Development Economics (PhD)
Risk and Insurance

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- *Bardhan, P. & Udry, C. (1999), Development Microeconomics, New York: Oxford University Press, chapter 8.
- *Robinson, J. (2012), Limited Insurance Within the Household: Evidence from a Field Experiment in Western Kenya. American Economic Journal: Applied Economics, 4(4): 140-164.

- Variability of outcome (e.g., harvest) is common in developing countries (particularly to those depending in agr.)
- People have to cope not only with severe poverty but also with such variability
- Examples: Weather variation, disease, pests, fire, price variability etc.. which create variability in output and income
- Variability in come exerts threats on livelihood even if income at some times is high
- Main goals of this lecture:
  - Describe pareto-efficient allocation of risk within a community
  - Examine the use of intertemporal consumption-smoothing through saving and credit markets *ex-post*
  - Investigate alternative *ex-ante* risk mitigation mechanisms and their consequences

- Some mechanisms may exist to allocate risk efficiently
  - Eg. hhs within a village, kinship group, or other social network
- There may exist a nearly-perfect flow of information reduce the problem of moral hazard and adverse selection
- Consider:
  - A village with members $i = 1, ..., N$, T periods indexed by t
  - S states of nature each with the objective and commonly known probability of occurrence π_S
  - In state s, each hh i receives an income of $y_{is} > 0$
  - Let c_{ist} is the consumption of hh i if state s occurs in period t
  - Each hh has a separate utility function of:

$$U_i = \sum_{t=1}^{T} \beta^t \sum_{s=1}^{S} \pi_s u_i(c_{ist}) \tag{1}$$

- $u(.)$ is twice continuously differentiable with $u' > 0, u'' < 0$, and $Lim_{x \to 0} u'(x) = +\infty$
- Maximizing the weighted sum of the utilities for each N

$$Max_{c_{iht}} \sum_{i=1}^{N} \lambda_i \, U_i \quad S.t \tag{2}$$

$$\sum_{i=1}^{N} c_{ist} = \sum_{i=1}^{N} y_{ist} \; \forall \; s, t. \tag{3}$$

$$c_{ist} \geq 0 \; \forall \; i, s, t. \tag{4}$$

where the weight of hh i is λ_i :$0 < \lambda_i < 1, \sum \lambda_i = 1$, would give a Pareto-efficient (*Pe*) allocation of risk within the village.

- Eq.[3] represents the set of village resource constraints
- Eq.[4] is the non-negativity constraint

- F.O.Cs

$$\frac{u_i'(c_{ist})}{u_j'(c_{jst})} = \frac{\lambda_j}{\lambda_i} \ \forall \ i, j, s, t \qquad (5)$$

- This equality extends across all $N, S,$ and T
- Marginal utilities consumption levels of all hhs in the village move together
- Consumption of any hh a monotonically increasing function of average village consumption $\Longrightarrow$
    - In *Pe* allocation, then, transient changes in income are fully pooled at the community level
    - No risk diversification is needed by a particular hh, because idiosyncratic shocks will not have a welfare impact
    - The only risk the hh faces is that faced by the whole community i.e., *covariate shocks*

- Clarifying the optimal result:
- Consider everyone in the village has identical constant absolute risk aversion utility function $\Longrightarrow$
- $u_i(x) = -(1/\sigma)e^{-\sigma x}$
- Apply this utility function on the FOC in [5] and take logs to get

$$c_{ist} = c_{jst} + (1/\sigma)(ln(\lambda_i) - ln(\lambda_j)). \tag{6}$$

which holds across all N hhs in the village at any point in time.

- Summing across these N equalities gives:

$$c_{ist} = \bar{c}_{st} + \frac{1}{\sigma}\left(ln(\lambda_i) - \frac{1}{N}\sum_{j=1}^{N} ln(\lambda_j) \right), \tag{7}$$

where

$$\bar{c}_{st} = (1/N)\sum_{j=1}^{N} c_{jst}.$$

- HH con = avg. level of consumption in the village + time-invariant hh fixed effect which depends upon the relative weight of the hh in the Pareto programme
- Change in hh consumption between any two periods = change in the average community consumption between the two periods

Allocation of risk

Pareto-efficiency Cont.

