BREAD open course on Development Economics

Module 2: Credit, Insurance and Risk

Winter 2022

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Class 1: Foundations of Risk Sharing

Risk: ubiquitous and potent

- Median CV over time of household income USA: 0.3
- Non-farm Enterprise
  - Sri Lanka microenterprises quarterly profits: 0.5
- Agriculture: CV of farm profits over time in
  - ICRISAT Maharashtra/Andhra Pradesh: 1.4
  - Northern Ghana: 3.71

- Risk matters more for the poor

A typology of risks

	Scale		
Duration		Idiosyncratic	Aggregate
	Transitory		
	Permanent		

A typology of risks

	Scale		
Duration		Idiosyncratic	Aggregate
	Transitory	Localized pests	Drought
	Permanent	Disability	Climate change

Dealing with risk

- People face multiple risks, of different scales and permanence.
- Choices, particularly of the poor, are shaped by the prospect and realization of risk
- Many institutions have a key role to play in addressing the consequences of risk

Risk, Finance and Village Organization

A typology of risk and responses with examples

	Income/production	**Consumption**
ex ante		
ex post		

Risk, Finance and Village Organization

A typology of risk and responses with examples

	Income/production	**Consumption**
ex ante	Contracts (sharecropping)	
ex post		

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A typology of risk and responses with examples

	Income/production	**Consumption**
ex ante	Contracts (sharecropping) Asset allocation: diversification Irrigation Occupational diversification	
ex post		

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A typology of risk and responses with examples

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ex ante	Contracts (sharecropping) Asset allocation: diversification Irrigation Occupational diversification	Precautionary saving Network formation
ex post	Labor supply Migration Input/technical adjustments	Leisure demand Borrow/lend/save/dissave Transfers/informal insurance

Risk, Finance and Village Organization

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Risk, Insurance and Saving

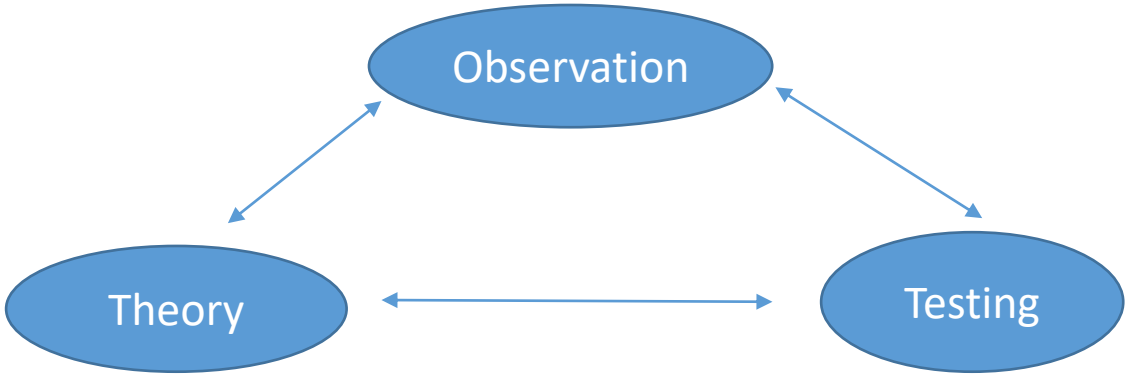
- Financial markets permit households to move resources over time and across states of nature
- Insurance across households within communities
- Saving and credit transactions moving resources over time
- What are the theoretical limits to insurance, saving, borrowing?

Risk, Insurance and Saving

- What are the constrained optimal responses to these limits?
- Are the actual insurance arrangements, patterns of saving and borrowing we observe consistent with the theory?
- How do existing informal financial markets interact with expansion of formal financial systems?

Risk, Finance and Village Organization

- Example of sustained research program spanning many researchers over many papers



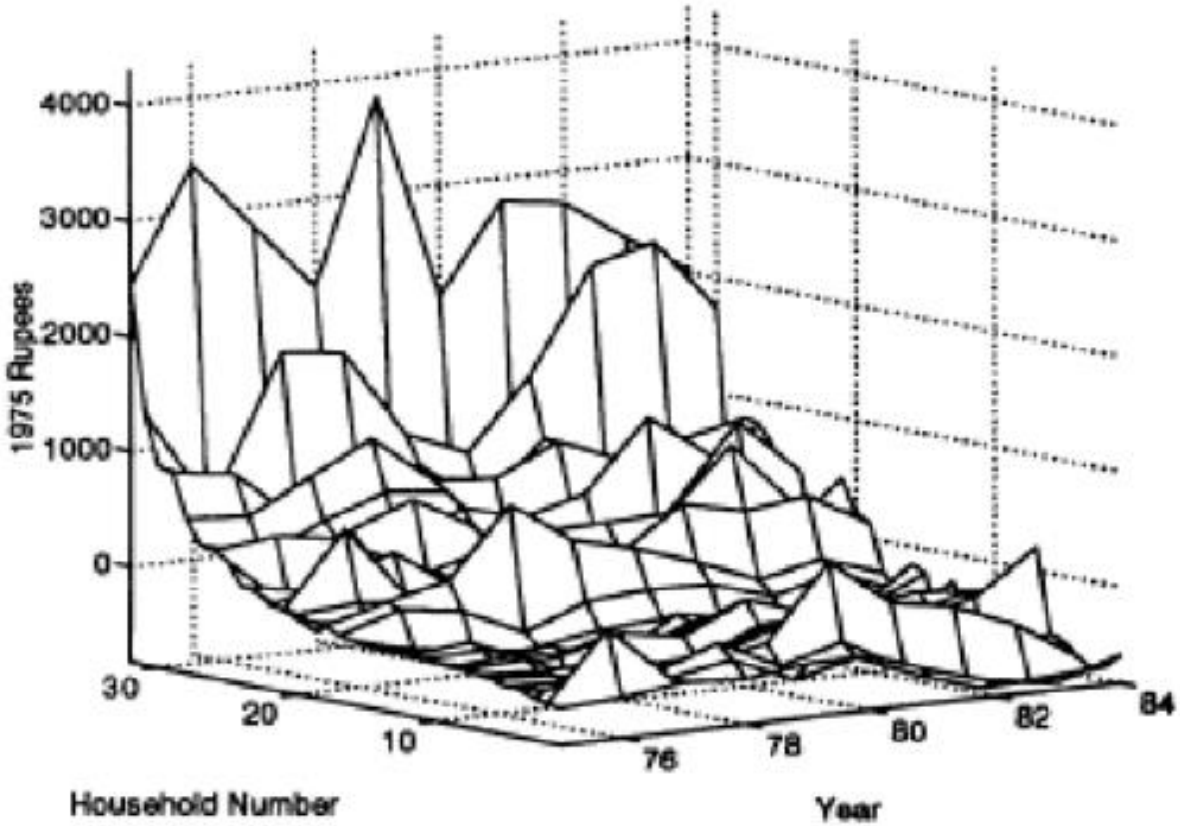
Within this broad literature, **Risk Sharing** has been the occasion of interesting back and forth between theory and empirics:

