Risk, Insurance and Wages in General Equilibrium by Mobarak and Rosenzweig (2014)

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Outline

Background

- Absence of formal insurance markets where needed
  - 75% of the world's poor engaged in agriculture
  - 90% of variation in Indian agriculture production caused by variation in rainfall
  - 90% of Indians are not covered by formal insurance
- Literature concludes towards providing insurance to farmers
- Policy issues
  - Ignore spillover effects on uninsured labor (poor)
  - India: agriculture insurance explicitly targeted to those with "insurable interest".

Research Question

What is the impact of rainfall insurance on labor market outcomes in agricultural markets?

Research Approach

- Design a labor market GE model
  - Labor demand, labor supply and GE wages.
  - Three policy scenarios: a) only cultivators are offered insurance, b) both cultivators and laborers are targeted and c) only laborers are targeted with insurance.
- Conduct a Randomized Control Trial (RCT):
  - Randomly market rainfall insurance to approx 4,800 cultivators and landless laborers across three states in India.
  - Index-insurance based on monsoon onset date.
  - Estimate the G.E. model and policy scenarios.

Key Findings

Insurance contracts should be offered to **BOTH** cultivators and landless laborers.

- If offered only to cultivators
  - Labor demand and equilibrium wages become more rainfall sensitive.
  - Laborers are worse off because of high wage volatility.
- If offered to laborers as well
  - Wages are smoothed across rainfall states by reducing labor supply during droughts when payouts are paid.

Outline

Literature

- Providing insurance leads formerly uninsured farmers to switch from **low to high yield** but **riskier** crop varieties.
  - Cole et al. (2013); Mobarak and Rosenzweig (2014)
- Insurance increases ag output but makes it **more rainfall-sensitive**
  - Karlan et al (2014); Mobarak and Rosenzweig (2013)
- Emphasis on GE effects rather than effect on the treated.
  - Previous approaches ignore spillover effects on the poor.
  - Cultivators may Δ labor demand therefore $\uparrow$ wage volatility.
  - Jayachandran (2006): non-experimental study of GE effects of credit market imperfections on wages.
  - Effects of insurance marketed through RCTs

Outline

Model Setting and Assumptions

- Two groups: cultivators and landless laborers
  - Cultivators own land and are net employers. No labor supply. Few exceptions (robust results)
  - Landless laborers: no lease in, no cultivation.
- One period/season model
  - Abstract from credit constraint (perfect credit market).
  - Empirical work allows for credit constraints (Jayachandran, 2006).

Labor supply

- Landless hh endowed w/ m non-earning inc. and 1 unit of t.
- U function is CD in leisure h and consumption c : $U = h^{\gamma}c^{(1-\gamma)}$
- Rainfall θ^{j} can be low (L) or high (H). L-state occurs w/ prob. q.
- Two groups of laborers: offered (not) insurance.
- Insurance unit price p and pay out in L state is I.

- They supply $(1-h)$ labor at wage w.
  BC are:
  $c^L = w^L(1-h) + m - pI + I$
  $c^H = w^H(1-h) + m - pI$
- E(U) maximization pgm:
  $Max_{I,h}E(U) = qU^L + (1-q)U^H$ yields FOC:
  $q(1-p)U_c^L = p(1-q)U_c^H$
  Labor supply: $l_c^j = 1 - \gamma - \gamma\frac{y^j}{w^j}$ where
  where $y^j = m - pI + I$ *if* $j = L$ *and* $m - pI$ *if* $j = H$

Labor supply (cntd)

Proposition 1

a. In the low state, the labor supply of the insured will be lower than that of the uninsured laborer.
b. In the high state, the labor supply of the insured will be higher than that of the uninsured laborer.

