Utility, Risk, and Demand for Incomplete Insurance: Lab Experiments with Guatemalan Cooperatives

Craig McIntosh, Felix Povel, and Elisabeth Sadoulet

Appendix A - Additional Tables and Figures

Table A.1: Distribution of States in Different Games

	Probabilities of Occurrence of States (*100)								
	Shocks (in Quetzales)								
Games	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000
I1	80.95	4.76	4.76	4.76	4.76				
I2	80.95	4.76			4.76	4.76	4.76		
I3	80.95	4.76					4.76	4.76	4.76
I4	80.95	4.76				14.29			
I5	80.95	4.76			4.76	4.76	4.76		
I6	80.95	4.76		4.76		4.76		4.76	
I7	80.95	4.76	4.76			4.76			4.76
I8	76.19	4.76	4.76			14.29			
I9	76.19	4.76			4.76	14.29			
I10	76.19	4.76				14.29			4.76
I11	66.67	4.76	14.29			14.29			
I12	66.67	4.76			14.29	14.29			
I13	66.67	4.76				14.29			14.29
I14	80.95	4.76	4.76	4.76	4.76				
I15	80.95	4.76			4.76	4.76	4.76		
I16	80.95	4.76					4.76	4.76	4.76
G1	80.95	4.76			4.76	4.76	4.76		
G2	80.95	4.76		4.76		4.76		4.76	
G3	80.95	4.76	4.76			4.76			4.76
G4a	80.95	4.76			4.76	4.76	4.76		
G4b	80.95	4.76			4.76	4.76	4.76		
G4c	80.95	4.76			4.76	4.76	4.76		
G5b	80.95	4.76		4.76		4.76		4.76	
G5c	80.95	4.76		4.76		4.76		4.76	
G6b	80.95	4.76	4.76			4.76			4.76
G6c	80.95	4.76	4.76			4.76			4.76
G7	80.95	4.76	4.76			4.76			4.76
G8	80.95	4.76	7.14			4.76			2.38
G9	80.95	4.76	9.52			4.76			
G10	80.95	4.76	2.38			4.76			7.14
G11	80.95	4.76				4.76			9.52
G12	80.95	4.76	4.76			4.76			4.76

Income without shock is Q10,000. Cells with grey background are not covered by the insurance.

Table A.2: Representativeness of Those Invited to Play Games

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Age	Female	Years of Education	Area of Land Planted in Coffee	Household Asset Index
Played in Insurance Games	0.39	0.01	0.19	-0.07	0.88***
	(0.654)	(0.018)	(0.177)	(2.188)	(0.081)
Constant (mean in Coop Survey)	49.28***	0.14***	3.74***	31.13***	2.98***
	(0.419)	(0.011)	(0.113)	(1.400)	(0.052)
Observations	1,569	1,579	1,575	1,578	1,579
R-squared	0	0	0.001	0	0.073
Number of Cooperativa	71	71	71	71	71

This table compares the averages from a representative household survey to the averages within the group of individuals who played the insurance games. Fixed effects at the level of the cooperative are included, and standard errors in parentheses. years of education counts through tertiary education, with any tertiary education coded as 13. Area of land is measured in *cuerdas*. The household asset index is a raw sum of dummies for the possession of a set of nine consumer durable assets. *** p<0.01, ** p<0.05, * p<0.1

Figure A.1: State Space and Payoffs in Games

Shock Occurs		Payout Occurs: Yes	Payout Occurs: No
Yes	Prob. of each state:	π_s	ω_s
Yes	Returns in each state: (uninsured; insured)	$R_s;\ R_s - c + P$	$D_s;\ D_s - c$
No	Probability:	$\varnothing$	$1 - \sum_s \pi_s - \sum_s \omega_s$
No	Returns: (uninsured; insured)	$\varnothing$	$K;\ K - c$

Appendix B - Change in WTP due to a small uninsurable shock in EU model

Simplify the model to include only one state with insurable shock (income R with probability π) and one state of uninsurable shock (income D with probability ω). In absence of uninsurable shock, the WTP wtp is defined by:

$$\pi u(R) + (1-\pi)u(K) = \pi u(R + P - wtp) + (1-\pi)u(K - wtp).$$

With an uninsurable shock $K - D$, the WTP wtp^* is defined by:

$$\pi u(R)+\omega u(D)+(1-\pi-\omega)u(K) = \pi u(R+P-wtp^*)+\omega u(D-wtp^*)+(1-\pi-\omega)u(K-wtp^*).$$

