How Does Informal Risk-Sharing Influence Insurance Decisions? Evidence from Randomized Experiments in India

Francis Annan[GA State U]   Bikramaditya Datta[IIT Kanpur]

DECEMBER 2019

Weather-risks and index contracts

- Business of agriculture inherently risky, particularly for poor: unpredictable weather
- Innovative index-based weather insurance emerged as way to insure
  - Index Contract: pays out when some constructed-index falls below or above a given non-manipulable threshold
- Previous research noted 2 fundamental puzzles about index products (contracts not been successful?):
  1. Demand lower than expected...
  2. Adoption particularly low from the most risk averse consumers

(2 Puzzles): Explanations

- Typically, range from trust, to credit constraints, to "basis risk" and price effects
  - another: pre-existing informal risk-sharing arrangements (open question)

"*...and when basis risk is large, having an informal network can help by providing insurance against basis risk. Thus the presence of informal risk sharing actually increases demand for index-based insurance in the presence of basis risk...*" -- **World Development Report (2014)**

Motivating Features → What We do?

- Variations exist: but for the same location (agr conditions)-variation in basis risk cannot explain take-up variations. So what drives variations?
- The literature is very thin on measuring basis risk
- Barriers (price and brisk) may bear on existing risk institutions e.g., (informal) risk sharing

What We do?

- We provide alternative measure(s) of brisk
- We combine measures with features about product priming to identify 2 novel forces that underlie variation in take-up of index contracts
- We interpret and confirm this as evidence of (informal) risk sharing — consistent with a developed theory...
  - group priming ↗ sensitivity to price **vs** ↘ sensitivity to basis risk
  - results more consistent with risk-sharing interpretations
  - likely driven by changes in risk preferences via (informal) risk-sharing

Motivating Features → What We do?

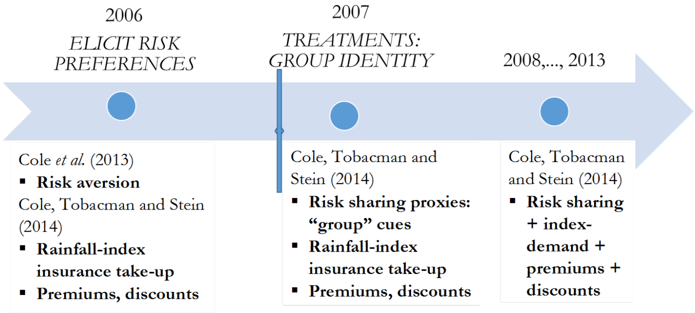
- Variations exist: but for the same location (agr conditions)-variation in basis risk cannot explain take-up variations. So what drives variations?
- The literature is very thin on measuring basis risk
- Barriers (price and brisk) may bear on existing risk institutions e.g., (informal) risk sharing

What We do?

- We provide alternative measure(s) of brisk
- We combine measures with features about product priming to identify 2 novel forces that underlie variation in take-up of index contracts
- We interpret and confirm this as evidence of (informal) risk sharing — consistent with a developed theory...
  - group priming ↗ sensitivity to price **vs** ↘ sensitity to basis risk
  - results more consistent with risk-sharing interpretations
  - likely driven by changes in risk preferences via (informal) risk-sharing

Data and Experiments

Figure: **Timelines of data and experimental treatments**



- Rainfall index contract, 2006-2013 marketing experiments
- Summer ("Kharif") monsoon growing season, JJA, (covers: drought and flood)

Product priming...

- Marketing teams employed 2 dimensional group identity treatments (seeded in 2007/08):

Religion (Hindu, Muslim, or Neutral): *A photograph on the flyer depicted a farmer in front of a Hindu temple (Hindu Treatment), a Mosque (Muslim Treatment), or a neutral building. The farmer has a matching first name, which is characteristically Hindu, characteristically Muslim, or neutral.*

Individual or Group (Individual or Group): *In the Individual treatment, the flyer emphasized the potential benefits of the insurance product for the individual buying the policy. The Group flyer emphasized the value of the policy for the purchaser's family.*