Labor supply (cntd)

Proof

Table 1

Insured and Uninsured Landless Labor Supply in the H and L States		
State of nature	L	H
Insured labor supply	$1 - \gamma - \frac{\gamma(m+(1-p)I)}{w^L}$	$1 - \gamma - \frac{\gamma(m-pI)}{w^H}$
Uninsured labor supply	$1 - \gamma - \frac{\gamma(m)}{w^L}$	$1 - \gamma - \frac{\gamma(m)}{w^H}$
Difference insured and uninsured	$\frac{-\gamma(1-p)I}{w^L}$	$\frac{\gamma pI}{w^H}$

Labor supply (cntd)

Compared to no insurance world, insurance effects:

- In L, labor supply $\downarrow$ because $m \uparrow$ and leisure is a normal good
- In H, labor supply $\uparrow$ because no payout and leisure is a normal good.

Labor demand

- Cultivators endowed w/ 1 unit of land and m non-earnings income.
- Production in **two** stages using CD technology with two inputs: l labor and x capital (seeds, fertilizer).
- **Stage 1** (Planting stage): Cultivators decide on input x and whether to buy insurance. Ignore the use of labor.
- **Stage 2** (Harvest stage): State of nature θ^j is realized, labor hired, profit maximized.
- Can save (s) at rate r, and borrow (b) within agriculture cycle.

Labor demand (cntd)

- **Stage-2 program**:
  $Max\ \pi = \theta^j l^\beta x^{(1-\beta)} - w^j l$, where l is hired labor.
- Labor demand: $l = x(\frac{\beta\theta^j}{w^j})^{\frac{1}{1-\beta}}$
- **Stage-1 program**:
  $Max_{x,l} E(U) = U(c_1) + b[qU(c_2^L) + (1-q)U(c_2^H)]$
  $c_1 = m - x - s - pl$
  $c_2^j = rs + \theta^j l^\beta x^{(1-\beta)} - w^j l + i^L l$
  where i^L is an indicator for low state, when insurance payout occurs.

Labor demand (cntd)

- In the absence of insurance, $x < x*$ due to risk.
- Amount of stage-1 x increases as cost of insurance falls.

Why?

- Purchasing insurance $\downarrow$ cultivator's MU in L
- Increasing $x \downarrow$ MU in H
- Given stage-2, the effect on l^d from $\Delta\Theta^j$ is stronger the lower the cost of insurance.

Labor market equilibrium

- Equilibrium condition for N landless households supplying labor and M cultivators demanding labor: $[1-\gamma-\gamma\frac{y^j}{w^j}]N = [x(\frac{\beta\theta^j}{w^j})^{\frac{1}{1-\beta}}]M$

Policy simulations

Proposition 2

Offering insurance to landless laborers dampens wage volatility Δw.

- Proof: $\uparrow$ y $\Rightarrow \uparrow$ w
- $\frac{dw}{dy} = \frac{\gamma(\beta-1)w}{\gamma y(\beta-1)-lw(\frac{M}{N})} > 0$

Policy simulations (cntd)

- In L state, $l_i^s < l_u^s$. This $\Rightarrow w^L$ increases compared to no insurance word.
- In H state, $l_i^s > l_u^s$. This $\Rightarrow w^L$ falls compared to no insurance word.
- Therefore, G.E of insurance to landless hh reduces wage risk.
- Income is smoothed if some landless hh purchase insurance.
- By symmetry, welfare of risk-averse cultivators $\downarrow$ in the L state.

Policy simulations (cntd)

Proposition 3

Offering insurance to cultivators increases wage volatility (Δw).

- Proof

$$\frac{d(\frac{dw^j}{d\theta^j})}{dx} = \frac{d(\frac{dw^j}{d\theta^j})}{d\theta^j} = \frac{-w\gamma y(\beta-1)\beta(\frac{\beta(\theta^j}{w^j})^{\frac{\beta}{1-\beta}} MN}{wx\beta(\frac{\beta(\theta^j}{w^j})M-\gamma y(\beta-1)N} > 0$$

Policy simulations (cntd)

- Offering insurance only to cultivators $\uparrow$ wage volatility and $\downarrow$ welfare of uninsured laborers.
- Insured cultivators use more 1st stage inputs x.
- The effect of $\uparrow$ in x on wages is higher in H than in L.
- It may also provide some benefits to the laborer:

Policy simulations (cntd)

Proposition 4

Offering insurance to cultivators increases average wages.

