Risk and Insurance in Village India

Robert M. Townsend (1994)

Presented by Chi-hung Kang

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Motivation

- Poor agricultural villages in Southern India face high risk from weather and crop diseases
  - Are landless labors more vulnerable than the landlords?
  - Does consumption fluctuate with the income shocks?
  - Are people fully insured at the village level?
  - Which economic activity is better insured?
- Is there any scope for policy reform?

Data

- Data of southern India villages from International Crops Research Institute of the Semi-Arid Tropics (ICRISAT)
    - Annual data 1975–1984
    - Three villages: Aurepalle, Shirapur, Kanzara
    - 40 households for each village
    - Panel data for 35, 32, 36 households respectively

Table I: Composition of Income

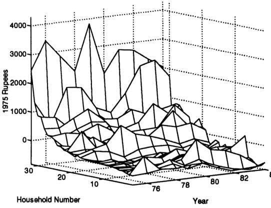
TABLE I

COMPOSITION OF INCOME, BY SOURCE AND LANDHOLDINGS[a]

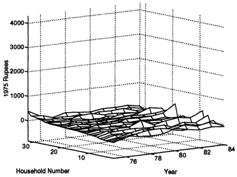
Village	Income Source	None	Small	Landholdings Medium	Large	All
Aurepalle	Crop	0.0225	0.2623	0.3967	0.5645	0.4476
	Labor	0.6527	0.3363	0.1623	0.0429	0.1538
	Trade & Handicrafts	0.2799	0.2919	0.3033	0.1242	0.1957
	Animal Husbandry	0.0449	0.1095	0.1373	0.2685	0.2029
Shirapur	Crop	0.4364	0.3735	0.5293	0.5617	0.4992
	Labor	0.4897	0.3825	0.3305	0.2268	0.3209
	Trade & Handicrafts	0.0002	0.0142	0.0000	0.0372	0.0189
	Animal Husbandry	0.0736	0.2298	0.1404	0.1743	0.1610
Kanzara	Crop	0.0529	0.2603	0.5002	0.6429	0.5109
	Labor	0.8506	0.5962	0.3513	0.1424	0.3056
	Trade & Handicrafts	0.0664	0.1144	0.0248	0.0034	0.0307
	Animal Husbandry	0.0301	0.0290	0.1237	0.2113	0.1528

[a] Figures reported are proportions of income from a given source, given village and landholdings.

Figure 1 and Figure 3: Deviation From the Village Average



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



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

- Deviation of individual income from the village average income is quite volatile
- Deviation of individual consumption from the village average consumption is relatively small

Prediction From the Model

Proposition

By Wilson (1968) and Diamond (1967), if the following assumptions hold,

1. *Preferences are time separable*
2. *Weak risk aversion*
3. *All individuals have the same discount rate*
4. *All information is held in common*

then a Pareto optimal allocation of risk bearing of a single good in a stochastic environment implies that all individual consumption is determined by aggregate consumption

- Idiosyncratic shocks should not influence individual consumption
- The implication holds in a multiple commodity world under separable preferences

The Model: Individual Preferences

(1) $$W^k(c_t^k, l_t^k) = U^k(c_t^k) + V^k(l_t^k)$$

(2) $$U^k(c_t^k) = -\frac{1}{\sigma_i} e^{-\sigma_i c_t^k}$$

- c_t^k consumption of individual k of household i at time t
- l_t^k leisure of individual k of household i at time t
- Utility function is separable between consumption and leisure
- All individuals in household i are equally risk averse

The Model: Household Decision

For a househould i with M individuals, the maximization problem is:

$$max \sum_{k=1}^{M} \lambda^k \left(\sum_{t=1}^{T} \beta^t E_0 \left[U^k(c_t^k) + V^k(l_t^k) \right] \right)$$

$$s.t. \sum_{k=1}^{M} c_t^k \leq \bar{c}_t; \ \sum_{k=1}^{M} l_t^k \leq \bar{l}_t,$$

$$c_t^k \geq 0; \ 0 \leq l_t^k \leq T_t^k,$$

$$0 < \lambda^k < 1, \ \sum_{k=1}^{M} \lambda^k = 1$$

- λ^k is the utility weight of individual k in the household

The Model: Household Decision

For any two individuals k and j in household i at time t, the weighted marginal utility should be the same to achieve Pareto optimal within the household:

$$\lambda^k \frac{\partial U^k}{\partial c_t^k} = \lambda^j \frac{\partial U^j}{\partial c_t^j} = \mu_c$$