Obs: vast array of apparent risk-sharing institutions (medieval villages, ethnographic accounts, conversations in northern Nigeria)

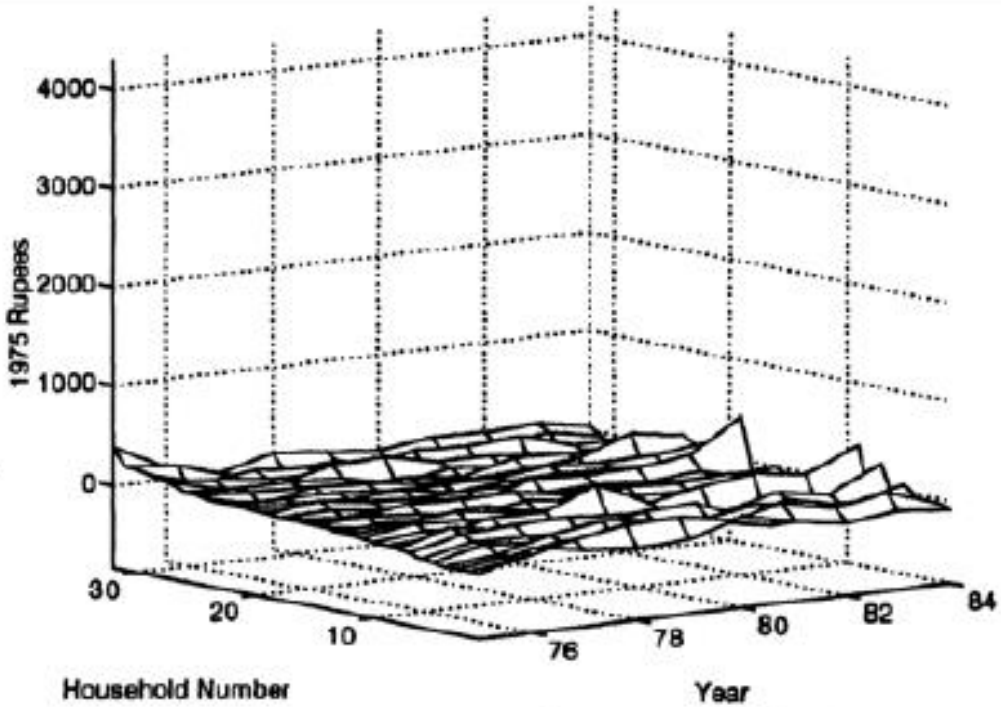
A Simple Null Hypothesis: maybe these work

Proposed by Robert Townsend (1994) 'Risk and Insurance in Village India.' *Econometrica*

- Theory: Efficient insurance
- Empirical implication: How much consumption smoothing do we expect in a Pareto efficient village economy?
- Data: Panel data on consumption/income from 3 ICRISAT villages in Andhra Pradesh and Maharashtra
- Results: Lots of insurance. Not fully efficient



(a) Comovement of household incomes (deviation from village average) Aurepalle.



(a) Comovement of household consumptions (grain only) (deviation from village average) Aurepalle.

Part 1: Full insurance – Economic Environment

Define a set of Pareto efficient allocations:

$$\max_{c_{ist}} U_N(c_{Nst})$$

subject to

$$U_i(\boldsymbol{c}_i) \geq \overline{U}_i \qquad \forall i \in \{1, \dots, N-1\} \qquad (\lambda_i)$$

$$\sum_{i=1}^{N} c_{ist} \leq \sum_{i=1}^{N} y_{ist} \qquad \forall s \in S, t \in T \qquad (\pi_{st})$$

$$y_{ist} \in \{y^1, y^2, \dots y^M\}$$

$$c_{ist} \geq 0$$

- How many constraints? Where are the probabilities?

- What have we assumed about:
  - Preferences?
    - The usual (household, technical) + one good
    - selfishness
  - Savings/borrowing?
    - None, but this is not essential
  - The community (risk-sharing group)?
    - Defined *ex ante* and known, closed

- Implications:

$$\lambda_j \frac{\partial U_j(\boldsymbol{c}_j)}{\partial c_{jst}} = \pi_{st}$$

$$\lambda_i \frac{\partial U_i(\boldsymbol{c}_i)}{\partial c_{ist}} = \pi_{st}$$

$$\frac{\dfrac{\partial U_i(\boldsymbol{c}_i)}{\partial c_{ist}}}{\dfrac{\partial U_j(\boldsymbol{c}_j)}{\partial c_{jst}}} = \frac{\lambda_j}{\lambda_i}$$

$$\frac{\frac{\partial U_i(\boldsymbol{c}_i)}{\partial c_{ist}}}{\frac{\partial U_j(\boldsymbol{c}_j)}{\partial c_{jst}}} = \frac{\lambda_j}{\lambda_i}$$

What are the empirical implications?

