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Consumption Smoothing Across Space

Testing Theories of Risk-Sharing in the ICRISAT Study Region of South India

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Abstract

Panel data from villages in rural south India have been used for leading econometric studies on risk-sharing in village economies. The work has influenced debate on safety net design world-wide and has driven scholarly agendas on household economics. This paper critically surveys work to date and provides new results. The data show that state-contingent transfers between households can in principle reduce total income risk by between 40 and 90 per cent. But risk-sharing with respect to total consumption is in practice quite imperfect, both at the village-level and within groups defined by caste and farm size. Taken together the results suggest that substitutes for formal credit markets function only moderately effectively, leaving substantial scope for remedial public action.

Keywords: consumption smoothing, risk sharing, informal insurance, India

JEL classification: D8, I3, O1

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Author's note

The paper is a substantial revision of work initially completed as the third chapter of my Ph.D. dissertation. That work profited from discussions with Anne Case, Madhur Gautam, Larry Katz, Masao Ogaki, Martin Ravallion, Mark Rosenzweig, Peter Timmer, and Tom Walker. Subsequent work has benefited from conversations with Debraj Ray and Robert Townsend. Research was funded by the Alfred P. Sloan Foundation and the IRIS Center at the University of Maryland. The revision was supported by UNU/WIDER, Helsinki, Finland. Data was kindly provided by the International Crops Research Institute for the Semi-Arid Tropics. Views and errors are my responsibility.

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1 The ICRISAT Village Level Studies and modern development economics

In the history of modern development economics, no single data set has yielded as many important microeconomic papers as the ICRISAT Village Level Studies. Of the twelve papers collected by Bardhan and Udry (2000) as highlights of recent empirical work on development issues, for example, one quarter draw on the ICRISAT studies. Scores of doctoral dissertations and scholarly articles have taken advantage of the data, collectively shaping policy debate and research directions across the field.[1]

Household-level data sets typically have three relevant dimensions. First is the number of households interviewed each round. Second is the number of rounds repeated on the same households. And third is the richness and variety of questions asked. Most surveys are strong on cross-sectional size, weak on repeated rounds, and modest on the extent of substantive coverage. The ICRISAT surveys, in contrast, are weak in terms of number of households surveyed (just 40 in each year from each village) but have until recently been unparalleled in the combination of length and breadth. Access to ten years of consumption and income data on many of the households and extensive modules on transactions and production have made possible an outpouring of work on dynamic issues. Despite a cross-section of just 120 households per year, the data are still yielding valuable new insights seventeen years after the last wave was collected in 1983–84 (e.g. Ligon et al. 2000).

The data were collected between 1974 and 1984 as a project of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The Institute serves mainly as an agronomic research station, and its centre in India (another centre is in Burkina Faso) is located amid experimental fields outside the city of Hyderabad. The surveyed villages are scattered across India's semi-arid tropics, an area of predominantly rainfed agriculture with considerable climatic variability from season to season and year to year. Levels of rainfall can fluctuate widely, and in parts droughts occur once a decade or more. But, while villages face common weather shocks, climatic and soil conditions are heterogeneous within villages such that much risk is idiosyncratic even in small regions. A simple decomposition of household income shows that as much as three-quarters of income variation in these villages is due to idiosyncratic shocks, suggesting substantial scope for risk-sharing even within villages. These conditions have made the ICRISAT study area a particularly promising environment for investigating communal risk-coping strategies.

As a result, the work to date allows a window on rural south India as well as critical perspectives on modern empirical development economics more broadly. I focus below exclusively on work surrounding risk-sharing and insurance, although the ICRISAT data have also yielded important work on nutrition, crop choice, tenancy contracts, labour supply, poverty dynamics, and financial institutions.

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1 Much of the early work with the ICRISAT data is surveyed by Thomas Walker and James Ryan (1990), who along with R. P. Singh, Hans Binswanger, and Narpat Jodha were instrumental in conceiving and implementing the longitudinal studies.

I draw two main lessons. The first is that while empirical work has been driven by the theory of communal risk-sharing, in this period the most important risk-coping mechanism by far appears to be self-insurance. The second is that self-insurance is limited and risk-coping strategies are costly, suggesting opportunities for institutions that can help households more effectively save, work, and accumulate buffer stocks to mitigate risk.

