high take-up with high subsidy, but falls to only 6-18% at market price (ATAI)

- All large-scale index insurance programs are **heavily subsidized** by government
  - India: 75% subsidy (AICI) to get a 60% uptake
  - China: 60% subsidy (PICC) to get a 40% uptake; now 100% subsidy

3. **Main reasons for low uptake are:**
   - **Basis risk**
     - **No weather index** is perfectly correlated with yields, making it an incomplete/imperfect insurance (Clarke)
   - **High cost** due to
     - High **loading** (40-60% over fair price)
     - **Incomplete data premium**
     - **Lack of re-insurance**
   - **Behavior**: difficult to understand for farmers
   - **Lack of trust** in insurance company

4. **But index insurance shown to work for shock-coping and risk management (including tech. adoption) where taken-up:**
   - **Coping**: In **Mexico (CADENA)**, insured farmers plant more the year after a shock than non-insured farmers (de Janvry et al.)
   - **Coping**: In **Kenya (IBLI)**, insurance helps pastoralists avoid decapitalize livestock in response to drought (Janzen & Carter)
   - **Management**: In **Andra Pradesh**, farmers with insurance are 6%pts more likely to plant cash crops (Cole et al.)
   - **Management**: In **AP, UP, and T Nadu**, insured farmers use riskier, higher-yielding production technology (Mobarak et al.)
   - **Management**: In **Ghana**, index insurance induces farmers to plant more maize and use more fertilizer (Karlan et al.)

Hence, worth trying to induce more take-up at market prices

5. **Many opportunities exist to make index insurance into a better product**
    a. **Better contract design**
        i. **Multiperil contracts** preferred (McIntosh et al.)
        ii. **Fail-safe contracts** combine indexing with audits (Carter)
        iii. **Institutional-level contracts**: coops Guatemala
    b. **Better data and measurement**
        i. **Better yield predictions** using remote sensing and crop modeling (Lobell)
        ii. **New data sources**: drones; geo-referenced crowd-sourcing photography

c. **Better marketing**
    i. **Regulation** (like for seeds): Safe minimum quality standards for index insurance (Carter)
    ii. Calibrated **subsidies** for learning (Dupas; Cai et al.)

d. **Better delivery**
    i. **Financial literacy**: (Cole et al., Cai et al.)
    ii. **Trust** in insurance provider: witness payouts

Conclusion

- Index insurance **can be effective** in reducing risk and inducing technology adoption,
    - But **confined** to **larger shocks** and at **institutional level** as expensive and hard to sell to individual farmers
    - And **complemented** by other risk-reducing financial instruments

4. Create flexible structures for savings and credit: BRAC emergency loan progam

- Given low demand for index-insurance, **BRAC** in Bangladesh offers emergency loans to help clients cope with income shocks (AMA-Basis project)

- Introduce a **pre-approved index-based credit product** designed to mimic index-insurance
    - Fits easily into BRAC's microfinance operations
    - Initially focused on flooding risk, a major source of income loss for farmers in Bangladesh
- **Objective**: help households cope shocks by accessing quick and reliable **liquidity**

Emergency loan properties: Three components

- **Eligibility**: Need a qualifying **credit score** with BRAC
- **Trigger**: Loans only made available when a **pre-specified threshold** water level height is passed
- **Pre-approval**: Borrowers are told they are **pre-approved** for an immediate loan up to 50% of their previously approved loan should the trigger be passed

Advantages

Avoids many of the determinants of low insurance demand

- **No up-front premium** required (no trust issue)
- **No perceived loss** if there is no shock (no difficult learning)
- **No decision to buy now** (no liquidity constraint)

Disadvantages

- **Inappropriate for large shocks** that require a long recovery period (one year loans)
- **Ineffective for multiple consecutive shocks**
- **Inaccessible** to new clients as need a **credit history**

Early results for emergency credit from RCT across branches

- **Shock coping**: helps prevent asset **decapitalization** and improves **recovery** from income shock among borrowers
- **Risk management**: Increase in agriculture **investment** and tech. **adoption** (fertilizer, pesticides) among eligible clients

Conclusion

- Pre-approved emergency loans can be **effective** for moderate shocks
- Should be **complemented** by insurance used to cover large and infrequent losses

4. Conclusion: Toward a portfolio approach to risk reduction

- RCT experiments have analyzed risk-reducing instruments **one or two at a time**: technology, index insurance, credit
- But the best fit of each instrument to reduce risk depends on **risk layers**: **frequency** of adverse events and **severity** of impact:

Risk layers				
Frequency of event	**Severity of impact**	**Risk financing strategy**	**Ex-ante risk management (arranged before a disaster)**	**Ex-post shock coping (arranged after a disaster)**
High	Minor	Risk retention	Precautionary savings	Expenditure reallocation
			Resilient technology	Adjusted income strategy
			Contingent pre-approved credit line	Emergency loans
		Risk transfer	Index insurance	
Low	Major		Social safety net	Discretionary aid

Portfolio management of weather risk for smallholder farmers

- Similar to framework used at the country-level for Sovereign Debt Risk Financing and Insurance (Dercon and Clarke, 2016)

Policy implications

Need a **portfolio approach to** use risk-reducing instruments for technology adoption

- **Demand-side**: Provide **information** on all available instruments and their complementarities
- **Supply-side**: Provide **performing markets** (credit, insurance) and **public goods** (technology) for each instrument
- **Subsidize portfolio** as opposed to individual instrument
- **Extension services** need guide use of risk-reducing "portfolios of the poor"
- **RCTs**: Experiment with portfolios and complementarities as opposed to individual and either/or instruments

End