Designing Insurance Contracts when Clients "Greatly Value Certainty"

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May 9, 2018

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I4 INDEX INSURANCE INNOVATION INITIATIVE

Index Insurance is Effective, but ...

- Evidence on the *ex ante* and *ex post* effects is emerging; Consider impacts from a study of cotton farmers in Mali:

	Loans (kCFA)	Area (ha)	Grain Area (ha)	Inputs (kCFA)	Harvest (kg)
Individual believes insured (instrumented)	138.944	1.569*	1.096	121.010**	837.7
	(89.144)	(0.852)	(0.908)	(52.570)	(775.325)
Constant	90.367	0.367	1.522**	35.294	178.6
	(65.346)	(0.456)	0.646	(26.680)	(672.7)
N	885	875	888	870	863

Elabed & Carter (2017) Ex Ante Impacts of Agricultural Insurance: Evidence from Mali

- But despite this and other evidence, insurance demand in many pilots has been sluggish

Behavioral Economics Insights into Insurance Demand

- Conventional economic approach to thinking about how we make decisions in the face of risk ("expected utility theory") would seem to suggest that risk averse farmers should eagerly buy insurance
- There are multiple conventional explanations for low demand despite general attraction to insurance:
  - Understanding and trust
  - Pricing
  - Contract quality (huge issue: later discuss need for quality standards & certification)
- But what if economics' conventional way of thinking about decisonmaking under risk is simply incorrect?
- In fact, decades of behavioral experiments suggest systematic deviations between our actual behavior and what economics' conventional perspective predicts

- We have begun to see the application of behavioral insights to the demand for insurance:
  - For example, Elabed & Carter (2015) find that ambiguity aversion of the Ellsberg Paradox radically cuts demand for index insurance
- Today explore the insurance implications of another important insight from behavioral economic experiments about how we make decisions under risk

Summary of What Follows

1. The Allais Paradox & its Implications for Insurance
2. Insurance Games: Burkinabe Cotton Farmers Greatly Value an Unconventional Insurance Premium Rebate Framing
3. Capturing Allais' insights as a "Extreme Preference for Certainty" (EPC)
4. Lottery Games to Measure the Extent of EPC Amongst Burkinabe Cotton Farmers
5. The impact of EPC on the Valuation of the Insurance Premium Rebate Framing
6. Welfare implications of our findings
7. Way forward for index insurance

- First consider the following alternative lotteries:

Experiment 1

Lottery 1A		*Lottery 1B*	
Pay-offs	Prob.	Pay-offs	Prob.
0	89%	0	90%
\$1 million	11%		
		\$5 million	10%

- If given a choice to play one lottery or the other, which would you choose?

- Now consider the following lotteries:

Experiment 2

Lottery 2A		*Lottery 2B*	
Pay-offs	Prob.	Pay-offs	Prob.
		0	1%
\$1 million	100%	\$1 million	89%
		\$5 million	10%

- Again, which would you rather play?

The Allais Paradox

- From the conventional economics perspective our preference for 1B to 1A implies that the 11% chance of $1m is valued *less* than a 1% chance of $0 plus the 10% chance of $5m
- Sounds reasonable, right?
- But our preference for 2A over 2B implies exactly the opposite: an 11% chance of $1m is valued *more* than than a 1% chance of $0 plus the 10% chance of $5m
- The 100% certainty of getting the million dollar payoff in Lottery 2A exerts a strong pull on us

Experiment 1				Experiment 2			
Lottery 1A		*Lottery 1B*		*Lottery 2A*		*Lottery 2B*	
Pay-offs	Prob.	Pay-offs	Prob.	Pay-offs	Prob.	Pay-offs	Prob.
0	89%	0	90%			0	1%
$1 million	11%			$1 million	100%	$1 million	89%
		$5 million	10%			$5 million	10%

The Allais Paradox & Insurance

- Allais himself made two observations about this paradoxical result:
  - Expected utility theory is ‘incompatible with the preference for security in the neighborhood of certainty’ (Allais, 2008)
  - But ‘far from certainty’, individuals act as expected utility maximizers, valuing a gamble by the mathematical expectation of its utility outcomes (Allais, 1953)
- In other words, Allais hypothesizes that we tend to exhibit a discontinuous or “extreme preference for certainty”

The Allais Paradox & Insurance

- So how do Allais' observations on how we behave relate to insurance?
  - Insurance is an alien commodity precisely because it (usually) has a certain cost (the premium), but an uncertain benefit
  - In explaining insurance to the never before insured, we often strongly emphasize this point so that farmers understand they may not in any particular year receive anything in return for their insurance purchase
- But if Allais is correct, then in making insurance purchase decisions, do we overweight the certain cost (the negative element of the contract) relative to the uncertain benefits of the contract, implying lower than expected insurance demand?