- $c_{ist} = h_i(\pi_{st})$ with $h_i' < 0$

- Additional assumptions on U() (e.g., EU, CARA, common preferences) add more structure:

$$U_i(\boldsymbol{c}_i) = \sum_{t=0}^{T} \delta^t \sum_{s \in \mathrm{S}} p_s u_i(c_{ist})$$
$$= \sum_{t=0}^{T} \delta^t \sum_{s \in \mathrm{S}} -p_s \left(\frac{1}{\sigma}\right) e^{-\sigma c_{ist}}$$

Which implies

$$\frac{\partial U_i(\boldsymbol{c}_i)}{\partial c_{ist}} = \delta^t p_s e^{-\sigma c_{ist}}$$

$$\frac{\partial U_i(\boldsymbol{c}_i)}{\partial c_{ist}} = \delta^t p_s e^{-\sigma c_{ist}}$$

So

$$\frac{\frac{\partial U_i(\boldsymbol{c}_i)}{\partial c_{ist}}}{\frac{\partial U_j(\boldsymbol{c}_j)}{\partial c_{jst}}} = \frac{\delta^t p_s e^{-\sigma c_{ist}}}{\delta^t p_s e^{-\sigma c_{jst}}} = e^{\sigma c_{jst} - \sigma c_{ist}} = \frac{\lambda_j}{\lambda_i}$$

$$\sigma\left(c_{jst} - c_{ist}\right) = \ln\left(\lambda_j - \lambda_i\right)$$

- So the FOC for PE becomes

$$c_{ist} = c_{jst} + \frac{1}{\sigma}\left(\ln(\lambda_i) - \ln(\lambda_j)\right)$$

sum over all N households (and setting $\lambda_N = 1$) and divide by N

$$c_{ist} = \bar{c}_{st} + \frac{1}{\sigma}\left(\ln(\lambda_i) - \frac{1}{N}\sum_{j=1}^{N}\ln(\lambda_j)\right)$$

… all idiosyncratic risk is pooled

So the key implication is

$$c_{it} = \alpha_i + \beta \bar{c}_{-i,t} + \zeta Y_{it} + u_{it}$$

with the exclusion restriction $\zeta = 0$

b. Panel Estimates with Grain Consumption[b]

Village:	Aurepalle			Shirapur			Kanzara		
Variable	(A) Std. ζ_w	(B) First Diff ζ_Δ	(C) 2 IV G − H ζ	(D) Std. ζ_w	(E) First Diff ζ_Δ	(F) 2 IV G − H ζ	(G) Std. ζ_w	(H) First Diff ζ_Δ	(I) 2 IV G − H ζ
All Income	0.0474*	0.0289*		0.0605*	0.0233		0.0725*	0.0697*	
	(0.0159)	(0.0151)	[0.599]	(0.0129)	(0.0142)	[1.676]	(0.0122)	(0.0152)	[0.120]
Crop Profit	0.0238	−0.0066		0.0463*	0.0172		0.0596*	0.0313*	
	(0.0224)	(0.0191)	[0.716]	(0.0175)	(0.0181)	[0.818]	(0.0165)	(0.0204)	[0.935]
Labor Income	0.0591	0.2335*		0.1022*	0.1456*		0.0623*	0.0721*	
	(0.0464)	(0.0522)	[−1.761]	(0.0345)	(0.0390)	[−0.497]	(0.0235)	(0.0279)	[−0.278]
Profit from	0.1241*	0.0430		0.0447	−0.0773	[illegible]	0.1199*	[illegible]	

Complementary approaches

- Townsend (1994)
  - Notes that consumption fluctuates less than income
  - Considers restrictions implied by optimal risk sharing
  - Rejects full efficiency, but argues that “it provides a surprisingly good benchmark”
- Udry (1994)
  - Studies a specific mechanism (informal loans)
  - Observes apparent state-contingency
  - If these loans are bundles of A-D securities that achieve PE risk allocation, what must they look like?
  - Rejects full efficiency
  - Develops hidden information model to account for rejection

Northern Nigeria – it turns out that credit contracts are state contingent

Realized terms vs. borrower and lender shocks received

Adverse shock received by	Sample means		
	Monthly interest rates[a]	Simple interest rates[b]	Repayment period in days
(A) Borrower			
—no shock	0·5%	20·4%	67
—adverse shock	−4·0%	−0·6%	72
Impact of shock			
—on mean:	lower	lower	longer
—(*t*)	(1·58)	(2·20)	(1·03)
(B) Lender			
—no shock	−7·5%	−5·0%	89
—adverse shock	2·6%	11·8%	80
Impact of shock			
—on mean:	higher	higher	shorter
—(*t*)	(4·56)	(3·06)	(1·89)

What would be true if contingent credit markets supported a PE allocation?

Same preferences as before –

$$U_i = \sum_{t=0}^{T} \delta^t \sum_{s \in \mathrm{S}} p_s u_i(c_{ist}(h_{t-1}))$$

PE implies:

$$c_{ist}(h_{t-1}) = c_{is} = c_i(\bar{c}_s)$$

Implemented as:

$$c_{ist}(h_{t-1}) = Y_{is} + R^{s}_{is^* t-1}(h_{t-2}) - \sum_{s'} q^{s'}_{st}(h_{t-1}) R^{s'}_{st}(h_{t-1})$$

Implications

- Own shocks should not affect borrowing. You've already insured against them.
- Conditional on village, shock of partner should not affect repayments to agent.