2 Data[2]

The surveys cover ten villages in five districts spread across different agroclimatic zones of the ICRISAT study region (Mahbubnagar in Andhra Pradesh, Sholapur and Akola in Maharashtra, Sabarkantha in Gujarat, and Raisen in Madhya Pradesh), but complete consumption data is available from just three villages (one from each of the first three districts). Aurepalle is in Andhra Pradesh while Shirapur and Kanzara are in Maharashtra State. The villages are poor and the main economic activity is dryland farming, with some irrigation.

Forty households were sampled from each village every year: 10 landless, 10 small-scale farmers, 10 medium-scale, and 10 large-scale. In 1975 the largest village, Aurepalle, had just 475 people and the 40 surveyed households make up 8, 12, and 21 per cent of the overall populations of Aurepalle, Shirapur, and Kanzara, respectively.

While the survey continued for ten years, few households stayed in the sample for the entire period. If attention is restricted to the eight years, 1976–1983, for example, a complete series of annual food consumption data is available for just 15 of 40 original households in Aurepalle, 3 in Shirapur, and 35 in Kanzara. Since the panels are incomplete and unbalanced, estimates of fixed effects in Aurepalle and Kanzara are less precise than often assumed in the long panel. But much of the drop off is at the end of the period, so a full panel exists for the shorter period, 1976–81 for 34 households in Aurepalle and 36 each in Shirapur and Kanzara.

The original intent was not to collect consumption data as a primary focus. But, seeing its potential value, ICRISAT researchers formed consumption measures using the data collected on household transactions (special nutritional surveys were also completed, but only for a limited duration). The consumption data are thus not drawn from expenditure diaries of the sort routine in household surveys (e.g. the World Bank's Livings Standards Measurement Studies), and data reliability has been debated.

Figure 1 displays the most evident source of concern. As in many household studies (Deaton 1997), measured consumption is substantially lower than measured income in all years (except for Shirapur in 1980). In Aurepalle in 1976, for example, average measured income per capita is 394 rupees while average measured consumption is 281 rupees. In 1981, the ratio is 612:449. If true, the households here are saving and investing in huge quantities, but this is implausible given the levels of poverty and lack of appealing saving instruments. The discrepancies stem mostly from the data on richer

[2] The descriptive information on the villages in this section is from Walker and Ryan (1990). The data are available from the Center for Data Sharing at the Economic Growth Center at Yale University.

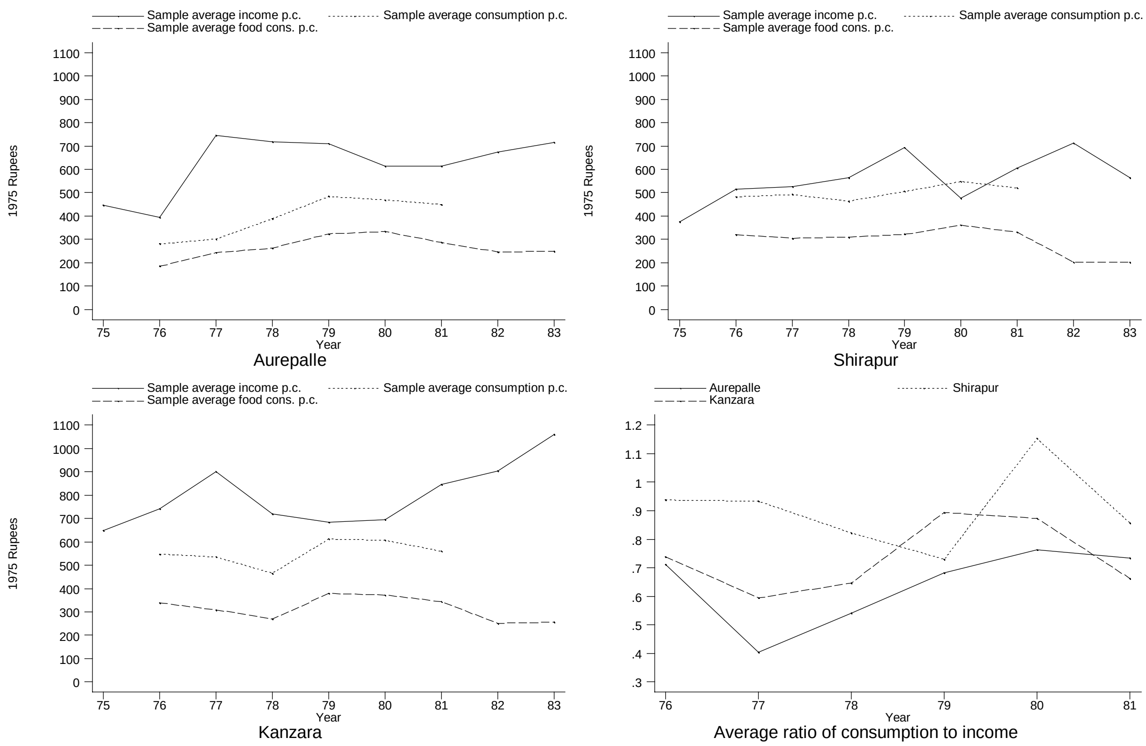
households, with consumption of poorer households tending to be quite close to income levels. In addition, the first and last years suffered from start-up and shut-down problems, and the quality of non-food consumption data slips after 1981 (see Townsend 1994, for information on food coverage).