- μ_c Lagrange multiplier for consumption constraint

The Model: Household Decision

Assume that $\sigma_i = \sigma$, summing over the FOC of total individuals in household i and total households N in the village gives Pareto optimal consumption of household i:

$$(3) \qquad c_t^i = \frac{1}{N_t^i}\sum_{k=1}^{N_t^i} c_t^k = -\frac{1}{\sigma}\left(ln(\lambda^i) - \frac{1}{N}\sum_{i=1}^{N} ln(\lambda^i) \right) + \bar{c}_t$$

$$\bar{c}_t = \frac{1}{N}\sum_{i=1}^{N} c_t^i$$

Assume that λ^i are the same for each household, then

$$(4) \qquad c_t^i = \bar{c}_t$$

Equivalence Scales

- c_t^i is adjusted by household size
  - Is $c_t^i = \frac{\sum_{k=1}^{N_t^i} c_t^k}{N_t^i}$ a good adjustment ?
- Deaton (2003) Simply deflating by total household size has two major problems
  - Ignoring the household composition
  - Ignoring any economies of scale in consumption within the household; "public goods" of the household
- Browning, Chiappori and Lewbel (2010)
  - Equivalence scales measure the ratio of costs of attaining the same utility level

Equivalence Scales

- Construct the equivalence scale A_t^k for individual k at time t according to the caloric intake from the survey of Ryan, Bidinger, Pushpamma and Rao (1985)

Age-sex categories	Equivalence Scales
Adult Males	1.00
Adult Females	0.90
Males aged 13–18	0.94
Females aged 13–18	0.83
Children aged 7–12	0.67
Children aged 4–6	0.52
Toddlers	0.32
Infants	0.05

The Model: Household Decision

- Incorporate the equivalence scale A_t^k in the individual utility function:

$$W^k(c_t^k, l_t^k, A_t^k) = U^k(c_t^k, A_t^k) + V^k(l_t^k, A_t^k)$$

$$U^k(c_t^k, A_t^k) = -\frac{1}{\sigma_i} e^{-\frac{\sigma_i c_t^k}{A_t^k}},$$

$$\frac{\partial U^k}{\partial A_t^k} = -\frac{c_t^k}{(A_t^k)^2} e^{-\frac{\sigma_i c_t^k}{A_t^k}} < 0$$

- Given the same consumption, with a higher equivalence scale A_t^k, individual k has a lower utility level.

The Model: Household Decision

- The Pareto optimal consumption of household i can be rewritten as:

$$c_t^{*i} = \bar{c}_t - \frac{1}{\sigma} A_t^i \tag{5}$$

$$c_t^{*i} = \frac{\sum_{k=1}^{N_t^i} c_t^k}{\sum_{k=1}^{N_t^i} A_t^k}, \quad \bar{c}_t = \frac{1}{N} \sum_{i=1}^{N} c_t^{*i}$$

The Model: Household Decision

- Where A_t^i is defined as:

$$(6) \qquad A_t^i = \frac{\sum_{k=1}^{N^i} A_t^k \, ln(A_t^k)}{\sum_{k=1}^{N^i} A_t^k} - \frac{1}{N}\sum_{i=1}^{N} \frac{\sum_{k=1}^{N^i} A_t^k \, ln(A_t^k)}{\sum_{k=1}^{N^i} A_t^k}$$

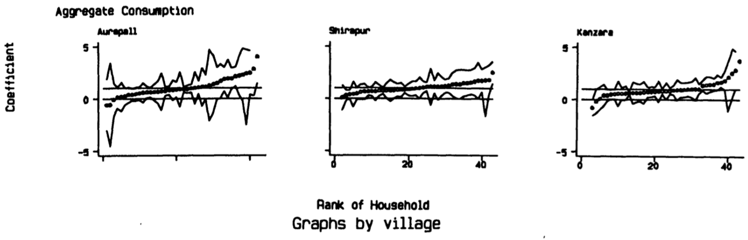
Time Series Estimation

- Estimate the following equation for each household:

$$c_t^{*i} = \alpha + \beta \bar{c}_t + \delta H_t^i + \zeta X_t^i + u_t^i \tag{7}$$

- H_t^i are control variables for household composition, e.g. number of household members, number of kids, and number of adults
- X_t^i is one control variable, such as income source
- One β for each household. For example, Aurepalle has 44 households, so it generates 44 β estimates for Aurepalle
- By the model derivation, $\beta = 1$ and $\delta = -\frac{1}{\sigma}$

Figure 5: Time Series Estimates



(A)