For the second:

Variable	Loan Size (net amount borrowed) (xN100)		Repayments (net amount paid in) (xN100)	
	Parameter	T-Ratio	Parameter	T-Ratio
CONSTANT	-3.095	-2.42	-0.756	-1.54
VILLAGE1	1.091	1.33	-0.258	-0.86
VILLAGE2	1.951	2.65	0.123	0.44
VILLAGE3	0.798	1.05	-0.564	-1.96
WEALTH	-0.055	-1.65	-0.010	-0.57
AGE	0.020	0.64	0.016	1.37
HERELONG	0.009	0.01	0.466	1.98
SKILLS DUMMY	0.713	1.28	-0.330	-1.58
UPLAND	0.086	0.59*	0.005	0.09¶
UPLAND SQUARED	-0.002	-0.36*	-0.000	-0.15¶
LOWLAND	0.650	0.77#	-0.377	-1.23§
LOWLAND SQUARED	-0.288	-1.41#	0.079	1.09§
PERIOD				
LENDING	-0.012	-0.31	-0.007	-0.43
BORROWING	-0.026	-0.64	-0.010	-0.56
FRICTION CUTOFF	-2.032	-3.54		
INDEX OF SELF-REPORTED SHOCKS				
ON UPLANDS			0.771	2.21
ON LOWLANDS			1.051	2.70
LOAN PARTNERS WITH SHOCKS (proportion of total loan value)			-0.648	-2.10

Now for some depressing results (and an easy summary of methods) from Kazianga and Udry (2006)

Routine specification

$$c_{it} = \lambda_i + \mu_{vt} + \delta X_{it} + \epsilon_{it}$$

Data: 6 villages across Burkina Faso surveyed by ICRISAT from 1981-85, some of the worst draught years on record

Table 14: Impact of Idiosyncratic Income Shocks on Consu

	(1)	(2)	(3)	(4)	(5)
			Consumption		
					Arellano-Bond
	OLS	OLS	IVE	IVE	IV-lagged instruments
cropincome	0.449		0.400		0.428
	[10.32]***		[4.93]***		[6.74]**
Poor cropincome		0.508		0.437	
		[9.71]***		[4.61]***	
Rich cropincome		0.374		0.311	
		[6.51]***		[2.19]**	
	[2.10]**	[2.05]**	[2.21]**	[2.23]**	
Constant	46.780	50.422	52.190	55.174	
	[1.81]*	[1.95]*	[1.92]*	[1.98]**	
Test of coefficient of poor=coefficient of rich					
F(2, 270)		4.01			
$\chi^2(2)$				0.57	
R-squared	0.62	0.62			

- But this null hypothesis is too strict

Heterogeneity

- Efficiency implies

$$\frac{\dfrac{\partial U_i(\boldsymbol{c}_i)}{\partial c_{ist}}}{\dfrac{\partial U_j\left(\boldsymbol{c}_j\right)}{\partial c_{jst}}} = \frac{\lambda_j}{\lambda_i}$$

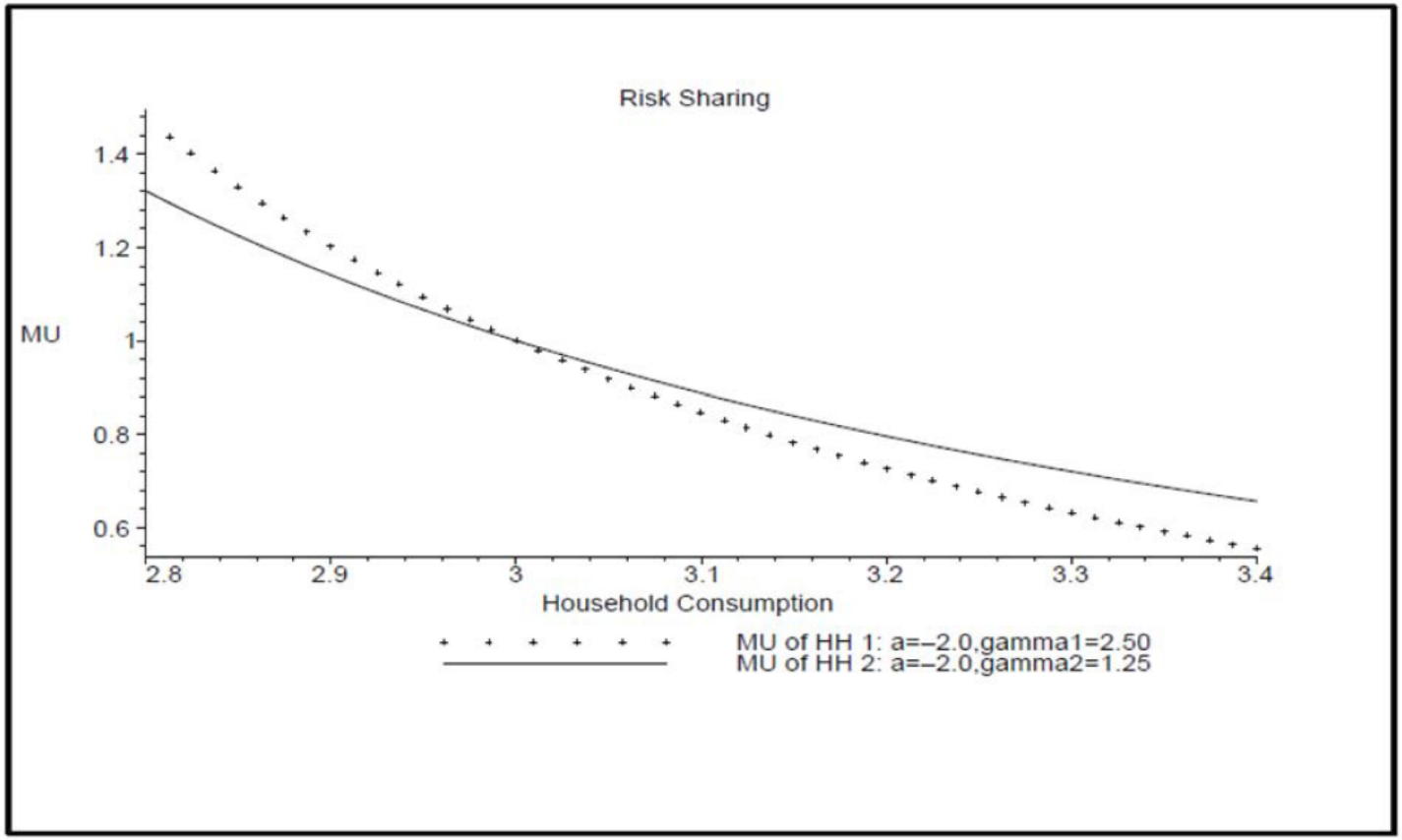
for all $\{i, j\}$ in any s and t.