- Proof:
- $\frac{d(\frac{dw^j}{x})}{dx} = \frac{(\frac{\beta(\theta^j}{w^j})^{\frac{\beta}{1-\beta}}(\beta-1)(w^j)^2 M}{\gamma y^j(\beta-1)N - xw(\frac{\beta(\theta^j}{w^j})^{\frac{\beta}{1-\beta}} M} > 0$
- Insured cultivators use more x.
- The effect of an increase in x on the eq. wage is positive in any state.

Summing up

In summary:

- Insuring landless workers $\downarrow$ wage volatility (insured workers supply less labor than uninsured in L and supply more labor in H).
- Insuring cultivators $\uparrow$ labor demand volatility across rainfall states (insurance allows cultivators to $\uparrow$ output in H relative to L state.)
- Sensitivity of wages to rainfall increases when large number of cultivators are insured.

Outline

Experimental Design

- **Randomised Controlled Trial** in 3 states of Andhra Pradesh (AP), Uttar Pradesh (UP) and Tamil Nadu (TN) of India
- Intervention: **Rainfall insurance** - Delayed Monsoon Onset index-based insurance product
  - Historical rainfall data used for expected onset date of rainfall (Source: REDS)
  - *Monsoon onset* defined as a certain level of accumulation (between 30-40 mm)
  - *Delay* if target rainfall not reached by one of the three pre-selected trigger dates
  - *Trigger dates* varied with villages - Rs. 300 (15/20 days late); Rs. 750 (20/30 days late) and Rs. 1200 (25/40 days late)
  - All farmers in a village received the same payout, if the village qualified.

Experimental Design (contd.)

- *Treatment Group*: 2400 cultivator households and 2400 pure agricultural labor households
- *Control Group*: 1619 households
- Random offer of Insurance subsidy (ranging from USD 1.6 to 4 across villages)
  - Average insurance premium - Rs. 145 (approx. USD 2.9)
  - 0, 10, 50 or 75 percent subsidy on insurance premium
- Marketing between Oct 2010 and Jan 2011
- Intention-to-Treat (ITT) effects estimated

Outline

Sampling

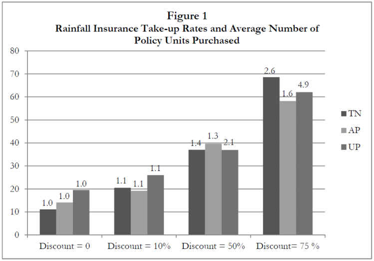
- Used household listing data from NCAER's Rural Economic and Development Survey (REDS) from 2006
- Eliminate members of castes with fewer than 50 households in the listing
  - 93 out of 118 castes selected
- Random selection of 42 villages (out of 63)
- Random selection of households within these villages, stratified by caste and occupation (cultivators and landless laborers)
- Cluster standard errors by caste and village groups
- Follow up survey after *Kharif* harvest in April 2011 in TN, between Dec 2011 and Mar 2012 in UP and AP

Data - Critique

- Elimination of smaller castes from the sample could lead to selection bias, larger caste groups may have larger informal social networks and hence, informal insurance
- Could lead to systematic elimination of certain vulnerable caste groups
- May have external validity issues

Outline

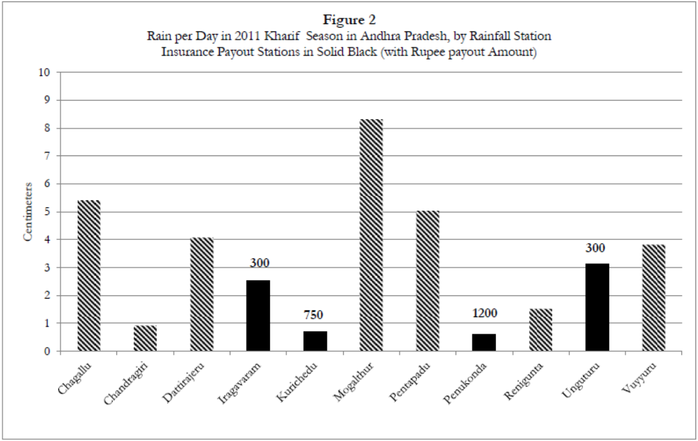
Insurance Take-up



The height of the bars in the % of households who choose to purchase any insurance. The numbers on top of the bars indicate the average number of units of insurance purchased

- 42% take up rate of insurance among households - 25% cultivators and 31% laborers
- Take up rate increases with subsidy
- Critique: Low take up rates, focus on LATE rather than ITT?