- For each village, rank households according to the magnitude of β. The dots in the figure are β for each household i, and the lines are 95% confidence interval

Table IV: Null Hypothesis Test for β

Table IV: Number of Times Failing to Reject the Null

	Population	N	$\beta < 1$	$\beta = 1$	$\beta > 1$	$\beta < 0$	$\beta = 0$	$\beta > 0$
A	All	133	22	107	4	9	55	69
	Aurepalle	44	5	38	1	2	24	18
	Shirapur	45	8	35	2	3	14	28
	Kanzara	44	9	34	1	4	17	23

- Fail to reject $\beta = 1$ for 107 households, and fail to reject $\beta = 0$ for 55 households
- Impose $\beta = 1$ for the panel estimation

Panel Estimation

- Fixed effect estimation:

$$c_t^{*i} - \bar{c}_t = \alpha^i + \delta H_t^i + \zeta_w X_t^i + e_t^i \tag{8}$$

- First-difference estimation

$$\Delta c_t^{*i} - \Delta \bar{c}_t = \delta \Delta H_t^i + \zeta_\Delta^i \Delta X_t^i + \Delta e_t^i \tag{9}$$

  - α^i is household fixed effect
  - H_t^i are the control variables for household composition, e.g. Number of household members, number of kids, number of adults
  - X_t^i is one control variable
  - ζ_w^i Within-village estimate
  - ζ_Δ^i First-difference estimate
  - Regress with one control variable each time

Table VIII: Panel Estimates From Equation (8) and (9)

- One coefficient represents one regression

	Village:	Aurepalle		
	Variable	(A) Std. ζ_w	(B) First Diff ζ_Δ	(C) 2 IV G − H ζ
1	All Income	0.0772*	0.0469	
		(0.0221)	(0.0236)	[0.768]
2	Crop Profit	−0.0150	−0.0380	
		(0.0312)	(0.0299)	[0.380]
3	Labor Income	0.0401	0.2597*	
		(0.0647)	(0.0830)	[−1.543]
4	Profit from Trade and Handicrafts	0.2363*	0.1495*	
		(0.0352)	(0.0389)	[1.197]
5	Profit from Animal Husbandry	0.0485	−0.0276	
		(0.0676)	(0.0689)	[−0.116]
6	Full Income	−0.0123*	0.0016	
		(0.0027)	(0.0058)	[−1.412]
7	Wage	−10.269	−7.1232	
		(8.4114)	(10.2640)	[0.004]
13	#Household Members	−45.778*	−49.071*	
		(6.3693)	(7.1571)	[0.333]
14	#Adults	−30.459*	−32.304*	
		(9.7187)	(12.8311)	[0.115]
15	#Children	−47.880*	−32.815*	
		(11.9590)	(12.9499)	[−0.781]

Panel Estimation: Control for All Income Sources

- Fixed effect estimation with income sources:

(10) $$c_t^{*i} - \bar{c}_t = \alpha^i + \delta H_t^i + \zeta_w X_t^i + Y_t^i \Gamma + e_t^i$$

- H_t^i are the controls of household composition
- X_t^i average village labors
- Y_t^i is a vector of income variables, including crop profit, labor income, trade and handicrafts, and animal husbandry
- If the consumption is fully insured against income shocks, the coefficients of income variables should be jointly zero

Table IX: Control for All Income Sources

Village:	Aurepalle
δ	111.1106
	(322.1838)
#Household Members	−9.3984
	(16.2527)
Average Village Labor	0.1967
	(0.5399)
Crop Profit	0.0149
	(0.0338)
Labor Income	0.1265
	(0.0903)
Profit from Trade and Handicrafts	0.1664*
	(0.0497)
Profit from Animal Husbandry	−0.1894*
	(0.0894)
F-Prob	0.0037

Effect of Landholding on Insurance

- Estimate the effect of village consumption on the landless household ℓ

$$c_t^{*\ell} = \alpha^\ell + \beta \bar{c}_t + \delta H_t^\ell + \gamma y_t^\ell + u_t^\ell \tag{11}$$

- α^ℓ is household fixed effect
- H_t^ℓ are the controls for household composition
- y_t^ℓ all income of landless household ℓ
- $\beta = 1$ if the idiosyncratic shocks are fully insured at the village level
- $\gamma = 0$ if the income shocks are fully insured

Table X: Effect of Landholding on Insurance

a. Effect of Landholding on Insurance (All Consumption)[a]