- Then we add assumptions on U() to make empirical progress. Separability across states and time, for example.

Or households may vary in their risk aversion.

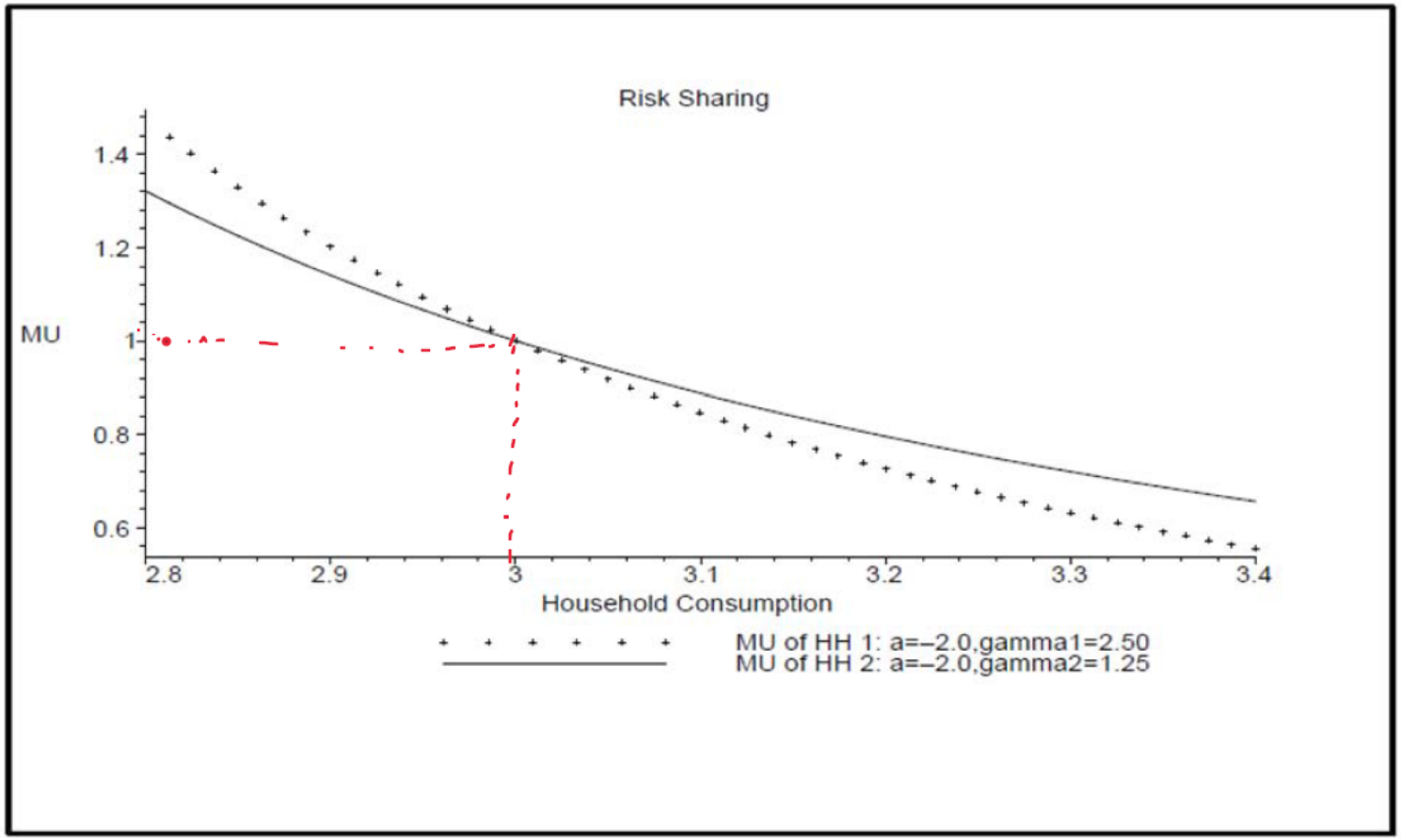
Which agent is more risk averse?

Figure 1: Efficiency Condition with Heterogeneous HARA Preferences and $\mu_1 = \mu_2$.



Endowment = 6

Figure 1: Efficiency Condition with Heterogeneous HARA Preferences and $\mu_1 = \mu_2$.