Rainfall Variation and Insurance Payout



Rainfall Variation and Insurance Payout (contd.)

- Four villages in AP qualified for a payout: 1 village (Rs. 1200); 1 village (Rs. 750); 2 villages (Rs. 300)
- No perfect correlation between total rainfall and payouts, Occurence of payout is a random shock.

Table 2: Comparison of Rainfall Characteristics of Payout and Non-Payout Villages

	Non-payout mean	Payout mean	T-stat of difference
Dev. of Kharif 2011 Rain per day from Historical Average	4.095	-2.066	-6.10
Rain per day during 2011 Kharif season	8.217	2.056	-7.28
Mean Historical Rainfall (1999-2006)	4.178	4.123	-0.11
Coefficient of Variation of Historical Rainfall	0.868	0.845	-0.16

Sample characteristics for treatment households

Table 4: Sample Characteristics

	Mean	SD	N
Sample for Labor Demand Estimates	Cultivator Households, Acreage>.5		
Offered Insurance	0.620	0.485	1,585
Acreage Cultivated	2.56	4.15	1,584
Days of Harvest Labor	15.1	23.9	1,575
Days of Planting Labor	22.5	32.7	1,575
Sample for Labor Supply Estimates	Landless Agricultural Wage Workers Aged 25 -49		
Offered Insurance	0.575	0.494	3,678
Age	35.5	6.99	3,678
Male	0.479	0.500	3,678
Deviation of Kharif 2011 Rain per Day from Historical Average	3.38	4.47	3,449
Village where Payout Occurred	0.140	0.347	3,678
Agricultural Labor Force Participation	0.345	0.475	3,676
Days of Agricultural Work conditional on Labor Force Participation	58.9	44.2	1,268
Migration during Kharif Season	0.023	0.151	4,272
Sample for General Equilibrium Wage Estimates	Landless Agricultural Wage Workers Aged 20+		
Offered Insurance	0.600	0.490	4,706
Age	43.3	14.0	3,872
Male	0.601	0.490	3,952
Bus Stop in Village	0.403	0.491	4,706
Paved Road to Village	0.896	0.305	4,706
Bank in Village	0.365	0.481	4,706
Rain per day during 2011 Kharif season	7.12	3.75	4,697
Historical Mean Rainfall	4.15	1.28	4,392
Village where Payout Occurred	0.150	0.358	4,706
Proportion Cultivators Offered Insurance in 2011	0.202	0.135	4,706
Proportion of Landless Labor Households Offered Insurance in 2011	0.252	0.160	4,706
Proportion of Agri. Labor Households in Castes Eligible to Receive Insurance	0.874	0.088	4,706
Proportion of Cultivator Households in Castes Eligible to Receive Insurance	0.849	0.182	4,706
Proportion of Village Households that are Cultivators	0.287	0.159	4,706
Proportion of Village Households that are Landless Agri. Laborers	0.382	0.176	4,706
Daily agricultural wage (rupees) in Kharif season	120	64.1	3,076

Critique

Critique: The authors do not show a balance test.

Regression Specification - Labor Demand

$$L_{jk}^{D} = \beta_1 I_{jk} + \beta_2 (I_{jk} * R_k) + \beta_3 OwnedArea + K_k + \epsilon_{jk}^{1} \qquad (1)$$

As per theory:

β_1 - linear ITT

$\beta_2 > 0$, labor demand for insured cultivators more sensitive to rainfall than for uninsured (Proposition#3)

Results - Labor Demand

Table 5: Village Fixed Effects Estimates: Demand for Kharif Season Labor by Cultivators by Stage of Production (Cultivators with at least .5 acres)