We derive a first order approximation for a small shock $(K-D)$ and the corresponding small change in WTP. Subtracting these two expressions gives:

$$\begin{aligned}
\omega\left[u(D) - u(K)\right] &= \pi\left[u(R - wtp^* + P) - u(R - wtp + P)\right] \\
&\quad +(1-\pi)\left[u(K - wtp^*) - u(K - wtp)\right] \\
&\quad +(\omega)\left[u(D - wtp^*) - u(K - wtp^*)\right] \\
\omega\left[u'(K)(D-K) + o(K-D)\right] &= -\pi u'(R - wtp + P)\Delta wtp + o(\Delta wtp) \\
&\quad -(1-\pi)u'(K - wtp)\Delta wtp + o(\Delta wtp) \\
&\quad -\omega[u'(K - wtp) + o(\Delta wtp)](K-D) + o(K-D)
\end{aligned}$$

where $\Delta wtp = wtp^* - wtp$ and $o(z)$ indicates any function $f(z)$ such that $\lim_{z\to 0} f(z)/z = 0$. This gives:

$$\Delta wtp \simeq \frac{\left[u'(K) - u'(K - wtp)\right](K-D)}{\pi u'(R - wtp + P) + (1-\pi)u'(K - wtp)}\omega < 0$$

This shows that in the EU model, the introduction of a small uninsurable shock induces a reduction in WTP that is approximately proportional to the probability ω of the shock.

Appendix C - Game Ordering, Data Entry Form Bracketing, and Framing Effects

Table C.1: Game Ordering

Title of the Games	Game Identification	Alternative Ordering of the Games A	B	C	D	E	F	G	H
MKTING: Before		1	1	1	1	1	1	1	1
IND: Risk, EL	I1-I3	2	3	2	3	6	7	6	7
IND: Risk, SDL	I4-I7	3	2	3	2	7	6	7	6
IND: Drought	I8-I13	4	4	4	4	8	8	8	8
GRP: Without Allocation Rules	G1-G3	5	5	5	5	2	2	2	2
GRP: With Allocation Rules	G4-G6	6	6	7	7	3	3	4	4
GRP: Heterogeneity	G7-G11	7	7	6	6	4	4	3	3
GRP: Deliberation	G12-G13	8	8	8	8	5	5	5	5
IND: Unframed	I14-I16	9	9	9	9	9	9	9	9
MKTING: After		10	10	10	10	10	10	10	10

Table C.2: Effect of Game Ordering and Bracketing in Data Entry Form

Dependent Variable: Willingness to Pay, US$	Bracketing	Time Trend	Sequencing of Group Game	Sequencing of SDL and Heterogeneity Games
	(1)	(2)	(3)	(4)
High Price Bracketing	1.90			
(bracket higher by $6.35)	(1.23)			
Order of Game		-0.52***		
		(0.12)		
Group Game * Group			-5.12***	-5.20***
Game after Individual Game			(0.77)	(0.77)
Group Game			1.71***	4.11***
			(0.52)	(0.56)
Standard Deviation of Loss				-0.58
* SDL after EL Game				(0.67)
SDL Game				2.14***
				(0.43)
Heterogeneity Game * Het Game				0.14
after Correlation Game				(0.63)
Heterogeneity Game				-3.34***
				(0.44)
Constant	23.77***	26.18***	31.08***	28.80***
	(0.91)	(0.70)	(1.07)	(0.26)
Observations	674	17,948	12,017	12,017
R-squared	0.014	0.412	0.514	0.526

*** p<0.01, ** p<0.05, * p<0.1. Regression in column 1 uses game I1 only, it is cross-sectional at the individual level and standard errors are clustered at the cooperative level. Regressions in columns 2-4 include fixed effects at the individual level, and standard errors are clustered at the individual level. Regression in column 2 use all individual and group games, it includes fixed effects for each specific game, so the trend is measured for the same game played in different places in the sequence. Column 3-4 include individual games I1-I7 and group games with specified rules of allocation G4-G11.

Table C.3: Robustness of Drought Effect to Game Ordering

Dependent Variable: WTP, US $.	Predicted WTP	Actual WTP	Difference Actual WTP - Predicted WTP
	(1)	(3)	(6)
Any Drought	-6.83***	-12.76***	
	(0.32)	(0.52)	
Any Drought x Ind. Game Before	-1.76***	-2.54***	
	(0.52)	(0.80)	
Residual SD of Income in Drought Games	-79.63***	-31.22***	
	(2.66)	(1.15)	
Residual SD of Income in Risk Games	62.79***	55.81***	
	(2.17)	(2.10)	
Mild Drought			-7.58***
			(0.44)
Mild Drought x Ind. Game Before			-1.71**
			(0.69)
Drought Inducing the Worst Possible State			1.92**
			(0.79)
Worstt x Ind. Game Before			1.11
			(1.16)
Constant	31.88***	31.68***	0.04
	(0.17)	(0.23)	(0.17)
Observations	8,355	8,385	8,355
R-squared	0.794	0.739	0.414

*** p<0.01, ** p<0.05, * p<0.1. Regressions are estimated using games I1-I13. There are fixed effects at the individual level, and standard errors are clustered at the individual level.