- Note that this result depends in our choice of utility functions
- Why does eq.[7] not contain y_{is}?
- Main Message:
  - **In a Pareto-efficient allocation of risk within a community, hhs face only aggregate risk. Idiosyncratic income shocks are completely insured within the community!**
- The above conclusion depends on the relative importance of aggregate and idiosyncratic shocks
- High income covariance among hhs in a village reduces the scope for risk-sharing
- The second welfare theorem $\Longrightarrow$ *Pe* allocation of risk can be supported by a competitive equilibrium with complete contingent markets

Allocation of risk

Pareto-efficiency Cont.

- However, competitive markets do not exist
- Risk-pooling mechanisms must overcome information and enforcement problems common in insurance contracts (unlikely)
- Information and enforcement obstacles, market failures $\Longrightarrow$ a competitive equilibrium will not be *Pe*
- However, risk-pooling, being efficient (nearly efficient) could be supported by a variety of other mechanisms
- Generalized reciprocity (usually in kinship groups), gift exchange, reciprocal credits etc..
- In general, empirical literature did not support the hypothesis of Pareto-efficient risk-pooling

- Absence of Pe risk-pooling $\Longrightarrow$ some idiosyncratic risk in general remains uninsured
- Also, cross-sectional risk-pooling cannot contribute to hhs' efforts to cope with the effects of aggregate community-level shocks to income
- The alternative *ex-post* mechanism to deal with consumption variability is consumption smoothing over time through savings and credits
- Assume a hh with no opportunity with cross-sectional risk-pooling, but has access to unlimited credit market
- The utility function (similar with eg.[1]) of the hh expected for its remaining lifetime is given by

$$U_t = E_t \sum_{\tau=t}^{T} \beta^{\tau-t} u(c_t) \qquad [1']$$

- Assume:
  - The hh can borrow or lend in any period on a credit market with interest rate r
  - Stock of asset is given by A_t, positive if lender, negative if borrower
  - The hh receives a random income y_t and decides on allocation of its resources into cons and saving

$$A_{t+1} = (1 + r_t)(A_t + y_t - c_t) \tag{8}$$

- Hh's objective: max [1'] s.t, [8], $c_t > 0$, and $A_{T+1} \geq 0$ (transversality condition)
- The value function in period t for the hh satisfies

$$V_t(A_t + y_t) = Max_{c_t}\{u(c_t) + \beta E_t V_{t+1}[(1 + r_t)(A_t + y_t - c_t) + y_{t+1}]\} \tag{9}$$

- The value of current resources (assets + income) = the optimal value of current consumption + the discounted expected value of resources next period
- Optimization and the envelope condition imply

$$u'(c_t) = \beta(1 + r_t)E_t u'(c_{t+1}) \tag{10}$$

- What does eq (10) say? Eq.[10] simplifies to

  $u'(c_t) = E_t u'(c_{t+1})$ if the yield on assets just offsets the subjective discount rate, i.e., $(\beta(1 + r_t) = 1)\forall\, t$.
- Assuming u to be quadratic gives

$$c_t = E_t c_{t+1} \Longrightarrow \tag{11}$$

- HHs make consumption plans such that expected consumption is constant!

- Since $A_{T+1} = 0$, combining (8) & (11) $\Longrightarrow$

$$c_t = \frac{r}{1+r}\left(A_t + E_t \sum_{\tau=t}^{\infty}(1+r)^{-(\tau-t)} y_\tau\right) \qquad (12)$$

- The permanent income hypothesis (PIH): current consumption is the annuity value of current assets plus the present value of the expected stream of future income!
- How will hhs' consumption respond to random variations in hh income? The answer depends on the information associated with the income shock
  - If income shock is transitory, and there is little or no change in the hh's expecations about future income stream, then consumption will change little
  - If the shock causes a large change in hhs' expectation on future income, consumption will change dramatically

Allocation of risk
Consumption smoothing cont.