Ravallion and Chaudhuri (1997) draw on the work of Madhur Gautam (1992) to create an alternative consumption measure based on cash flow data. It corrects some problems but still shows an unexpectedly sharp drop in 1982/83, under-predicts consumption levels, and yields some predicted values that are negative. Ravallion and Chaudhuri use instrumental variables to address these problems and find that the instruments make a large difference.

Here, consistent with Townsend (1994), the focus rests with the data distributed by ICRISAT, but I narrow the focus to data collected between 1976 through 1981 for total consumption and 1976 through 1983 for food consumption only. In addition, three observations were deleted for which either consumption growth, income growth, or food consumption growth were implausibly large (larger than 300 per cent). The resulting samples are of the most even quality, and the most problematic results that emerge when using the entire series are avoided.

Figure 1

Consumption and income patterns in the ICRISAT sample



3 Perspectives on village economies

Economists have considered villages to be ‘natural’ insurance units: locations conducive to insurance provided via informal, reciprocity-based, repeated relationships between neighbours. Giving ‘gifts’ to those in need (with expectation of reciprocity) is the most investigated phenomenon, but a range of more subtle relationships command attention as well. Gift-giving has also been much investigated by anthropologists (e.g. Mauss 1967, Malinowski 1922, Sahlins 1976), economic historians (e.g. Polanyi 1944), and political scientists (e.g. Scott 1986 and Popkin 1979).

Not surprisingly, views are sharply divided. Anthropologists for the most part downplay the place of gifts and other transfers as a product of the rational calculus associated with informal insurance systems; instead they highlight roles in securing social status and signaling commitment to the community (e.g. Mauss 1967 and Malinowski 1922). Other observers of village life in India suggest that the notion of an integrated village economy is often at odds with realities of segmentation, conflict, and discrimination (e.g. on South India, see Epstein et al. 1998). Polanyi (1944) stakes out a middle ground by arguing that, to the extent it occurred, redistribution was done to maintain a basic sense of ‘justice’ in a sense close to that of John Rawls (1971), but that more extensive redistribution was typically limited.

Still, the idea that a village should be a natural insurance unit remains powerful for most economists trained in the tradition of Coase. The problems of imperfect information and costly enforcement that hinder broad-based insurance markets are limited in small communities. Villagers tend to know a good deal about what their neighbors are up to, and they can fall back on ‘informal’ enforcement mechanisms like social sanctions when disputes arise. Experimental research has also shown that ICRISAT households care about risk and use a wide variety of instruments to reduce it (Binswanger 1981). Since supply and demand are both in force, it stands to reason that there ought to be a lot of insurance activity. And it is true that many insurance mechanisms exist within villages. Still, it remains unclear how effective these mechanisms are when taken together, where and how strongly constraints bind, and the extent to which gift-giving is an important feature of informal insurance systems (Morduch 1995, 1999). Rosenzweig (1988), for example, shows that reciprocal transfers within extended families (cutting across villages) are actively used to address risk, but the magnitudes are so small that insurance due to family-based transfers is not close to being complete (Morduch 1999).[3]

Robert Townsend’s (1994) paper on the ICRISAT villages provides a structured way to ask how effective households’ coping mechanisms are when taken together. Specifically, how well, in the end, can households protect consumption levels in the face of idiosyncratic income shocks? His insight was to derive testable implications from dynamic general equilibrium models, beginning with an explicit social planner’s problem as a benchmark. Like other approaches built around testing exclusion restrictions, inability to reject the benchmark model is highly informative. On the other hand, rejecting the model when several plausible alternatives exist is less informative. Townsend’s initial work was so striking because it came very close to *not rejecting* the full risk-sharing model.