Endowment ≈ 5.75

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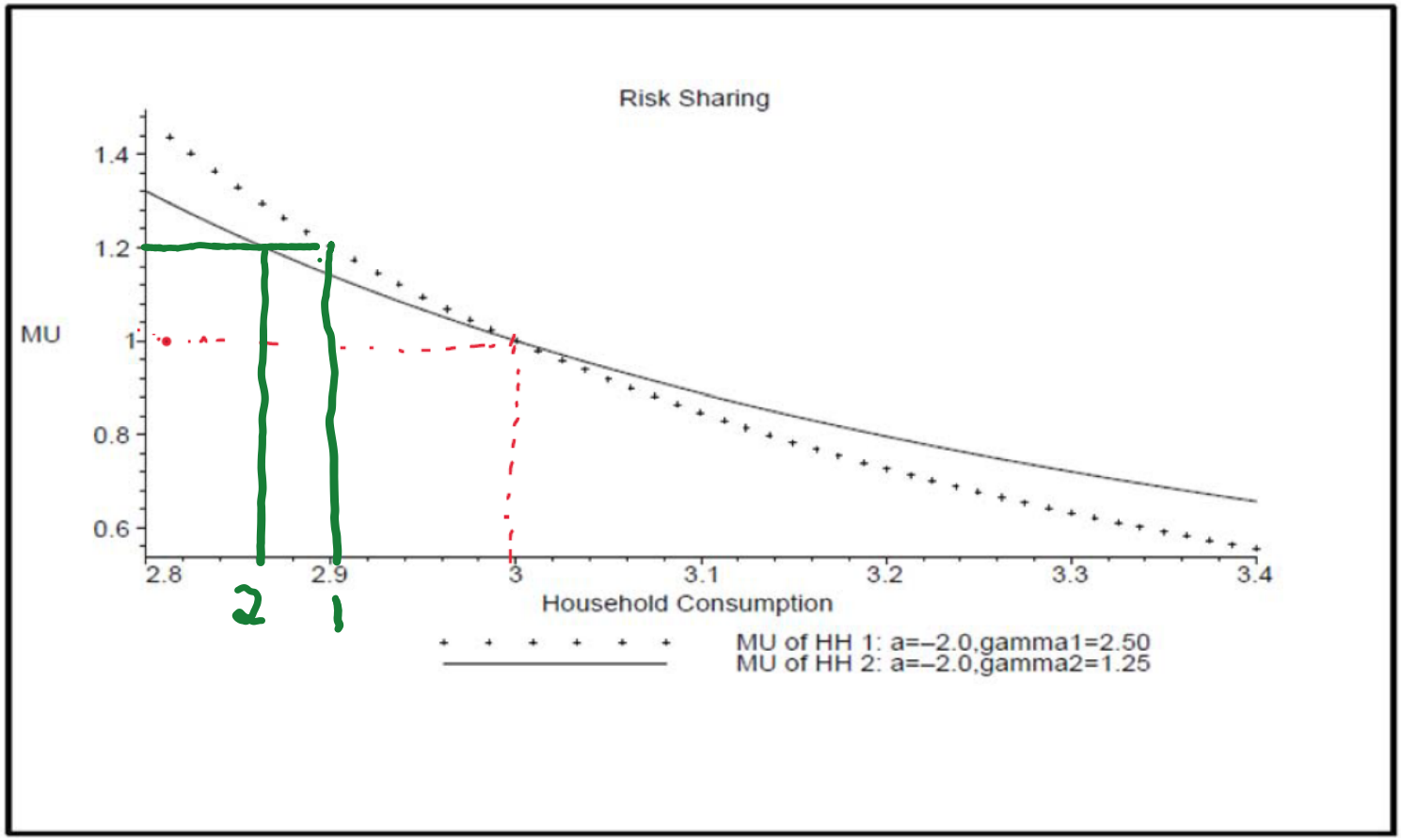
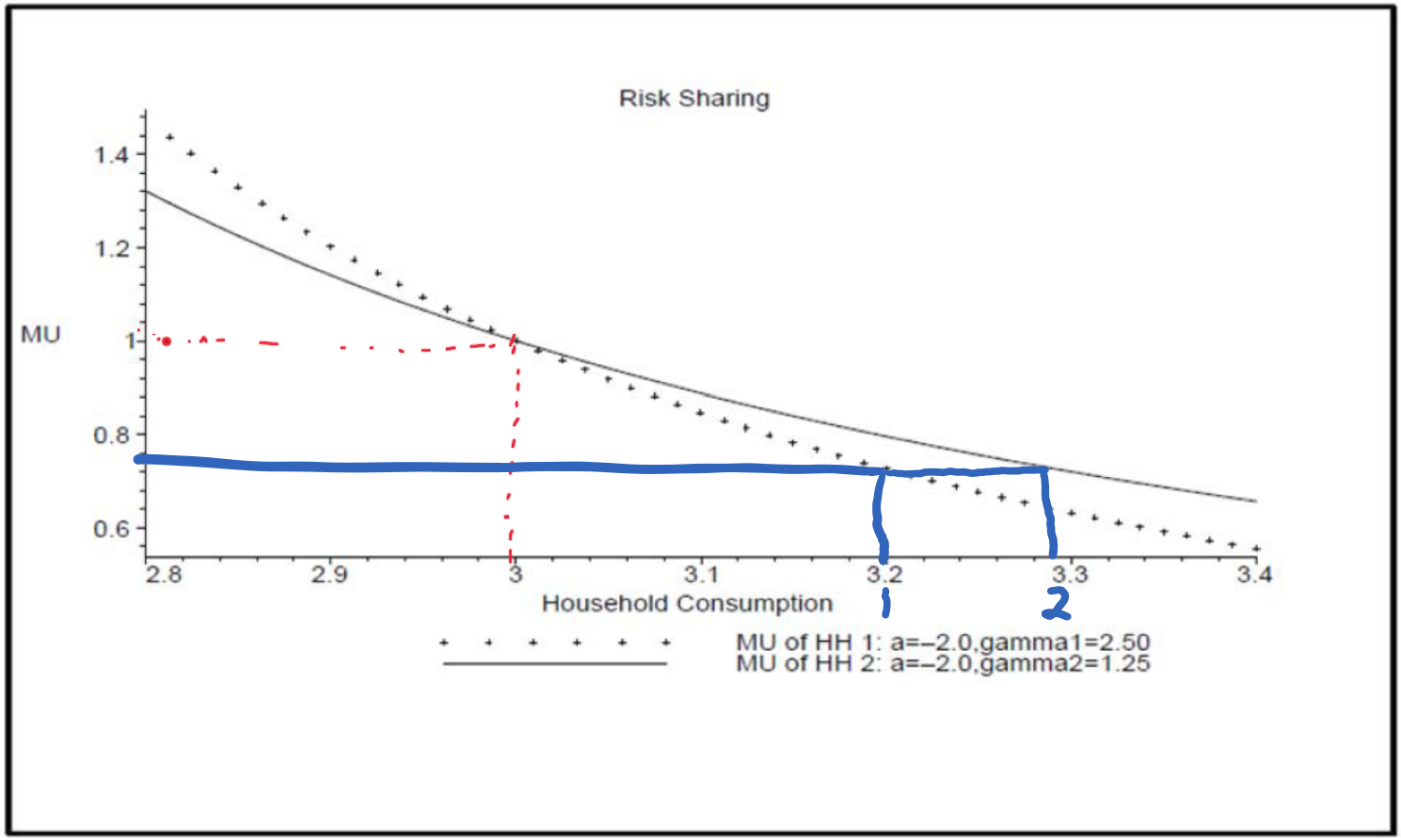


Endowment ≈ 6.45

Figure 1: Efficiency Condition with Heterogeneous HARA Preferences and $\mu_1 = \mu_2$.