Data Summaries

Table: **SUMMARIES**

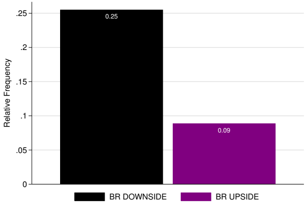
VARS	N	Mean	SD	Min	Max
1(Bought=Yes)	4,948	0.39	0.49	0	1
Risk aversion (Yr=2006)	4,948	0.53	0.32	0	1
Premium	4,948	159.4	56.08	44	257
Discount	4,948	5.4	17.51	0	90
1(Payout=Yes)	4,948	0.12	0.32	0	1
Payout/ Policy	4,948	63.8	56.50	0	257
1(Group cues) (Yr=2007)	4,948	0.04 (0.29)	0.19	0	1
1(Hindu cues) (Yr=2007)	4,948	0.03 (0.21)	0.16	0	1
1(Muslim cues) (Yr=2007)	4,948	0.03 (0.22)	0.17	0	1
# of HH /V /D	645 /60 /3 (state of Gujarat)				

Measuring basis risk I

"Mismatch": Measure of basis risk (Household i, Village v, Mkt Year t)..Indicators:

$$briskDOWNSIDE_{ivt} = \mathbf{1}(\mathbf{1}[loss_{ivt-1} = Yes] > \mathbf{1}[payout_{ivt-1} = Yes])$$
$$briskUPSIDE_{ivt} = \mathbf{1}(\mathbf{1}[loss_{ivt-1} = Yes] < \mathbf{1}[payout_{ivt-1} = Yes])$$

Figure: **Distribution of basis risk**



Notes: Figures display the distribution of basis risk measured as the mismatch between households experience of pre-insurance loss in crops or revenue and receiving an index payout, respectively. Revenue is measured for market years in which a crop loss is reported, and captures the "amount" of crop loss: calculated as the difference between that market year's agricultural output and the mean value of output in all previous years where crop loss was not reported.

Measuring basis risk II

"Correlation": Measure of conditional corr b/n payAmount and croplossAmount | coverageAmount

- 1st Estimate:

$$payA_{ivt-1} = \alpha + \beta C_{ivt-1} + \epsilon_{ivt-1}$$
$$lossA_{ivt-1} = \alpha + \gamma C_{ivt-1} + \eta_{ivt-1}$$

- 2nd: Compute correlation of residuals: $\hat{\epsilon}_{ivt-1}$ and $\hat{\eta}_{ivt-1}$ by village v and mkt year t
- "Smaller" values imply the presence of "more" basis risk and vice versa...

Measuring basis risk: validity?

- To what extent is exclusion restriction satisfied?
  - Previous year experiences might reflect other effects e.g., binding credit constraints?
  - If "significant" then might lead mismeasurement and influence results
- Validity?
  - re-affirming previous results on effects of basis risk...[next 2 slides: column (1)]
  - alternative measure(s) yielding similar results (+ interaction identified?)
  - include fixed effects to soak up time-invariant effects specific to households
- **Merits:** data on "distance to weather monitor" may not be available, potential adverse selection

Empirical strategy

Understanding insurance decisions? We evaluate two aspects of index contract: price vs brisk

- **Intuition (for identification):** random variations from product priming + price shifter + basis risk
- **Balance and Validity of Design:** Identification requires that receiving prime treatments are independent of any relevant household-level statistics (we use baseline 2006/07 data: 17 observables)

$$y_{iv} = \alpha + \mathbf{X}'_{iv}\xi + \epsilon_{iv}$$

- Table A2.5 (In paper): Strong evidence in favor of balance

Model specification:

$$D_{ivt} = \gamma_1 \boldsymbol{Prime}_{ivt} \times brisk_{ivt} + \gamma_2 \boldsymbol{Prime}_{ivt} \times Discount_{ivt} + \alpha brisk_{ivt} + \beta Discount_{ivt} + \mu_i + \delta_t + \epsilon_{ivt}$$

- $D_{ivt} = \mathbf{1}(bought = Yes)_{ivt}$
- FEs μ_i and δ_t (errors clustered at village v level)
- γ key parameter(s) of interest