Field Experiment in Burkina Faso: Insurance Game

- Working with 577 farmer participants in the area where we offer area yield insurance for cotton farmers, played an incentivized insurance games intended to elicit willingness to pay for insurance under alternative framings.
- Game was set up to mimic farmer's reality:
  - 1 hectare of land to use to cultivate cotton
  - Stochastic yields with 1200 kg of cotton in good year (80% probability) & 600 kg in bad year (20% probability)
  - Cotton price & input costs set at realistic levels
  - Endowed with an initial wealth of 50,000

	Good Yield (80%)	Bad Yield (20%)
Net Cotton Revenue	188,000	44,000
Initial Endowment	50,000	50,000
Terminal Wealth	238,000	94,000

- After subjects learned how to “farm” in this game, they were presented with one of two, randomly chosen, insurance contracts:
  - *Standard Certain Premium Frame*
    The amount of your savings is 50,000 CFA. You decide to buy an insurance before knowing your yield. The insurance price is 20,000 CFA. You pay the insurance with your savings. In case of bad yield, the insurance gives you 50,000 CFA. In case of good yield the insurance gives you 0 CFA.
  - *Premium Rebate Frame*
    The amount of your savings is 50,000 CFA. You decide to buy an insurance before knowing your yield. The insurance price is 20,000 CFA. You pay the insurance with your savings, BUT only in case of good yield. In case of bad yield the insurance gives you 30,000 CFA. In case of good yield the insurance gives you 0 CFA.
- Note that the rebate frame could be implemented in the context of cotton production

Balance Test

	(1) Standard Frame	(2) Premium Rebate Frame	(3) T-test (p-value)
Age	43.67	44.56	0.5
	(12.34)	(13.29)	
Years of Formal Education	0.99	0.98	0.97
	(2.16)	(2.19)	
Religion : Muslim	0.46	0.35	0.27
	(0.50)	(0.48)	
Religion : Animist	0.31	0.37	0.19
	(0.46)	(0.48)	
Religion : Christian	0.22	0.29	0.39
	(0.42)	(0.45)	
Ethnicity : Bwaba	0.41	0.36	0.67
	(0.49)	(0.48)	
Ethnicity : Mossi	0.38	0.38	0.97
	(0.49)	(0.49)	
Other Ethnicity	0.21	0.26	0.51
	(0.41)	(0.44)	
Household size	8.78	8.69	0.86
	(5.45)	(5.08)	
Number of children	4.24	4.34	0.69
	(3.27)	(3.03)	
Years in cotton group	10.13	10.59	0.51
	(6.03)	(6.43)	
Total area cultivated (hectares)	9.81	10.5	0.43
	(6.9)	(7.23)	
Area in cotton (hectares)	3.81	3.91	0.72
	(3.14)	(3.38)	
Group leader (president or secretary)	0.07	0.09	0.30
	(0.26)	(0.29)	
Willingness-to-pay for insurance	15052	16549	0.08
(1000 CFA)	(10350)	(10480)	
Number of individuals	287	284	

Standard deviation in parentheses. T-test of equality of means across frames.

