Evidence from a large scale Rainfall-Indexed Insurance Program in Mexico

Alan Fuchs

"Authors' Workshop "Poverty and Climate Change Flagship - An Overview of the LAC Region"

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Question

How does rainfall-indexed insurance affect:

- Crop yield: $tons/hectares$
- Risk management: crop diversification/specialization
- Rural households' per capita expenditure and income

Motivation: Weather Shocks

World's poor

- Limited access to formal insurance and credit markets (no collateral, information and administrative costs)
- Particularly vulnerable to risks
- Accentuated in rural areas (survival depends on stochastic factors like weather, crop disease, personal illness)

Weather shocks

- Source of income fluctuation that leads to consumption interruptions
- Destroy assets accumulated through years of limiting consumption (Barnett & Mahul 2007)
- Can be catastrophic, triggering famine, and displacing families
- Transmit poverty across generations: malnutrition and school dropout (Alderman & Haque 2008, Maccini & Yang 2008)

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Motivation: Poverty traps

Low levels of wealth + Uncertainty + Risk Aversion

$\implies$ **Lower Productivity**

1. Under-investment
   - Uncertainty and risk aversion => under-investment
   - Sandmo (1971), Fafchamps (1997, 2009)
2. Produce low-risk/low-profit crops
   - Uncertainty and low levels of wealth => poverty traps
   - Rosenzweig & Binswanger (1993), Barnett, Barrett & Skees (2008)

WII could lead to:

1. Use higher quality seeds & fertilizers (increase investment)
2. Switch to higher yielding crops

Weather Index Insurance (WII)

- Uses measures of weather realization highly correlated with agricultural production
- Reduces administrative costs (w.r.t. traditional insurance):
    - no need for loss estimation nor visits
    - analyzes regional instead of individual risk
- Simple implement: pays if realization exceeds threshold
- Deals information problems: adverse selection & moral hazard
- Attention in last years to insure generalized shocks
- Not exclusive for agriculture nor developing countries

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Weather Index Insurance (WII)

- Expensive to Start => Public Provision (NGOs, International Organizations or Government)
- Beneficiaries still subject to "basis risk" (Barnett and Mahul 2009)
- Low take-up rates among potential buyers
    - => Donors reluctant support WII projects anymore (Gates Foundation)
- Our paper deals with low take-up rates as farmers under WII in Mexico are automatically enrolled

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Example: Apaseo el Alto, Gto. (6,885 maize hectares insured)

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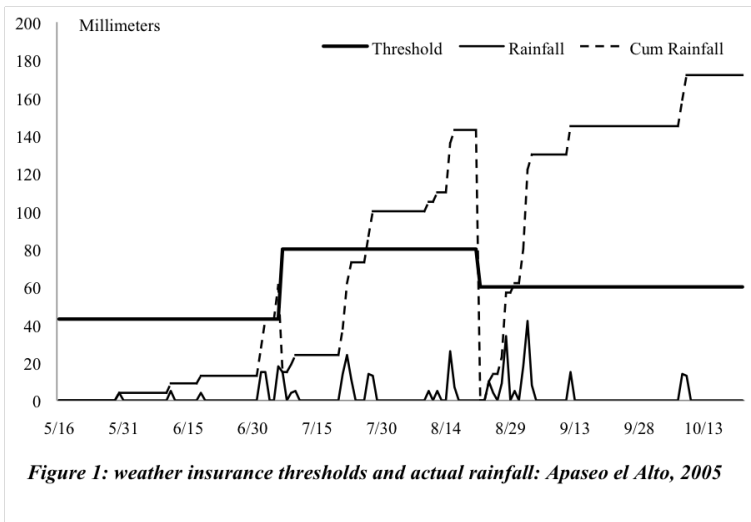scale
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Figure 1: weather insurance thresholds and actual rainfall: Apaseo el Alto, 2005

Premiums paid: US$35 thousand (insured value US$390 thousand); no indemnity was paid.

Example: Leon, Gto. (6,875 maize hectares insured)

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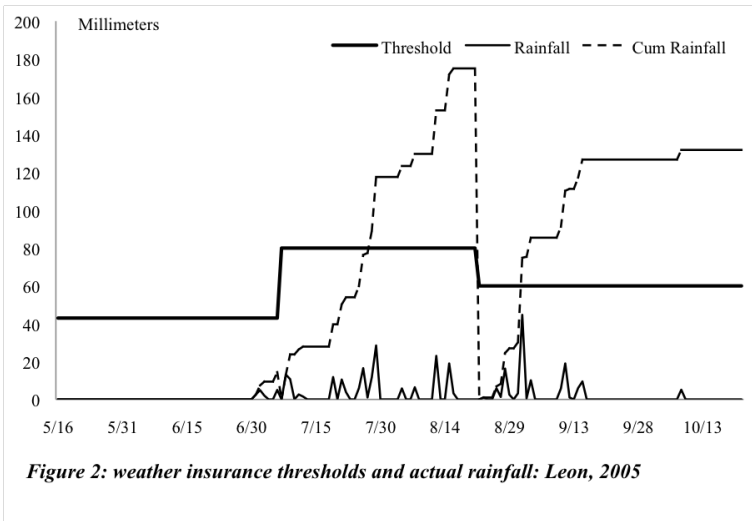scale
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Figure 2: weather insurance thresholds and actual rainfall: Leon, 2005

Premiums paid: US$44 thousand (insured value: US$395 thousand),
Indemnity paid: US$395 thousand.