Heterogeneity

- The standard risk sharing specifications can all be derived as special cases of

$$f\left(c_{i,t+1}\right) - f(c_{it}) = \frac{1}{2}\sum_{j=1}^{2}\left(f\left(c_{j,t+1}\right) - f\left(c_{jt}\right)\right)$$

- If u() is CARA $f(c) = c$. If u() is CRRA, $f(c) = \ln(c)$. HARA implies $f(c) = \ln(c + a)$

- Think of the standard regression

$$c_{it} = \lambda_i + \mu_{vt} + \delta y_{it} + \epsilon_{it}$$

If y_{it} is income, we take $\delta > 0$ as an indication of risk sharing failure.

- Think of the standard regression

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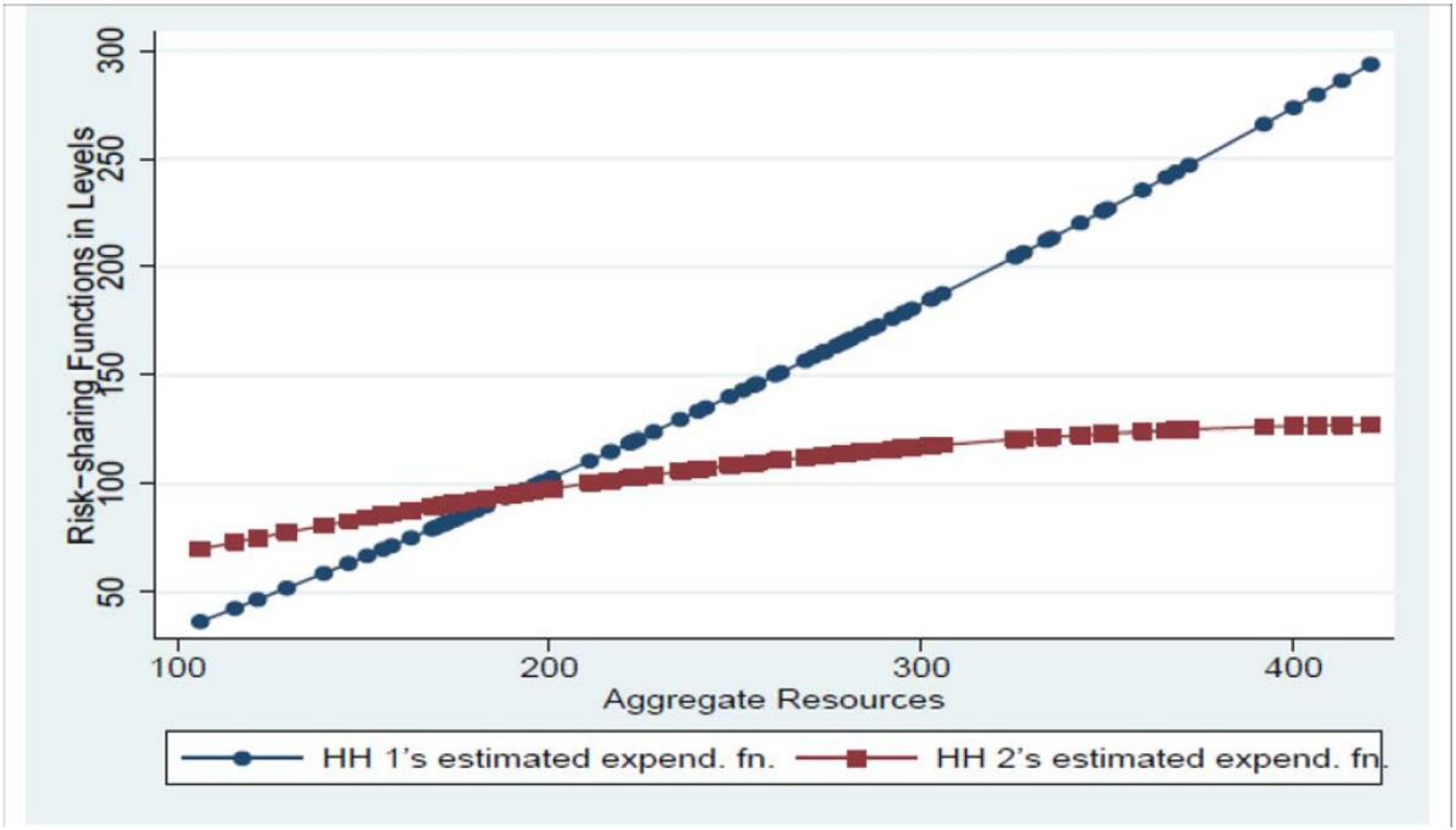
But if $cov(y_{it}, \bar{c}_{vt})$ is greater for less risk averse agents, y_{it} will be positively correlated with c_{it} conditional on μ_{vt} and $\mathrm{plim}\ \hat{\delta} > 0$.