Empirical Evidence

- Paxson 1992: used deviations of rainfall from it's average level to identify transitory income shocks affecting Thai rice farmers
  - Used these estimates to compute marginal propensity to save transitory income
  - Farmers save three-quarters to four-fifths of transitory income changes
- Despite consumption-smoothing using credits and savings, the PIH can be rejected even in developed countries
  - Hayahsi 1987: used micro data from USA and Japan to show that hhs are liquidity constrained
- Morduch (1992) shows that borrowing constraints strongly affect the behavior of relatively poor hhs in a set of villages in semi-arid India

Empirical Evidence

- Liquidity constrained hhs engage in less risky production activities than unconstrained hhs
- Rosenzweig and Binswanger (1993) also find evidence of limitations on the hhs' ex post smoothing capabilities in rural India
  - Wealthier hhs, invest in significantly more risky production activities and earn significantly higher mean returns from these activities than poorer hhs
- Deaton (1991): HHs may be able to achieve a high degree of intertemporal consumption-smoothing even with no access to a credit market at all, through the use of assets as buffer stocks.

Empirical Evidence

- But when wealth falls to zero, consumption becomes highly variable and there will be little consumption-smoothing
- This hypothesis has been proved in the famine literature
- But if assets that are used to buffer consumption from income fluctuations are themselves used in the production process, then temporary income shocks will have a long-term effect on welfare
- Rozenzweig and Wolpin (1993) show that hhs in rural India purchase and sell bullocks to smooth consumption when income fluctuates, but bullocks are also used in the production process

Empirical Evidence

- Udry (1995): hhs withdraw a productive asset to smooth consumption when all other saved asset is exhausted.
- Rosenzweig and Wolpin (1985) show that hhs are 150% more likely to sell their land when subject to two consecutive years of drought
- We will discuss Paxson (1992), and Udry (1995) more carefully in the *Savings* section

- Complete risk-pooling $\Longrightarrow$ hhs cons. responds to average community consumption
  - Holding community consumption constant, a shock to a hh's own income, whether transitory or permanent, has no effect on hh consumption
  - Key assumptions: no access to credit and no goods are stored by the community $\Longrightarrow$ income = consumption in all periods by the community
  - When there is no risk-pooling but the hh has access to a perfect credit market, community income does not matter for hh consumption decision, but cons changes in response to the hh's permanent income
- Cons-smoothing through insurance and cons-smoothing through transferring resources over time are conceptually very distinct!

- It is difficult however to distinguish between the two by looking at the relationship between hh cons and hh and village income
- But both models $\Longrightarrow$ changes in hh income may have only a small correlation with changes in hh consumption
- But both models $\Longrightarrow$ hh cons might be highly correlated with village income and uncorrelated with transitory shocks to hh income
- Deaton and Paxson (1994) distinguish between the two by examining the distribution of consumption of a cohort of people over time
  - In a pareto-efficient allocation eq. (7) will remain stable over time: idiosyncratic risk will be ensured
  - If PIH is approximately true, the relationship equation e.q (12) will be broken (different hhs over time receive different information regarding their true income prospets

Risk Pooling Vs Consumption smoothing Cont.

- If hhs smooth consumption through either of these *ex post* strategies, then risk-averse hhs will act in some other respects if they were risk-neutral.

- Risk-averse hhs invest in *ex ante* mechanisms to deal with risk when *ex post* mechanisms fail
- Implication:
  - New technologies with positive (but uncertain) expected profits might not be adopted or will be adopted more slowly
  - Engage in low risk and low return production activities, e.g:
    - Plant low yield but rapidly maturing seed varieties to reduce the effect of rainfall shortage
    - Plant multiple crops in widely dispersed fields
  - Spread members across space through migration or marriage in order to reduce the variance of aggregate hh income
  - Engage in activities such as sharecropping $\Longrightarrow$ no profit-maximizing production levels of output but reduce the variance of income
- All these reduce expected profits, but also reduce the variance of income

- Reference: Robinson, J. (2012), Limited Insurance Within the Household: Evidence from a Field Experiment in Western Kenya, American Economic Journal: Applied Economics, 4(4): 140-164.

Robinson (2012)

Motivation

- Individuals in developing countries face enormous income risk
- Formal insurance mechanisms are almost non-existent
- Hhs instead use informal mechanisms to mitigate idiosyncratic risk
- But informal risk sharing arrangements face asymmetric info and payment enforceability
- Inter-household risk-sharing networks are most of the time inefficient
- The natural place of risk-sharing is within the hh
- Whether such risk-sharing arrangements are effective is a question of high importance
- If risk is not insured within the hh, programs which improve individuals' risk coping ability would be welfare enhancing

Robinson (2012)

Motivation cont.