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3 This evidence is not inconsistent with complete village risk sharing, but it suggests that the village may not be the most natural locus of insurance aqctivity.

Subsequent work with more elaborate models and alternative data have mainly rejected the full risk-sharing model, setting out a search for models that perform better with the data. Researchers inspired by Townsend have turned to identifying constraints that keep the full risk-sharing model from holding (following examples from Townsend's own work in Thailand). The two leading contenders are information asymmetries and enforcement problems that prevent effective long-term contracting between villagers. Specification errors and various forms of unobserved heterogeneity are plausible too, in isolation or in combination with the other concerns. On top of this, it is seldom easy to distinguish these newer models of imperfect village-based insurance from simpler models of imperfect self-insurance.

The newer work strengthens arguments for moving away from the village as the 'natural' level at which to organize informal insurance. In recent theoretical work that draws inspiration from the ICRISAT studies, for example, Genicot and Ray (2000) show that with imperfect enforceability of contracts, stable insurance groups at levels below *or above* the village-level can exist even when village-level arrangements break down. The counter-intuitive arguments do not require exogenous costs to group formation but hinge instead on the changing benefits of risk-pooling under self-enforcing insurance arrangements. The tension lies between the benefits of pooling risks with more people versus the tendency for larger groups to sub-divide into smaller coalitions; they show that the stability of coalitions is highly non-linear as their size changes. The results reinforce the call to focus beyond the village-level.

The next section provides evidence on idiosyncratic versus aggregate shocks, and the concluding section returns to disentangling underlying mechanisms and policy implications. The approach and extensions are described in the sections inbetween, with particular attention to risk-sharing within groups identified by caste.

4 Idiosyncratic versus common income shocks

A simple decomposition of the income process for each village suggests that idiosyncratic risk accounts for as much as 75 to 96 per cent of income variation.[4] This can be seen by decomposing observed income of each household *i* in each period *t* (Y_{it}) as a multiplicative function of a base income level specific to the household (Y_i), a factor which scales the base level up and down for common shocks to the village (τ_t), a factor which does the same for idiosyncratic shocks to the household (τ_{it}), and measurement error (β_{it}):

$$Y_{it} = Y_i \tau_t \tau_{it} \varepsilon_{it}.$$

With no other assumptions, this is an identity. By taking the logarithm, it can be estimated as a regression equation, where the household and common village factors are treated as fixed effects. Measurement error and idiosyncratic shocks are contained in the residual, and their combined magnitude can be inferred from $1-R^2$ of the regression.

4 Throughout the paper, 'income' refers to total income from all activities of the household (including non-market activities) less transfers received. Where noted, household income is deflated by measures of family size.

Table 1
Idiosyncratic elements in income and consumption
1976/77 to 1981/82

Village	1 - R^2 from regression of total income on year fixed effects	Ratio of variance of consumption under complete risk sharing to variance under autarky	(Standard deviation)	1 - R^2 from regression of total consumption on year fixed effects
Aurepalle	0.75	0.57	(0.51)	0.60
Shirapur	0.96	0.09	(0.09)	0.96
Kanzara	0.84	0.50	(0.77)	0.77

Notes: Data are in 1975 rupees, deflated by family size. Equations were estimated with fixed household effects and five year dummies.

This gives an upper bound on the variance of the uncorrelated idiosyncratic components as a fraction of the variance of total income.

Column 1 of Table 1 presents these statistics for regressions run on six year samples in each of the three villages. The figures show that idiosyncratic elements explain as much as three quarters of income variation in Aurepalle, up to 95 per cent in Shirapur and up to more than 80 per cent in Kanzara. Even if half of residual variation is due to measurement error, these figures are striking.[5]

While there appears to be substantial scope for risk-sharing in the villages, what is its potential in reducing total household risk? The relative importance of the time and space components can be gauged by comparing the variation in consumption if risk-sharing is complete (but intertemporal smoothing is not possible) to the variation of consumption with no smoothing at all. If consumption smoothing is impossible, neither across space nor time, consumption each period equals income, $C_{it} = Y_{it}$ and the variance of household consumption (between period 1 and T) is:

$$\frac{1}{T}\sum_{t=1}^{T}\left(Y_{it} - Y_i\right)^2,$$

where Y_i is the household's sample average. If there was complete pooling of idiosyncratic shocks, subject to the condition that there was no income redistribution on average (i.e. the average of household i's consumption over the sample is still Y_i), then $C_{it} = \beta_i Y_t$. Here, Y_t is total village income in period t and β_i reflects the share of total income allocated to the household. Under these assumptions, the share is:

5 When income is not deflated by household size, $1 – R^2$ is 0.80, 0.83 and 0.79 for Aurepalle, Shirapur, and Kanzara, respectively. Similar results are found for income disaggregated by source. See Morduch (1991).

$$\theta_i = \frac{\frac{1}{T}\sum_{t=1}^{T} Y_{it}}{\frac{1}{T}\sum_{t=1}^{T}\sum_{i=1}^{N} Y_{it}} = \frac{Y_i}{\sum_{i=1}^{N} Y_i},$$

where there are N households in the village. This is the fraction of village income over the entire sample attributable to household i. A measure of the potential for risk-sharing in eliminating a household's total risk is then:

$$\frac{\sum_{t=1}^{T}\left(\theta_i Y_t - Y_i\right)^2}{\sum_{t=1}^{T}\left(Y_{it} - Y_i\right)^2}.$$

This is the variance of consumption over time under complete sharing for household i, as a fraction of the variance under autarky.

Column 2 of Table 1 reports the average of these statistics across households for each village. The calculations show that in Aurepalle the average variance of consumption under complete risk-sharing would be nearly 60 per cent of the variance under autarky. While a 40 per cent average reduction is relatively large, households still face most of the variation they would without risk-sharing. The situation is very different in Shirapur, where complete risk-sharing would reduce total income risk to less than 10 per cent. The calculations for Kanzara are closer to those for Aurepalle: on average half of total risk would remain under complete sharing.

Together, these results and the calculations suggest that risk-sharing can be important in reducing total income risk. How does this potential translate into practice? Column 4 of Table 1 reports on the extent of idiosyncratic components actually found in total consumption. The results are close to the figures in column 1 for income, suggesting that there is limited consumption smoothing in the villages, either across space or time. Only in Aurepalle do any of the idiosyncratic components in consumption appear to be mitigated. There, 60 per cent of total consumption variability is idiosyncratic, whereas this is true for 75 per cent of income variability. In Shirapur and Kanzara, 96 and 85 per cent of consumption variability is idiosyncratic, respectively. As with income, this is a great deal more than can be explained by measurement error.

These preliminary results leave little cause for optimism with regard to finding evidence of complete risk-sharing, but a more rigorous set of tests must be implemented before conclusions are drawn. In those tests, some instances of risk-sharing are evident, although the weight of the findings echoes those above.

5 Theory

Household Consumption Decisions. Imagine a household that makes consumption and saving decisions while facing uncertain future income. The household derives utility from its consumption each period, such that consumption at time t, C_t, generates utility $U(C_t)$; this utility function is assumed to be time and state separable. A forward-looking household (with discount factor β) will choose consumption each period to maximize expected lifetime utility:

$$E_t \sum_{k=0}^{T-t} \delta^k U(C_{t+k}) , \qquad (1)$$

subject to the constraints that assets at the start of period t+1, A_{t+1}, grow with net savings balances and income, Y_{t+1}; consumption is always non-negative; and the household is not in debt in the final period T (the transversality condition):

$$\begin{aligned} &A_{t+1} = (A_t - C_t)(1 + r_{t+1}) + Y_{t+1}, \\ &C_{t+k} \geq 0 \quad \text{for } k = 0, \ldots T - t, \qquad (2) \\ &A_T \geq 0. \end{aligned}$$

All uncertainty is introduced via stochastic income. No restrictions have been placed on the ability to borrow and save, but, even with perfect credit markets, households face risk due to unanticipated shocks.

Tests for risk-sharing. In principle, households can also reduce exposure to unanticipated shocks through state-contingent transfers and contracts that benefit those with bad luck, as set out by Townsend (1994). The optimal outcome corresponds to that determined by a fictional social planner who seeks to maximize the (socially-weighted) sum of lifetime utilities across households:

$$\max \sum_{i=1}^{N} \theta_i \left[E_t \sum_{k=0}^{T-t} \delta^k U_i(C_{i,t+k}) \right], \qquad (3)$$

(where i indexes households) subject to non-negativity and transversality constraints and the village resource constraint:

$$\sum_{i=1}^{N} A_{it+1} = \sum_{i=1}^{N} (A_{it} - C_{it})(1 + r_{t+1}) + \sum_{i=1}^{N} Y_{it+1} \qquad (4)$$

which is just the sum of equation (2) over all of the N households in the village. The social weights, β, are bounded by zero and together they must sum to 1.