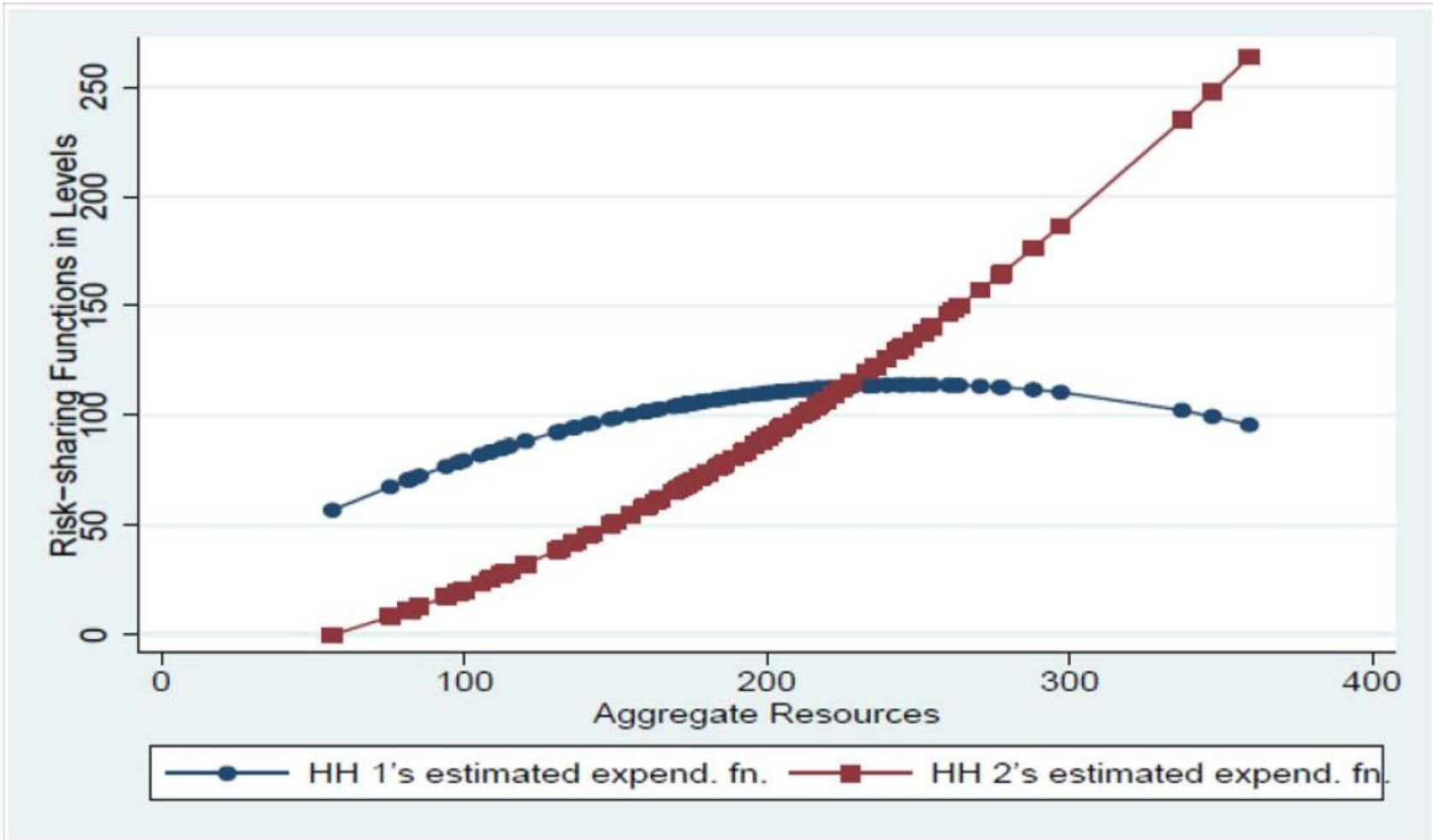
- So how to test?

- Compare every pair of households



- Rejects common risk aversion, not risk sharing

- Compare every pair of households



- Rejects risk sharing

Step back: What is concerning?

- Who cares about testing? For sure we should reject.
- Definition of community; networks
- Functional form
- Endogenous income
- Heterogeneous preferences
- Households
- etc….

Very large literature building on this

- Limited commitment (Coate/Ravallion; Fisher; Ligon/Thomas/Worrall).
- Imperfect information (Kinnon, Ligon)
- Different groups
- Also can look at specific mechanisms (Fafchamps, Rosenzweig)

Summary of Round 1

- There is a great deal of insurance in many rural communities
- Especially effective for idiosyncratic short-term risk
- But unconstrained PE is not achieved

Barriers to insurance: Moral Hazard

"Now we just have to sit back and wait for the Fed to bail us out."

HT to NU PhD student Felipe Berrutti

- $p_s(\boldsymbol{e})$ with $\boldsymbol{e}$ unobserved and costly
- Hence incentive compatibility constraints must be satisfied; full risk sharing generally not achievable
- If higher levels of effort increase probability of states with high incomes relative to probability of states with low incomes, high income realizations are signals of high effort
- To encourage high effort, households with high income receive higher consumption
- Insurance is incomplete

Barriers to insurance: Limited Commitment

"Will I be penalized for not having health insurance if I'm young and actually invincible?"

- In some states $y_{is} \gg c_{is}$; in such a state agent i might be tempted to exit the risk sharing arrangement
  - What happens if this is possible with finite T?
- Hence limited commitment constraints must be satisfied.

$$v_{it}(h_{t-1}) = u\big(c_{ist}(h_{t-1})\big) + \beta v_{i,t+1}(h_t) \geq u(y_{ist}) + \beta v_{aut}$$

- Full risk sharing generally not achievable
- Agents with particularly high income realizations have to receive higher rewards, to keep them participating

Barriers to insurance: Hidden income

- Agents can misreport their income
- The risk sharing arrangement must be compatible with truth-telling.
  - A farmer truthfully reporting low income has lower current consumption than a farmer (mis)reporting low income
  - So the truth-telling farmer has higher current MU of consumption.
  - But they have the same value of future consumption.
  - To encourage truth-telling, current amount of consumption of farmers reporting low income is raised relative to future consumption.

- Let $y_{irt} < y_{ist}$ be the income *reported* by farmer i in state s in period t.
- Truth telling requires a constraint like

$$v_{it}(h_{t-1}) = u\big(c_{ist}(h_{t-1})\big) + \beta v_{i,t+1}(h_t)$$
$$\geq u\left(y_{ist} + \big(y_{irt} - c_{irt}(h_{t-1})\big)\right) + \beta v_{i,t+1}(\tilde{h}_{rt})$$

- Again, full risk sharing not generally achievable
- Individuals reporting low income are insured, but at the cost of lower future consumption

Barriers to insurance: continued

- Adverse selection
- Transaction costs
- Fraud
- Trust
- Basis risk
- Limits on scope and duration