Results

Table: **PRODUCT PRIMES IMPACTS ON TAKE-UP OF CONTRACT**

DV: $\mathbf{1}$(bought=Yes)	(1)	(2)	(3)
bRisk	-0.131***		-0.133***
	(0.0227)		(0.0227)
bRisk $\times \mathbf{1}$(Prime=Yes)			0.118**
			(0.0496)
$\mathbf{1}$(discount=Yes)	0.558***		0.458***
	(0.0775)		(0.0891)
$\mathbf{1}$(discount=Yes)$\times \mathbf{1}$(Prime=Yes)			0.488***
			(0.0958)
$\mathbf{1}$(Prime=Yes)		-0.074	-0.243***
		(0.0554)	(0.0468)

Interpretations of results

- Key results: -88% ($= \frac{0.118}{-0.133} \times 100$) decrease in basis risk effects **vs** $>+100\%$ ($= \frac{0.488}{0.458} \times 100$) increase in price effects (when combined with product group primes)

Product priming has receive 2 popular interpretations, either:

1. Group identity as inducing Risk-sharing (Karlan et al. 2009) – via 'preferences' **vs**
   - Risk-sharing: evaluate both in theory and empirically
2. Alternatives: inducing Trust & Identity (Attanasio et al. 2009)
   - Identity and Trust: evaluate empirically

[A Motivating Theory of Risk-sharing]: Set up

- Consumer i with absolute risk aversion parameter $\gamma_i > 0$ and receives utility $u_i(z) = -e^{-\gamma_i z}$ from consuming income z
- Faces uncertain income: $z_i = w_i + \underbrace{\varepsilon_i + v}_{h_i}$
- Idiosyncratic shocks ε_i insured by informal schemes
- Aggregate shocks v insured by formal index contract
  - $\varepsilon_i \sim N(0, \sigma_i^2)$
  - $v = \begin{cases} 0 & \text{with prob. } (1-p) \\ -L & \text{with prob. } p \end{cases}$

Formal: Index contract

- Two Sided Basis Risk (Clark 2016)

Table: Joint probability structure

	Index=0	Index=I	
$v = 0$	1-q-r	**q+r-p**	1-p
$v = -L$	**r**	p-r	p
	1-q	q	

- Basis risk, r (downside) vs. $q + r - p$ (upside)
- Can purchase indexed cover of βL at premium multiple of $m > 1$
  - Premium of $\pi = mq\beta L$ buys claim payment of $\eta = \beta L$ if Index $= I$

(Wilson 68) Informal: Risk sharing

- $\exists$ group g (representative agent) that i may join
- Denote income realization of group as: $z_g(\epsilon) = w_g + h_g$
  - $h_g \sim N(0, \sigma_g^2)$ insured via risk-sharing arrangements
- If matched (i, g): enter into binding agreement before incomes realized (to share pooled incomes later)

R1: joining risk-sharing group yields lower risk aversion, effectively

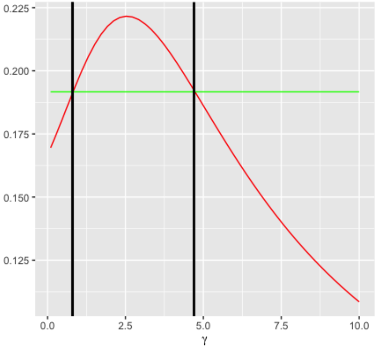
- *Suppose individual i decides to join group g and risk is shared efficiently between them. Then (under transferable CEs) we can think of pair (i, g) as a representative agent with risk aversion parameter γ_{i^*} where $\frac{1}{\gamma_{i^*}} = \frac{1}{\gamma_i} + \frac{1}{\gamma_g}$*
- **R1 Implication:**

$$\gamma_{i^*} < \min(\gamma_i, \gamma_g)$$

- I.e., risk aversion of the individual i will be lower if he is in a group, as compared to if he was acting as an individual $\Rightarrow$ "index decision" parameter

R2: *Risk-sharing may Impede/Not Index demand, Ambiguity*

Figure: INDEX TAKE-UP



- Where: $p = q = \frac{1}{3},\ L = 1,\ r = \frac{1}{9},\ \beta = 0.5,\ m = 1.15$
- Vertical black lines correspond to $\gamma = 0.8$ and $\gamma = 4.7$