- Robinson tests whether intra-household risk-sharing arrangements offer full insurance using a field experiment in Kenya
- Followed 142 married couples for 8 weeks
- Every week, each individual had a 50% chance of receiving a 150 Kenyan Shillings (US$2.14)
  - Roughly equivalent to 1.5 days of income for men and 1 week's income for women
- Information about the the shocks was public knowledge
- Easy to directly and simply test for allocative efficiency since the shocks are random, transitory, and idiosyncratic by definition
- The shocks are too small to affect intra-household bargaining power

Robinson (2012)
Motivation cont.

- If shocks are uninsured within the hh containing risk-averse members $\Longrightarrow$ a rejection of the unitary hh model
- If hhs pool risk efficiently, increases in private consumption should be the same for shocks received by an individual and those received by his spouse
- However Robinson finds that husbands increase their expenditures on privately consumed goods in weeks in which they receive the shock but do not change their expenditures in weeks in which their wives do
  - A rejection of Pareto-efficiency
- There were no statistically significant responses to either type of shock for women
- Information asymmetry did not play role since experimental shocks were fully observable

Robinson (2012)
Previous Literature

- Previous studies in developing countries focused on testing:
  - Productive efficiency (that hhs maximize profits)
  - Allocative efficiency (whether allocation decisions are sensitive to transitory income shocks)
- Udry (1996): rejects efficiency in prod in Burkia Faso; plots owned by women are cultivated much less intensively
- Schaner (2012): hhs are unable to maximize returns on savings because spouses have different discount rates
- Robinson tests whether couples are able to insure each other against income shocks
  - Doing so requires identification of exogenous, idiosyncratic shocks which affect income realizations significantly but should not be substantial to affect intra-household bargaining position

Robinson (2012)
Previous Literature

- Previous studies used rainfall/weather shocks (Duflo and Udry 2004; Dubois and Ligon, 2009, Doss, 2001; Bobonis, 2009), health shocks (Dercon and Krishnan, 2000; Goldstein, 2004)
- Except Bobonis (2009), all reject pareto-efficiency
- Robinson's contributions:
  - Small shocks unlike earlier studies
  - Small enough not to affect bargaining weights
  - Efficiency within the hh is context specific and it may be that hhs achieve efficiency in some aspects (areas). The paper provides additional evidence on this.
  - Working with real-world risk sharing in an experimental set-up outside the lab

- HHs, under pareto-efficient collective model maximize a unitary utility function
  - S.t a budget constraint in which all resources of the hh income are pooled
- Pretty much similar with what we saw in lecture 1 of this part
- The key hypothesis to test is whether idiosyncratic risk is insured within the household
- Or checking if income shocks received by the husband are spent in the same way as income shocks to the wife

- Assume exponential preferences $\Longrightarrow$ CARA
- CRRA is alternative but requires non-zero dependent variable (because it should be in logs)
- Basic empirical specification:

$$y_{ht}^{i} = \gamma S_{ht}^{i} + \delta S_{ht}^{j} + \nu_i + \mu_t + \varepsilon_{ht}^{i} \tag{13}$$

- h=household, t=time, j=spouse, and y_{ht}^{i} represent outcomes of interest (private consumption)
- S_{ht}^{i} and S_{ht}^{j} represent the amount each spouse received in experimental shocks
- ν_i, μ_t, and ε_{ht}^{i} represent week (time) fixed effect, individual fixed effect, and a random error term respectively

Robinson (2012)

Empirical Specification cont.

- Key identification assumption: weeks of the shocks are randomly determined (testable using placebo test)
- Test for pareto-efficiency: shocks only affect private expenditures through their effect on the pooled budget constraint

$$\gamma = \delta \tag{14}$$

- Data on 142 couples is used for the experiment from three semi-urban areas in Western Kenya
- All were daily income earners
- 150 KSh ($2.14) with a probability of 50% was randomly provided for each spouse at the end of every week
- Three possibilities: only one spouse, two of them, or neither of them get the shock
- The shock was as transparent as possible
- Individuals had the choice to spend the money however they choose

Robinson (2012)

Experimental Income shocks cont.