Weather Index Insurance in Mexico

- 80% of agricultural catastrophic risk: Droughts (Ministry of Agriculture)
- No Private Insurers: Systemic risk, low profitability and land fragmentation
- WII Program (2003): Assist small farmers deal with droughts
  - 2008 covered 1.9 million hectares in 656 counties ($\approx$ 15% of rain-fed ag. land)
  - Covers 4 crops: maize, barley, beans & sorghum
- Maize most important crop: 39% of sowed land (and 42% for rain-fed)

Note
1 hectare = 2.47 acres

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Weather-Indexed Insurance in Mexico

Exclusively provided by Agroasemex:

- Uses system of equations representing crop-soil-weather relationships
- Determines critical thresholds below which indemnity payments are triggered
- Takes advantage of existing weather data
- Re-insures risk in international markets

Individual producers don't pay

Automatically enrolled, get informed through PROCAMPO's regional offices and are confident of coverage

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- Daily rainfall & temperature data (1990-2008)
- County level rainfed agricultural production (2002-2008)
  - Over 300 crop species: sowed & harvested hectares, production in tons
- WII administrative data (2003-2008)
  - Stations used, covered crops, insured hectares, premiums paid, value of insured production and indemnity payments
- PROCAMPO (full beneficiary census 1994-2008: plot size, crop produced, ownership)
- National Household Expenditure and Income Survey ENIGH (2002, 2004, 2005, 2006 and 2008)
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- Variation across time and space due to rollout

- Panel of 2,337 counties from 2002 to 2008 (around 92% of counties in the country)

- County fixed effects: control for time invariant characteristics

- Year fixed effects: control for common contemporaneous shocks

- County observable characteristics: PROCAMPO beneficiaries and weather data

Identification Strategy

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Insurance rollout I: 2003 introduced 108,000 hectares (5 counties Guanajuato)

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Insurance rollout II: 2004 Expansion to Puebla (250,000 hectares)

Results: Effects on Log Maize Productivity

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FE Specs	Presence	Coverage
WII Presence	0.050*/(0.029)	.
WII Coverage	.	0.067*/(0.034)
Rain Deviation	0.068***/(0.02)	0.068***/(0.021)
Temp Deviation	-0.41**/(0.19)	-0.40**/(0.18)
Private Producers	1.58**/(0.59)	1.59**/(0.59)
Small Producers	0.17/(0.62)	0.17/(0.62)
Constant	0.233/(0.612)	0.241/(0.611)
Observations	14,791	14,791
R-squared	0.029	0.029
County FE	YES	YES
Year FE	YES	YES

Results: Effects on Real Log Per Capita(adult equivalent) Household Income

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FE Specs	Presence	Coverage
WII Presence	0.083**/(0.04)	.
WII Coverage	.	0.079**/(0.04)
Rain Deviation	0.058/(0.05)	0.057/(0.05)
Temperature Deviation	-0.46/(0.36)	-0.43/(0.36)
Small Producers	-1.24/(0.74)	-1.23*/(0.72)
PROCAMPO	0.001***/(0.00)	0.0007***/(0.00)
OPORTUNIDADES	-0.0011***/(0.00)	-0.0011***/(0.00)
Education Years	0.058***/(0.002)	0.057***/(0.01)
Constant	8.51***/(0.96)	8.51***/(0.94)
Observations	36,190	36,190
R-squared	0.357	0.357
County FE	YES	YES
Year FE	YES	YES

Results: Matching

- **Marginal and Medium Income levels** (CONAPO 2000):
  Include County & Year FE

FE Matching	Coverage	Coverage	Coverage	Coverage
WII Coverage	0.075/(0.062)	0.085/(0.069)	0.083***/(0.025)	0.048/(0.05)
RainDev	0.08*/(0.040)	0.025/(0.019)	0.085*/(0.044)	0.097**/(0.04)
TempDev	-0.44/(0.25)	-0.31/(0.24)	-0.47*/(0.25)	-0.37/(0.43)
% Private Land	0.98***/(0.13)	-0.26/(0.40)	3.6***/(1.3)	2.06***/(0.88)
% Small Farmers	0.76***/(0.19)	-0.35/(2.28)	1.25**/(0.58)	-0.144/(1.01)
% PROCAMPO	-0.004/(0.05)	-0.20**/(0.08)	0.082/(0.11)	-0.091/(0.09)
Constant	-0.60***/(0.17)	0.69/(2.28)	-0.91/(0.63)	0.942/(0.98)
Observations.	2,465	5,730	3,094	3,502
R-squared	0.045	0.036	0.044	0.027
Matching	Extreme Poor	Poor	Medium	Other

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  - We take advantage of a large-scale risk management tool placement considered exogenous to individual farmers
- Results consistent with theory:
  - Positive and significant increase on maize yields (between 5% and 8%)
  - Positive and significant association on rural household per capita expenditure and income (about 8%)
  - No clear pattern on specialization/diversification
- Effect concentrated on medium income counties

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