Table C.4: Robustness of Group Effect to Game Ordering

Dependent Variable: WTP, US $.	Predicted WTP	Actual WTP
	(1)	(2)
Group with No Loss Adjustment	0	-3.08***
	(0.00)	(0.68)
Group with Moderate Loss Adjustment	1.93***	0.06
	(0.14)	(0.68)
Group with Maximal Loss Adjustment	6.54***	3.33***
	(0.47)	(0.72)
Group with No Loss Adjustment * Group after	0	-4.33***
	(0.00)	(1.02)
Group with Moderate Loss Adjustment * Group after	0.47**	-4.74***
	(0.20)	(1.03)
Group with Maximal Loss Adjustment * Group after	1.68**	-5.12***
	(0.69)	(1.09)
Constant	29.41***	29.14***
	(0.11)	(0.38)
Observations	2,616	2,625
R-squared	0.954	0.743

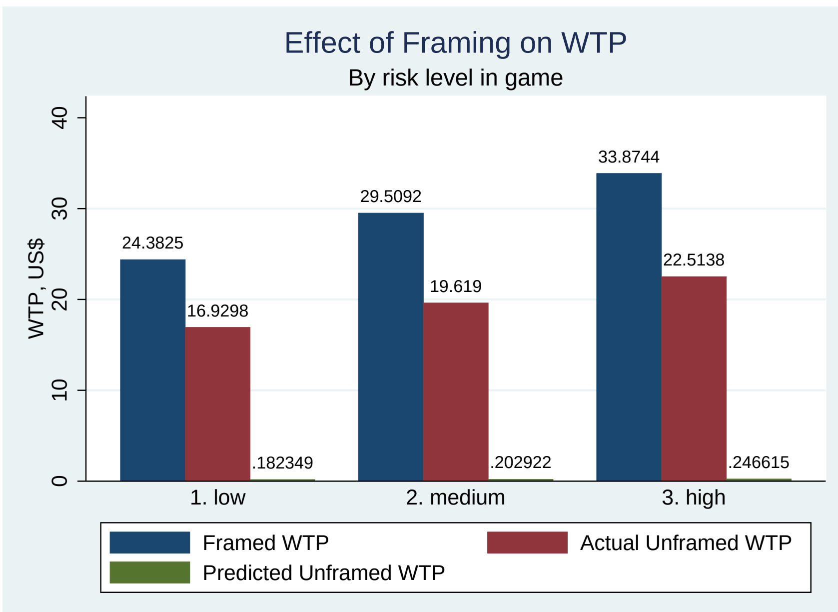
*** p<0.01, ** p<0.05, * p<0.1. Regressions include fixed effects at the individual level, and standard errors are clustered at the individual level.

Table C.5: WTP in Unframed Games

Dependent Variable: Willingness to Pay, US$	Predicted WTP		Actual WTP	
	(1)	(2)	(3)	(4)
Framed	29.21***	22.95***	9.79***	7.72***
	(0.58)	(0.56)	(0.70)	(0.66)
Framed * Medium Insured Shock		6.95***		2.29***
		(0.27)		(0.45)
Framed * Large Insured Shock		11.85***		3.92***
		(0.44)		(0.54)
Medium Insured Shock		0.03		2.50***
		(0.02)		(0.26)
Large Insured Shock		0.07***		5.29***
		(0.02)		(0.38)
Constant	0.21	0.18	19.50***	16.90***
	(0.28)	(0.28)	(0.35)	(0.34)
Observations	3885	3885	3864	3864
R-squared	0.83	0.869	0.598	0.653

*** p<0.01, ** p<0.05, * p<0.1. Regressions include fixed effects at the individual level, and standard errors are clustered at the individual level. Regressions used games I1-I3 and I14-I16.

Figure C.1: Actual and Predicted Demand in the Unframed Games



Appendix D - Discussion of Group Deliberation and Heterogeneity Games

Willingness to loss adjust after shocks are realized.