This framework could arise from several scenarios. Most directly, choices made by village leaders who are entrusted with basic allocation decisions for the village might look approximately like the problem in (3) and (4). This would be analogous to the extended family choice framework of Altonji et al. (1992), where the weights are determined according to the strength of altruism toward each family member. If the social planner is a utilitarian, the weights would be equal. Alternatively, such a framework could arise as a solution to a competitive game among self-interested actors, where the weights partly reflect bargaining power. Or, with the weights a function of household wealth, the framework could correspond to a decentralized competitive solution with complete insurance markets (Townsend 1994). Whichever the mechanism, the first-best result is a full pooling of risks.

The first order conditions of the problem yield that in every period:

$$\theta_i U'(C_{it}) = \theta_j U'(C_{jt}) = \alpha_t \qquad (5)$$

for all households *i* and *j*, where β_t is the Lagrange multiplier on the village resource constraint – i.e. the marginal utility of village income. Equation (5) says that at the optimum the weighted marginal utilities of all households are equal to each other (and equal to the marginal utility of village income). The social planner cannot transfer resources from one household to another and improve the weighted sum of their utility; at the optimum any further transfers reduce social welfare. Since equation (5) holds in all periods, it must then hold that:

$$\frac{U'(C_{it+1})}{U'(C_{it})} = \frac{U'(C_{jt+1})}{U'(C_{jt})} = \frac{\alpha_{t+1}}{\alpha_t} \qquad (6)$$

for any pair of periods and any pair of households. This means that the *growth* of marginal utilities for all households is also equal under the null hypothesis. Here, the social weights neatly cancel out, leaving a result that is potentially testable.

6 Empirical approach

The formal tests for risk-sharing here follow from Townsend's (1994) approach, which, under additional assumptions about the form of utility functions, draws on equation (6) to exploit the fact that the consumption of households in each village can be described as a system of Frisch demands in which the marginal utility of village income is common to the sample. The first test of equation (6) is an exclusion restriction (or excess sensitivity) test similar to that common now in finance and macroeconomics. This is the main form of the tests used by Townsend (1994), Morduch (1991), and Ravallion and Chaudhuri (1997).

Deaton (1997) describes a second test, implemented in work on Taiwan, Britain, and the US with Christina Paxson. If there is full risk-sharing, the cross-sectional variance of the growth of marginal utility (where the growth rate is measured for households across time, and the variance is then measured across households in the cross-section) should be zero since growth rates ought to be identical for all. But with imperfect sharing, some people do better and some do worse. Since the consumption shocks accumulate over time, the cross-sectional variance should increase over time too. Results from this test are not described here since the data set is too small to provide adequate reliability.

Instead, the first method above is extended here to provide a third test. The test pertains to common fixed time effects: if there truly is full village-level risk-sharing, the growth in marginal utilities should not differ across groups within the same village. The test examines whether failure of the village-level tests belies substantial risk-sharing within families or within members of a village subgroup (e.g. a caste).

Following Townsend (1994), constant relative risk aversion (CRRA) utility functions are assumed:

$$U_i(C_{it}) = \frac{C_{it}^{(1-\gamma)}}{1-\gamma}; \quad U_i^{'}(C_{it}) = C_{it}^{-\gamma} \qquad (7)$$

and household consumption is adjusted for the size of the household and differences in the consumption needs of its members.[6] Substituting the assumed form of the marginal utility from equation (7) into (6) yields that

$$\left(\frac{C_{it+1}}{C_{it}}\right)^{-\gamma} = \left(\frac{C_{jt+1}}{C_{jt}}\right)^{-\gamma} = \frac{\alpha_{t+1}}{\alpha_t} \qquad (8)$$

and taking the logarithm and simplifying gives a sharp, testable result:

$$\log\frac{C_{it+1}}{C_{it}} = -\frac{1}{\gamma}\log\frac{\alpha_{t+1}}{\alpha_t} \qquad (9)$$

for all households and all periods. Although the term on the right is unobservable, it is a constant (i.e. the same for all households in any period) and can thus be captured with a set of time-specific fixed effects. Since (9) should hold exactly (except for random error picked up by the residual β), an over-identification test can be employed:

$$\log\frac{C_{it+1}}{C_{it}} = \sum_{i=1}^{T}\beta_t D_t + \beta_y \log\frac{Y_{it+1}}{Y_{it}} + \varepsilon_{it}. \qquad (10)$$