- Three key features of the experiment:
  - The shocks are small compared to total income but they are not trivial either (1.5 days and one week income of men and women respectively)
  - The shocks were publicly observable: information asymmetry did not play role
  - Follow-up survey questions helped in comparing experimental results with real world responses to fluctuations in weekly labor income
- Major limitation: due to ethical and practical reasons, the income shocks were positive unlike real-world shocks (negative)
- Another possible limitation: windfallness of income (testable if responses were the same with fluctuations in labor income)

Robinson (2012)
Key results

- Pvt. expenditure by men responds by 16.9% during weeks with shocks
- Pvt. exp. by men did not change during the week in which the wife receives the shock
  - Thus, the null hypothesis for efficiency (the marginal propensities are equal) is rejected at the 5%
- Women's private expenditure did not respond to the shocks (received by either her or her husband)!
- Women transfer 16.3% of the shock to their husbands
- Men save 78.2%, and women' save 58.6% of the shock (represents saving cash informally at home)
- The permanent income hypothesis is not rejected for either spouse (most probably due to imprecision in the estimates)

Robinson (2012)

Key results cont.

TABLE 3—EXPERIMENTAL SHOCKS AND EXPENDITURES

	Expenditures						
	Total (1)	Private (2)	Shared food (3)	Medical (4)	Children (5)	Other shared (6)	Transport (7)
Panel A. Men							
Shillings received in experimental shock by respondent	0.190 (0.194)	0.169 (0.064)***	−0.025 (0.089)	0.048 (0.041)	−0.012 (0.032)	−0.096 (0.102)	0.102 (0.068)
Shillings received in experimental shock by spouse	−0.163 (0.192)	−0.027 (0.069)	−0.016 (0.087)	0.057 (0.045)	−0.019 (0.030)	−0.086 (0.111)	−0.069 (0.060)
Observations	898	898	898	898	898	898	898
Number of households	142	142	142	142	142	142	142
p-value for *F*-test of equality	0.21	0.05**	0.93	0.84	0.88	0.95	0.09*
Mean of dependent variable (Ksh)[a]	889.32	135.66	413.77	56.95	24.09	144.77	114.55
SD of dependent variable (Ksh)	557.30	122.24	298.74	143.25	84.40	250.88	106.76
Proportion of weeks dependent variable = 0	0.00	0.12	0.03	0.52	0.86	0.12	0.18
Panel B. Women							
Shillings received in experimental shock by respondent	0.180 (0.148)	−0.020 (0.042)	0.056 (0.067)	0.079 (0.041)*	0.032 (0.026)	0.041 (0.059)	−0.007 (0.047)
Shillings received in experimental shock by spouse	−0.058 (0.123)	−0.026 (0.039)	−0.051 (0.064)	0.015 (0.034)	−0.025 (0.024)	0.050 (0.041)	−0.021 (0.039)
Observations	898	898	898	898	898	898	898
Number of households	142	142	142	142	142	142	142
p-value for *F*-test of equality	0.14	0.91	0.23	0.07*	0.1*	0.88	0.77
Mean of dependent variable (Ksh)	428.51	47.28	227.98	28.43	18.25	68.51	38.07
SD of dependent variable (Ksh)	482.65	123.77	262.65	94.87	65.80	119.21	101.60
Proportion of weeks dependent variable = 0	0.03	0.61	0.08	0.64	0.84	0.28	0.72

Robinson (2012)

Key results cont.

- Robustness tests performed
  - The role of lagged shocks
  - Behavior outside of experiment: check if income from labor is spent in a similar pattern
  - Possible difference in risk preference between the two genders

Robinson (2012)
Conclusions

- Exogenous shocks are required to test intra-household risk coping without affecting bargaining position
- Random, idiosyncratic, transitory, perfectly observable and relatively small experimental shocks have been applied on couples
- Spouses do not fully ensure eachother
  - Risk sharing is incomplete, and efficiency is not achieved
- Main implication:
  - Interventions providing formal individual risk-coping devices enhance welfare