- If premium was set at 20k CFA, farmer would face the following options under the different insurance frames

	Std Frame		*Rebate*		*No Insurance*	
	Good	Bad	Good	Bad	Good	Bad
Premium, π	20	20	20	0	0	0
Indemnity, I	0	50	0	30	0	0
Net, π-I	-20	30	-20	30	0	0
Terminal Wealth	*218*	*124*	*218*	*124*	*238*	*94*

- Note that standard and rebate frames are actuarially identical
- The actuarially fair price of insurance is 10k CFA (20% x 50k CFA)

Playing the Game

- Started with an initial pair where insurance was priced at 50,000 so that no insurance was the dominant choice
- In each subsequent pair, insurance price was dropped (with prices of 30,000; 25,000; 20,000; 15,000; 10,000; 5000; 0)
- Farmer chose whether and when to switch to the 'safer' insurance option
- Never purchasing insurance was an option
- Under standard expected utility theory, risk averse agent would be expected to purchase insurance at some price in excess of the actuarially fair price of 10,000 irrespective of frame
- If farmers "greatly value certainty," then they should show a higher WTP when offered the rebate frame

- The raw willingness to pay results are:

Willingness To Pay	Mean	Std. Dev.	N
All	15,796	10438	571
Standard Certain Premium	15,052	10356	287
Premium Rebate	16,549	10486	284
Premium Rebate - Standard	1497*		

* The p-value of the student test of equality of means is 0.08

- While these results tell story, let's take a more refined look at certainty preference before examining data econometrically

Andreoni & Sprenger Perspective on the Allais Paradox

- Motivated by Allais' observations summarized above, Andreoni & Sprenger propose a parsimonious approach to capture Allais' observations:
  - Suppose we simply discontinuously value certain outcomes with a more favorable utility function; for example:
    - $v(y) = y^{\alpha}$ if y is certain; and,
    - $u(x) = x^{\alpha-\beta}$ if x is uncertain, where $\beta \geq 0$ is a measure of a discontinuous or extreme preference for certainty (EPC)
    - Note that if $\beta = 0$, the reduces to the standard economist's formulation; $\beta > 0$ implies an "extreme preference for certainty"
- Andreoni and Sprenger report lab experiments that confirm that expected utility works well if comparing uncertain things, but breaks down "in the neighborhood of certainty," that is, as soon as individuals compare a risky lottery with a degenerate lottery/sure thing (fatal attraction of certainty!)

Adapting A&S to the Mixed Prospects of Insurance

- Possible to adapt the Andreoni & Sprenger formulation to insurance contracts:
  - A farmer with a discontinuous preference for certainty would prefer the rebate frame
  - Whereas a 'conventional' (expected utility maximizing) farmer would equally value both contracts
- So how many farmers exhibit this kind of EPC psychology and do they drive the willingness to pay for insurance results?

Testing for "Extreme Preferences for Certainty"

- Choose between 8 binary lotteries with $p_b = p_g = 1/2$; Initially lottery R stochastically dominates lottery S, but R becomes riskier
- Where the individual switches from R to S brackets farmer's degree of risk aversion γ.

Pair	Riskier Lottery (R)		Safer Lottery (S)		*E(R)-E(S)*	Risk Version
	Bad outcome	Good outcome	Bad outcome	Good outcome		(CRRA)
1	90,000	320,000	80,000	240,000	45,000	–
2	80,000	320,000	80,000	240,000	40,000	–
3	70,000	320,000	80,000	240,000	35,000	$1.58 < \gamma$
4	60,000	320,000	80,000	240,000	30,000	$0.99 < \gamma < 1.58$
5	50,000	320,000	80,000	240,000	25,000	$0.66 < \gamma < 0.99$
6	40,000	320,000	80,000	240,000	20,000	$0.44 < \gamma < 0.66$
7	20,000	320,000	80,000	240,000	10,000	$0.15 < \gamma < 0.44$
8	0	320,000	80,000	240,000	0	$0 < \gamma < 0.15$

- Note that those who switch at row 2 appear as (quasi-) Gneezy et al. (2006) type players who value a risky prospects by less than its worst

Testing for "Extreme Preferences for Certainty"

- Replace safer lottery with a degenerate lottery *D* with certain payoff (risky lottery *R* is the same)
- The value of the degenerate lottery at each row equals the certainty equivalent of safe lottery *S* for an individual who would have switched at that point

Pair	Risky Lottery (R)			Certain 'Lottery' (D)
	Bad outcome	Good outcome	*E(R)-E(D)*	
1	90,000	320,000	145,000	60,000
2	80,000	320,000	120,000	80,000
3	70,000	320,000	67,800	127,200
4	60,000	320,000	51,000	139,000
5	50,000	320,000	39,000	146,000
6	40,000	320,000	29,300	150,700
7	20,000	320,000	12,600	157,400
8	0	320,000	0	160,000