If there is full risk-pooling, the time-specific fixed effects, D_t, should fully explain systematic movements in consumption growth (i.e. the right hand side of equation 9). If that is so, the coefficients on the income growth term in (10) should not differ significantly from zero ($\beta_y = 0$). On the other hand, if the model is completely wrong and all income shocks translate into consumption variation then $\beta_y = 1$. The test is narrow in that it can only reject (or not reject) evidence of complete risk-sharing within villages. Interpretation of $0 < \beta_y < 1$ is up for grabs: the test is mute on the ability to smooth consumption inter-termporally or to share risks with households outside the village (equation 6 holds equally well if there are extensive or absent credit or savings possibilities).

Homogeneity of Fixed Time Effects. Equation (6) implies another test as well. Allowing different fixed time effects for sub-groups of the sample should be redundant if equation (6) and the ancillary assumptions describe reality. The fixed time effects should be

6 In the empirical work, consumption is deflated by the number of household members and by two measures of adult equivalence. The results are robust to parameterizing using the constant absolute risk aversion form, where $U(C) = -1/\sigma \exp\{-\sigma C\}$ and $U'(C) = C$.

equal for all sub-groups in each period, no matter how the sample is divided. If there are G sub-groups in the village, $\beta_{gt} = \beta_{ht}$ for every group g and h:[7]

$$\log \frac{C_{igt+1}}{C_{igt}} = \sum_{g=1}^{G} \sum_{i=1}^{T} \beta_{gt} D_t D_g + \beta_y \log \frac{Y_{it+1}}{Y_{it}} + \varepsilon_t \,. \qquad (11)$$

Results following equation (11) are reported in Morduch (1991) for sub-groups by landholding and by caste as identified by Victor Doherty (1998) (Walker and Ryan 1990). Below instead results are presented for the more flexible specification of equation (10) estimated independently for sub-samples defined by caste groupings.

7 Results

This section describes results from Morduch (1991) and subsequent work. Table 2 provides evidence on risk-sharing following equation (10), using as dependent variables first total consumption and, second, food consumption only.

Coefficients on income growth tell just part of the stories: overall fit matters too. As expected, the fit of the equations is far weaker for total consumption than for food consumption. This is not surprising since non-food items are more likely to be discretionary and thus volatile, leaving more variance to be explained. The levels of R^2 rise from 0.18 to 0.32 in Aurepalle, from 0.09 to 0.26 in Shirapur, and from 0.05 to 0.32 in Kanzara. If the model was right, we would expect better fits in all cases.

Table 2
Risk-sharing tests by village

	Growth of total consumption (1976-81)			Growth of food consumption (1976-83)		
	Coefficient on income growth	R^2	Obser-vations	Coefficient on income growth	R^2	Observations
Aurepalle	0.27 (3.36)	0.18	193	0.24 (4.49)	0.32	272
Shirapur	0.19 (1.61)	0.09	192	0.25 (2.68)	0.26	268
Kanzara	0.24 (3.23)	0.05	191	0.21 (6.43)	0.32	270

Notes: Data are in 1975 rupees, deflated by family size. Absolute values of t-statistics in parentheses. Equations are estimated with a full set of time fixed effects and are heteroskedasticity-corrected taking into account the stratified sampling of the survey.

7 The approach employed in the empirical section is to estimate the equation with a village-wide fixed time effect and additional fixed time effects for sub-groups. Under the null hypothesis, the latter fixed time effects should equal zero.

The coefficients on income growth are in all cases between 0.19 and 0.32. If consumption responded exactly to income, the coefficient would be 1.0. But this would only be so if there was no village-level insurance at all, nor any self-insurance by households. So households are a long way from simply consuming what they earn. On the other hand, the coefficient on income growth is large and statistically significant in all cases (but marginally significant in Shirapur for total consumption) – a clear rejection of the complete insurance model. What can't be told from the results is whether the reason that the coefficients are relatively large but far below 1.0 has much to do with village-level activity (or any other group-level activity) – or whether it's mostly due to self-insurance. As Deaton (1997) and others have argued, the results could equally well be explained by households atomistically borrowing and saving while following the permanent income hypothesis under borrowing constraints.