We now try to understand decisions over loss adjustment in a more natural deliberative context. The actual decision over group loss adjustment requires an aggregation of individual preferences into a group decision, and the successful implementation of group insurance requires that those individuals who suffered less severe shocks remain willing to pool after these losses have been realized. Rather than being a legal contract like index insurance, group loss adjustment is informal and hence vulnerable to ex-post renegotiation. To try to simulate this possibility in a laboratory context, we conducted a sequenced 'group deliberation exercise' (G12).

The graphical support for this exercise was a group game with the possible three options for the distribution of payouts seen before (none, moderate, and as much as possible). We first reminded them that groups could loss adjust, framed the pros (better risk protection) and the cons (tensions within the group), and asked players as individuals what degree of loss adjustment they would prefer (1 = none, 2 = moderate, 3 = as much as possible) if they were obtaining group insurance. We then asked them to discuss and decide upon this issue as a group, and recorded the outcome. Finally, we attempted to mimic the incentive to renege on group risk sharing by asking each individual to draw an actual rainfall shock (and thus a level of income) and to vote again on the group risk pooling decision. These three outcomes (pre-deliberation individual preference, group choice, and post-shock individual preference) provide a window directly into the desirability of this theoretically central feature of group insurance.

Column 1 of Table D.1 shows that players who are risk averse or ambiguity averse have a lower preference for sharing, although the point estimates are small. The group decision, explained in Column 2, shows that groups with more women and with less educated members reach agreement on a higher level of risk pooling after deliberation. The core point of the exercise, however, is illustrated in Column 3. Even in this contrived environment in which individuals are ask to state their preference twice over a very short period of time and with only a small sum of money at stake, we find evidence that the ex-post incentive incompatibility of risk pooling will prove problematic. Individuals who draw large negative shocks pivot to desire greater pooling, and those who draw small shocks desire less pooling. The extent to which preferences for sharing are altered in this interval provides an application of withdrawing the Rawlsian Veil of Ignorance, as agents who had previously not known their exact position in a shock redistribution now know what they personally stand to win or lose. The magnitude of the change in behavior provides some evidence for the extent to which the inability to writing binding contracts will pose a constraint on pooling agreements that must be ex-post incentive compatible.

The coefficients on the desired degree of risk sharing can be taken back to the coefficients from Table 6 in which the expected degree of risk pooling is estimated. Across all three of the group deliberation games participants report wanting 'moderate' risk sharing (50% of potential), and yet they expect that the groups will only provide 25% of the potential risk sharing. Given our evidence that the dynamic consistency of risk sharing is a problem in practice, the expectation that actual risk pooling will come in below the level desired may be well justified.

The effect of heterogeneity in expected losses

We now address the effect that asymmetric loss exposure may have on demand. This is a critical issue because this asymmetry introduces a dimension of expected transfer into the loss adjustment mechanism. If certain people are subject to more extreme shocks (because, for example, they are insuring steep or flood-exposed farmland) then loss adjustment will systematically entail a transfer of payouts towards these more exposed individuals and away from those who are less exposed to risk. This alters the actuarially fair premium. The greater the heterogeneity within a group in the exposure to these shocks, the more difficult we would expect group contracting to be.

To investigate this, we introduced five scenarios in which the group was presented as being composed of heterogeneous members with different risk exposure. While the average income in the group was assumed to be $R =$ Q5,000 and idiosyncratic income could still be $R - \sigma, R$ and $R + \sigma$, with $\sigma =$ Q2,000, some members had a higher probability of smaller income $R - \sigma$, and others a higher probability of higher income $R + \sigma$. In the example represented Figure 1d, the player faces a relatively less risky environment than average, with the probability of low loss of Q2,000 equal to 6/84, while the probability of high loss of Q8,000 is 2/84. Across the five scenarios, the probability of low loss varies from 8/84 to 6/84, 4/84, 2/84, and 0, with the complementary probability to 8/84 for high loss, and the probability of average loss of Q5,000 kept at 4/84 Throughout we maintained that there would be partial risk pooling, fixing the amounts to be pooled with payout of Q560, Q1,400 and Q2,240, respectively, depending on the severity of the loss incurred. These five scenarios give the basic dislike of heterogeneity, and the change in WTP as the expected losses to that individual change.