1. IRSA might support Index take-up, E.G. $\gamma^{umatched} = 6 \rightarrowtail \gamma^{matched} \in (0.8, 4.7)$
2. IRSA might not-support Index take-up, E.G. $\gamma^{umatched} = 3 \rightarrowtail \gamma^{matched} \in (0, 0.8)$ [Proposition and Proof in paper]

Implications of Model

Empirical (test) implication #1. Informal risk-sharing arrangements make decision makers less sensitive to basis risk but more sensitive to premium. Thus the overall impact of informal risk-sharing schemes on the demand for index contracts may be ambiguous: it depends on whether or not the basis risk effect dominates the price effect.

Empirical (test) implication #2. Changes in risk attitudes or preferences are likely channels that informal risk-sharing act to affect the take-up of index insurance contracts.

Empirical Test: Risk-sharing/ $\triangle$risk preferences

$$D_{ivt} = \gamma_1 \boldsymbol{rAversion}_{ivt} \times brisk_{ivt} + \gamma_2 \boldsymbol{rAversion}_{ivt} \times Discount_{ivt} + \alpha brisk_{ivt} + \beta Discount_{ivt} + \mu_i + \delta_t + \epsilon_{ivt}$$

- **rAversion**: we use 2006 data on risk aversion

Table: $\triangle$RISK PREFERENCES/ RISK-SHARING CHANNEL FOR PRIMING IMPACTS

DV: **1**(bought=Yes)	(1)	(2)
bRisk	-0.130***	-0.112***
	(0.0232)	(0.0292)
bRisk × *riskAversion*		-0.0371
		(0.0430)
Discount	0.0035***	0.0040***
	(0.0006)	(0.0011)
Discount × *riskAversion*		-0.0009
		(0.0014)

Empirical Test: Identity + Trust

$$D_{ivt} = \gamma_1 \textbf{\textit{Identity}}_{ivt} \times brisk_{ivt} + \gamma_2 \textbf{\textit{Identity}}_{ivt} \times Discount_{ivt} + \alpha brisk_{ivt} + \beta Discount_{ivt} + \mu_i + \delta_t + \epsilon_{ivt}$$

- **Identity + Trust** (Cole et al 2013 results) ⇒ proxies: match (vs mismatch) in own religion with religious symbol of group flyer

Table: IDENTITY AS A CHANNEL FOR PRIMING IMPACTS

DV: **1**(bought=Yes)	(1):IDENTITY MATCH {21%}	(2):IDENTITY MISMATCH {22%}
bRisk	-0.178***	-0.096**
	(0.0423)	(0.0376)
bRisk ×**1**(Prime=Yes)	0.238***	0.051
	(0.0562)	(0.061)
1(discount=Yes)	0.306**	0.134
	(0.1116)	(0.091)
1(discount=Yes)×**1**(Prime=Yes)	0.598***	0.836***
	(0.02372)	(0.098)
1(Prime=Yes) ...	-0.288***	-0.290***

Discussion...

- Priming impacts also significant (mostly) for Identity-match subsample $\Rightarrow$ suggests Identity effects are relevant (but hard to benchmark with $\triangle$risk preferences)

Overall takeaways?

- [I] Theory + empirical (directional) support for changes in risk-preferences
- [II] Not obvious for how Identity/ Trust will **increase** price sensitivity (OK for decrease in basis risk sensitivity)

$\Rightarrow$ Risk-sharing channel likely plausible interpretation...

Conclusion

- We provide new evidence on how product priming impacts adoption of index contracts
- Identify 2 novel forces: basis risk effects (-88%) vs price effects (>+100%)
- For interpretation: appeal to consumer's lowered risk aversion from product priming
  - Results likely explained by informal risk-sharing (Karlan et al. 2009), less so for trust and identity directly

POLICY

- Should we subsidize index insurance? or should we reduce basis risk? Sell index contracts to a group or not – for public finance reasons?
- Possible Answer: promote informal arrangements (E.g., cooperatives) which could tackle basis risk but also want to subsidize insurance at the same time...