	(1)	(2)	(3)	(4)
VARIABLES	Days of Harvest Labor		Days of Planting Labor	
Offered Insurance in 2011	-0.161	-1.030	-1.669	-0.383
	(-0.12)	(-0.45)	(-1.49)	(-0.26)
Offered Insurance x Deviation of Kharif 2011	0.654	0.835	0.459	0.191
Rain per Day from Historical Average	(2.39)	(1.96)	(1.41)	(0.48)
Offered Insurance in a Village where Payout		2.324		-3.442
Occurred		(0.70)		(-1.22)
Acreage Cultivated	2.462	2.460	2.994	2.997
	(2.43)	(2.43)	(2.56)	(2.56)
Observations	1,468	1,468	1,468	1,468

Robust t-statistics, based on standard errors clustered by village-caste, in parentheses

Regression Specifications - Labor Supply

$$L^S_{ijk} = \alpha_1 I_{jk} + \alpha_2(I_{jk} * R_k) + \alpha_3(I_{jk} * r_k) + Z_{ijk}\pi + K_k + \epsilon^2_{jk} \qquad (2)$$

As per theory: (Proposition#1)

$\alpha_1 < 0$, In low rainfall state, insured landless laborers will supply less labor than the uninsured

In high rainfall state, insured landless laborers supply more labor than the uninsured

$\alpha_2 < 0$, Labor supply less sensitive to realised rainfall for insured landless laborers

Results - Labor Supply

Table 6: Village Fixed Effects Estimates: Labor Supply and Migration during Kharif Season by Landless Agricultural Wage Workers Aged 25 - 49

	(1)	(2)	(3)	(4)
Dependent Variable:	Agricultural Labor Force Participation: Any Agricultural Work?		Number of Days of Agricultural Work	
	Payout Villages	Non-Payout Villages	Payout Villages	Non-Payout Villages
Offered Insurance	-2.559	-0.162	-323.1	-21.10
	(-3.14)	(-3.46)	(-1.83)	(-5.28)
Offered Insurance x Deviation of Kharif 2011 Rain per Day from Historical	-1.197	0.0155	-161.9	3.298
	(-3.05)	(1.30)	(-1.83)	(2.01)
Male	0.192	0.114	5.131	5.523
	(5.47)	(4.06)	(1.09)	(1.98)
Observations	515	2,932	287	1,191
Predicted Effect of Insurance Offer at Median Rainfall (t-stat)	-0.285	-0.0846	-15.44	-4.611
	(-3.051)	(-1.635)	(-1.391)	(-0.600)

Robust t-statistics, based on standard errors clustered by village-caste, in parentheses. Age and age-squared also

Regression Specifications - General Equilibrium Wage Equation

$$\log(W_{ik}) = \gamma_1 CI_k + \gamma_2 (CI_k * r_k) + \gamma_3 LI_k + \gamma_4 (LI_k * r_k) + \gamma_5 IP_k + Z_{ik}\alpha + V_k\delta + \epsilon_{ik}^3 \quad (3)$$

As per theory:

$\gamma_2 > 0$, ↑ insurance for cultivators, ↑ wage volatility across rainfall states

$\gamma_4 < 0$, ↑ insurance for wage workers, ↓ wage volatility across rainfall states

$\gamma_5 > 0$, Landless laborers supply less labor when insurance payouts occur, ↑ wages

Results - General equilibrium effects on wage volatility

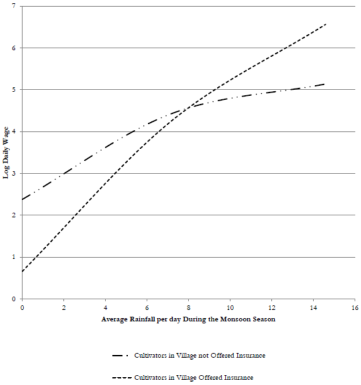
Table 7: General Equilibrium Effects of Insurance Provision and Rainfall on Log Wages
(Landless Agricultural Wage Workers Ages 20+)