In the first scenario, we merely presented the issue of heterogeneity, but the player's exposure to risk is the same as the average in the group (probabilities for high and low losses are equal). Results in Table D.2, column 1 show that simply framing the group as consisting of heterogeneous membership drives down WTP by \$6.54, an amount greater than the overall penalty to group insurance. The next four scenarios placed the individual in different parts of the expected loss distribution, meaning that group loss adjustment would predictably serve as a transfer to or from that individual of the difference between net expected payout and the group average. When facing a higher probability of low losses a farmer's expected payout is lower than the average payout to the group (in this particular case, expected payout is Q160 when the group average is Q200). This means an average transfer of Q40 to the group. In contrast, a farmer with higher probability of high losses will be net receiver. As a way of understanding what this move in expected payouts should have done to demand, again utilize our utility structure to predict WTP. Column 2 shows that predicted WTP from the utility models should have decreased by $1.21 for each marginal dollar to be transferred (this number is less than negative one because the money is transferred in the worst states), while column 3 shows that the actual WTP drops by only $.60. Thus, at the margin, the decrease in WTP from disutility of making transfers to other group members is only half of what it is when the transfers are to the insurance company. Columns 4 and 5 repeat this analysis showing each scenario separately; High (low) transfer provider corresponds to the scenario with probability 8/84 (6/84) of low loss, respectively. High (low) transfer receiver corresponds to the reverse scenarios with probability 8/84 (6/84) of high loss. The results indicate that the divergence between the two types of WTP is particularly pronounced for the high transfer provider, i.e., when an individual is the one least exposed to shocks.

The takeaway from this analysis is that while group heterogeneity depresses demand for group insurance, and individuals do respond in the predicted way to their own shock exposure relative to the rest of the group, these individuals are only half as unwilling to transfer money to each other to reduce inequality as they are to lose money to the insurance company.

Table D.1: Group Deliberation

	Initial Individual Preference for Sharing	Group Decision on Sharing	Final Sharing Preference for Sharing
	(1=none, 2=moderate, 3=maximum possible)	(1=none, 2=moderate, 3=maximum possible)	In Difference from Group Decision
	(1)	(2)	(3)
Loss Shock Drawn after Deliberation ('000 US dollars)	-0.0109	-0.9055	0.0568*
	(0.07)	(0.66)	(0.03)
Female	0.1258	1.2967**	-0.0465
	(0.09)	(0.54)	(0.04)
Education	-0.0084	-0.0745*	0.0042
	(0.01)	(0.04)	(0.00)
Wealth	-0.0398	0.3876	-0.0188
	(0.06)	(0.42)	(0.03)
Trust in Cooperative	-0.0186	0.0722	0.0115
	(0.03)	(0.15)	(0.02)
Utility-based Risk Aversion	-0.0804**	0.4145*	-0.0308
	(0.03)	(0.22)	(0.03)
Ambiguity Aversion	-0.0510**	-0.1168	0.0297***
	(0.02)	(0.15)	(0.01)
Constant	2.7018***	-0.4691	0.1166
	(0.25)	(1.80)	(0.20)
Mean of Dependent Variable	1.98	2.01	0.00
Observations	610	68	610
R-squared	0.024	0.174	0.026

*** p<0.01, ** p<0.05, * p<0.1. Regressions are clustered at the group level; Column 3 includes group fixed effects. The dependent variable in column 1 is the preference expressed before deliberation. Column 3 reports on the group decision as function of mean value of the indicated independant variables in the group. In column 3, the dependent variable is the difference between the preference for sharing after having drawn individual shocks and the agreed upon group choice.

Table D.2: Group Heterogeneity

Dependent Variable: Willingness to Pay, US$	Heterogeneous vs. Homogenous Group	Predicted WTP	Actual WTP	Predicted WTP	Actual WTP
	(1)	(2)	(3)	(4)	(5)
Group is Heterogeneous	-6.54***				
	(0.65)				
Expected Transfer to Others		-1.21***	-0.60***		
		(0.03)	(0.02)		
High Transfer Provider (G9)				-26.78***	-7.17***
				(0.68)	(0.35)
Low Transfer Provider (G8)				-5.01***	-3.86***
				(0.23)	(0.27)
Low Transfer Receiver (G10)				3.79***	4.52***
				(0.22)	(0.28)
High Transfer Receiver (G11)				7.07***	8.28***
				(0.43)	(0.42)
Constant	33.10***	42.19***	26.74***	46.37***	26.38***
	(0.31)	0.00	0.00	(0.18)	(0.17)
Observations	1252	3330	2990	3330	2990
R-squared	0.791	0.848	0.817	0.899	0.818
Games Used:	G6b & G7	G7-G11	G7-G11	G7-G11	G7-G11

*** p<0.01, ** p<0.05, * p<0.1. Regressions include fixed effects at the individual level, and standard errors are clustered at the individual level. Expected transfers to the group are US$ 0, 6.3, 12.7, -6.3, and -12.7 in scenarios G7, G8, G9, G10, and G11, respectively.