- By construction, an expected utility maximizer with $\beta = 0$ should switch at the same pair, whereas switch earlier if $\beta > 0$

Lottery Switch Point Results

- Main diagonal (in bold) are expected utility maximizers who switch at same point
- Lower triangle (in blue) have an extreme certainty preference' with $\beta > 0$ (row 4 example)

		Risky vs Degenerate Game									
		2	3	4	5	6	7	8	9	Total %	Total freq
Risky vs Risky Game	2	**39.29**	16.67	10.71	3.57	2.38	7.14	9.52	10.71	100	84
	3	10.53	**27.63**	26.32	13.16	7.89	7.89	2.63	3.95	100	76
	4	8.33	19.79	**29.17**	18.75	9.38	6.25	5.21	3.12	100	96
	5	2.25	10.11	17.98	**30.34**	20.22	5.62	7.87	5.62	100	89
	6	1.82	14.55	7.27	12.73	**21.82**	20.00	12.73	9.09	100	55
	7	4.65	6.98	6.98	11.63	18.60	**20.93**	18.60	11.63	100	43
	8	7.81	3.12	9.38	12.50	4.69	20.31	**31.25**	10.94	100	64
	9	9.38	3.12	4.69	6.25	1.56	4.69	10.94	**59.38**	100	64
	Total %	11.38	13.66	15.59	14.36	10.33	10.33	11.21	13.13	100	
	Total freq	65	78	89	82	59	59	64	75		571

Prevalence of EPC Preferences

Agent Types	Core Definition	Conservative Definition
Extreme Preferences for Certainty (EPC)	29%	15%
Non-EPC	71%	85%
N	571	571

- Given that about one-third of farmers appear to have a extreme preference for certainty, the key question then becomes if these farmers are sensitive to contract design and framing
- Specifically, will these farmers
  - undervalue conventionally framed insurance relative to Expected Utility types
  - respond positively to rebate frame for insurance
- Results are robust to more conservative definitions of EPC

EPC Affect Willingness to Pay for Insurance

- So do EPC farmers prefer the rebate frame?

		Core		Conservative	
	All Agents	EPC	Non-EPC	EPC	Non-EPC
Standard Frame	15.1	13.5	15.8	14.2	15.2
	(10.4)	(10.5)	(10.2)	(11.2)	(10.2)
Rebate Frame	16.54	17.6	16.2	19.3	16.1
	(10.5)	(10.5)	(10.5)	(10.9)	(10.4)
Difference p-value	0.08	0.01	0.70	0.03	0.34

Standard Deviation in parenthesis.

- Can more carefully examine and test the robustness of these results econometrically, but the story is the same
- So let's summarize what we have learned

Conclusions: Potential Welfare Gains from Rebate Frame

- Using distribution of agent types and willingness to pay estimates, we can calculate what percentage of the farmer population would purchase the insurance if offered with the rebate as opposed to the standard frame:

Insurance Price	**Std Frame** Cum Pct Buying	**Rebate Frame** Cum Pct Buying
30000	15.68	20.42
25000	27.88	34.86
20000	44.60	52.11
15000	60.98	64.08
10000	70.74	75.35
5000	81.19	84.15
0	100	100

- If we take the Elabed & Carter insurance impact results from Mali, then cotton production could be increased by several percentage points annually simply by shifting from a standard, certain premium to a premium rebate frame.

Conclusions: Way Forward for Index Insurance

- Results thus suggest a basis for an alternative insurance contract design that should meet with bigger demand and have the potential to pick up some of the money being left on the table every year by risk avoiding farmers
- Learning how we are wired to make decisions in the face of risk is one way forward to index insurance
- In addition, we face massive challenges in defining and certifying insurance contract quality
    - Problem of hidden quality is even more severe for insurance than it is for seeds
    - Quality can be defined and certified, but requires institutional support
    - In the BASIS/I4 research program we are trying to mount private and public sector support for a quality certification for index insurance
- Stay tuned!