	(1)	(2)
Proportion Cultivators Offered Insurance in 2011		-6.724
		(-3.12)
Proportion Cultivators Offered Insurance * Rain per Day in 2011 Kharif Season		0.842
		(3.96)
Proportion of Landless Labor Households Offered Insurance in 2011		4.357
		(1.76)
Proportion of Landless Labor Households Offered Insurance * Rain per Day in 2011 Kharif Season		-0.627
		(-3.10)
Proportion of Households Offered Insurance in a Village where Payout Occurred		2.470
		(2.66)
Rain per day during 2011 Kharif season	0.145	0.804
	(1.10)	(7.03)
Rain per day during 2011 Kharif season, squared	-0.00305	-0.0133
	(-1.38)	(-5.56)
Historical Mean Rainfall	-0.125	0.0689
	(-1.98)	(1.18)
Bus Stop in Village	0.107	0.542
	(1.21)	(2.33)
Bus Stop in Village * Rain per Day in 2011	-0.0452	-0.149
	(-1.38)	(-3.76)
Paved Road to Village	0.751	0.909
	(3.37)	(4.20)
Paved Road to Village * Rain Per Day in 2011	-0.0473	-0.222
	(-1.32)	(-7.58)
Bank in Village	0.431	0.167
	(2.15)	(0.71)
Bank in Village * Rain Per Day in 2011	-0.0568	0.0230
	(-1.37)	(0.38)
Male	0.307	0.310
	(9.89)	(9.93)
Observations	2,693	2,693
R-squared	0.327	0.337

Robust t-statistics, based on standard errors clustered by village-caste, in parentheses. All specifications include state fixed effects and control for education, age of respondent and a squared term in age, and 11 variables characterizing soil type, depth and drainage characteristics. All specifications also include 6 variables controlling for the proportion of village that are agricultural laborers or cultivators, and their interactions with rain per day, and proportion village laborers or cultivators that are eligible to receive insurance marketing.

Policy Simulation # 1 - Effect of marketing insurance to cultivators in the village

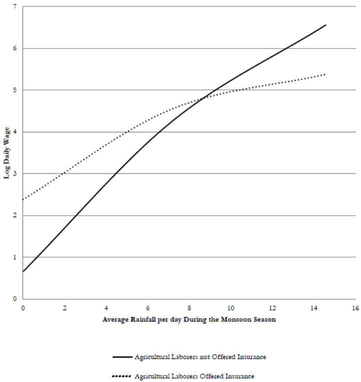
Figure 3: Effect of Marketing Rainfall Insurance to Cultivators on the Equilibrium Wage Rate



Sensitivity of wages to rainfall $\uparrow$ when cultivators are offered insurance

Policy Simulation # 2 - Effect of marketing insurance to landless laborers in the village

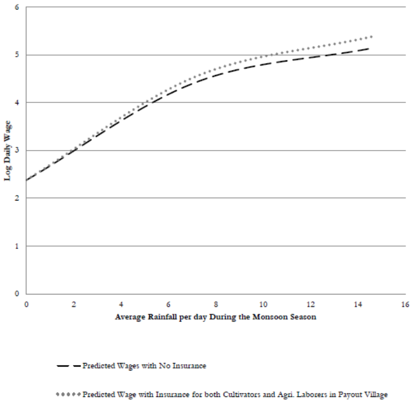
Figure 4: Effect of Marketing Rainfall Insurance to Agricultural Laborers on the Equilibrium Wage Rate



Sensitivity of wages to rainfall ↓ when landless laborers are also offered insurance

Policy Simulation # 3 - Combined effects

Figure 5: Effect of Marketing Rainfall Insurance to both Laborers and Cultivators on the Equilibrium Wage Rate



Sensitivity of wages to rainfall *vanishes* when both cultivators and landless laborers are offered insurance

Outline

- Net spillover effects of insurance marketing to cultivators and landless laborers on wage volatiility non-existent
- Wage volatility increases with marketing of insurance to only cultivators $\implies$ reducing welfare for landless laborers who also cannot afford insurance prices.
- Wage volatility decreases with marketing of insurance to landless laborers as well $\implies$ offering insurance not just to farmers but also to wage laborers
- Importance of understanding the aggregate effects of interventions (even in experimental settings) using GE framework