Village	Land Class	Village Consumption	All Income
Aurepalle	Landless	0.3172*	0.3553*
		(0.1413)	(0.0762)
	Farmers	1.0485*	0.0421*
		(0.1070)	(0.0205)

b. Effect of Landholding on Insurance (Grain Consumption)[b]

Village	Land Class	Village Consumption	All Income
Aurepalle	Landless	0.0513	0.3214*
		(0.1818)	(0.0625)
	Farmers	1.2431*	0.0009
		(0.1241)	(0.0170)

Kinship and Financial Networks, Formal Financial Access, and Risk Reduction

Cynthia Kinnan and Robert Townsend (2012)

Presented by Chi-hung Kang

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Motivation

- Access to borrowing and lending can be helpful to insure against short-term idiosyncratic risks
  - Informal credit: borrowing from relatives
  - Formal financial institution: banks
- What are the effect of these two channels on consumption smoothing?

Consumption-smoothing specification

$$
\begin{aligned}
\Delta c_{ivt} = & \alpha_1 \Delta y_{ivt} + \alpha_2 \Delta y_{ivt}\, d_{i,B} + \alpha_3 \Delta y_{ivt}\, r_{i,B} \\
& + \alpha_4 \Delta y_{ivt}\, k_i + \alpha_5 \Delta y_{ivt}\, \bar{w}_i + \delta_{B,t} + \epsilon_{it}
\end{aligned}
$$

- Δc_{ivt} Difference of consumption for household i in village v at time t
- Δy_{ivt} Difference of income for household i in village v at time t
- $d_{i,B} = 1$ if i borrows directly from the bank
- $r_{i,B} = 1$ if i borrows from someone who borrows from the bank
- $k_i = 1$ if having any kin in the village
- $\bar{w}_i$ household i's average net worth over the sample period
- $\delta_{B,t}$ common time effect of households directly connected to the bank

Result for Consumption-smoothing specification

$$
\begin{aligned}
\Delta c_{ivt} = & 0.0078\Delta y_{ivt} - 0.1658\Delta y_{ivt}\, d_{i,B} - 0.1643\Delta y_{ivt}\, r_{i,B} \\
& + 0.0102\Delta y_{ivt}\, k_i - 0.00021\Delta y_{ivt}\, \bar{w}_i + \delta_{B,t} + \epsilon_{it}
\end{aligned}
$$

- Δc_{ivt} Difference of consumption for household i in village v at time t
- Δy_{ivt} Difference of income for household i in village v at time t
- $d_{i,B} = 1$ if i borrows directly from the bank
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Investment-smoothing specification

$$\left(\frac{I}{A}\right)_{ivt} = \alpha_1 \left(\frac{y}{A}\right)_{ivt} + \alpha_2 \left(\frac{y}{A}\right)_{ivt} r_{i,B} + \alpha_4 \left(\frac{y}{A}\right)_{ivt} k_i + \alpha_5 \left(\frac{y}{A}\right)_{ivt} \bar{w}_i$$
$$+ \beta_1 r_{i,B} + \beta_2 k_{i,B} + \beta_3 \bar{w}_i + \delta_v + \delta_{B,t} + \epsilon_{it}$$

- I is total household investment
- y is total household income
- A is total household assets
- $r_{i,B} = 1$ if i borrows from someone who borrows from the bank
- $k_i = 1$ if having any kin in the village
- $\bar{w}_i$ household i's average net worth over the sample period
- δ_v village fixed effect
- $\delta_{B,t}$ common time effect of households directly connected to the bank

Table 1: Kinship, Financial Access, and Investment

TABLE 1—KINSHIP, FINANCIAL ACCESS, AND INVESTMENT

	No controls (1)	All households (2)	Above-median investment size (3)	Below-median investment size (4)
Income	0.1078*	0.6526***	0.6370***	0.0077
	(0.0649)	(0.1950)	(0.2102)	(0.3359)
Income				
X Any link to bank		−0.1268	−0.0821	0.2931
		(0.1288)	(0.1292)	(0.3983)
X Kin in village		−0.4136***	−0.5056***	0.4543
		(0.1549)	(0.1599)	(0.3256)
X Net worth (mill. baht)		−0.1087	−0.0405**	−0.3710
		(0.0762)	(0.0205)	(0.2357)
Observations	6,055	5,794	2,319	3,463

Note: Heteroskedasticity-robust standard errors in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Extension

- An indicator for having a kin in the village does not capture the whole effects of personal networks
  - Network characteristics rather than just an indicator
- The indicator for direct connection to the bank can be endogenous
  - For US data, use the total banks around the neighborhood as a proxy for formal financial access