Table 3

Risk-sharing tests by caste group

	Growth of total consumption (1976-81)			Growth of food consumption (1976-83)		
	Coefficient on income growth	R^2	Observations	Coefficient on income growth	R^2	Observations
Aurepalle Caste 2	-0.12 (2.81)	0.18	33	-0.20 (2.69)	0.40	45
Caste 7	0.54 (4.24)	0.63	52	0.53 (5.00)	0.57	77
Caste 10	0.60 (4.94)	0.49	32	0.46 (6.24)	0.58	46
Caste 12	0.43 (1.81)	0.31	25	0.34 (1.95)	0.43	35
Shirapur Caste 1	0.20 (1.70)	0.09	100	0.26 (4.05)	0.21	138
Caste 5	0.009 (0.12)	0.27	47	0.07 (0.57)	0.37	66
Kanzara Caste 1	0.10 (0.68)	0.28	35	-0.04 (0.24)	0.29	49
Caste 4	0.22 (8.69)	0.14	67	0.19 (2.65)	0.58	97
Caste 11	0.32 (3.00)	0.41	35	0.42 (3.37)	0.61	48

Notes: Data are in 1975 rupees, deflated by family size. Absolute values of t-statistics in parentheses. Equations are estimated with a full set of time fixed effects and are heteroskedasticity-corrected taking into account the stratified sampling of the survey.

Table 3 considers tests for groups where communal insurance seems more likely, relative to mutual insurance of the entire village. Here, insurance within castes is tested, with attention restricted to just the largest castes in the sample. The caste numbering follows the most disaggregated codes used by ICRISAT investigators. The codes follow a hierarchy by social status, with 1 being the highest caste in a village.

The theory described above implies that if complete village-level insurance exists, the finding should be replicated exactly when investigating the behaviour of any sub-group. Coefficients should be identical no matter how the sample is divided.

Table 3 shows clearly that coefficients are not identical, but interesting patterns emerge. In Morduch (1991), the results by caste provide evidence that food consumption (but not total consumption) appeared to be well-insured for some castes, suggesting that the right model may be one where neighbours insure each other against dire events but are left to cope individually in the face of minor shocks. These findings are consistent with studies that describe distributive systems limited to subsistence needs (Polanyi 1944, Sahlins 1976, Scott 1986), rather than comprehensive arrangements characterized by tests for Pareto optima (Townsend 1994). Those findings do not hold up in the more flexible specification here, however. Instead, while coefficients vary between caste groups, they are remarkably consistent within caste groups for when the dependent variable is either growth in total consumption or growth in food consumption only.

In Aurepalle and Kanzara, the tests suggest that the highest ranked castes (lowest numbers) appear to be better 'insured' than others (although sample sizes are small and the Aurepalle coefficient is significantly negative). The castes classified as being of lower status show signs of weaker 'insurance' systems. The results (although they are not replicated in Shirapur) suggest that evidence of quite good insurance for some is being averaged in with evidence of weaker insurance for others. Disaggregating is critical to get a full picture.

The results caution against the temptation to interpret coefficients from village-level tests as yielding the extent to which the 'average' villager is protected from idiosyncratic shocks. There may be no 'average' villager in a meaningful sense. Instead, the results yield an average of protection levels across groups that may vary quite widely from each other.

8 Relation to previous work

The results provide a context in which to view Townsend's evidence. He uses a 'mongrel' version of equation 10 to suggest that risk-sharing is important in the ICRISAT villages (β_y is small), although complete risk-sharing is statistically rejected and poorer households appear to have less access to risk reducing arrangements. In particular, Townsend finds that the marginal propensity to consume out of a household's own income is nowhere greater than 0.14. Ravallion and Chaudhuri's estimates of the marginal propensity to consume (using equation 10 and a variety of data sources) fall between 0.12 and 0.46. Their 'preferred estimates' are at the high end of the range. These results suggest that informal insurance exists, but it is not nearly perfect. Ligon et al. (2000) find similar results, as do I (Morduch 1991, and here). [8]

Townsend's results, however, are given support by Rosenzweig and Binswanger (1993). They find that in the ICRISAT sample, a 100 rupee decline in profits reduces food consumption by 7 rupees. But when the effect of common weather shocks is removed from the profit variable, the residual explains only 0.6 per cent of that of total profits. Idiosyncratic shocks thus appear to be almost completely smoothed away, while households must bear some of the impact of common weather shocks. But note that, as shown in Morduch (1991), results for total consumption can differ from those for food only (although Tables 2 and 3 here do not bear that out).

When disaggregating villages by agricultural status in Morduch (1991), I find evidence consistent with Rosenzweig and Binswanger for large-scale and medium-scale farmers, but not for small-scale farmers and landless labourers. I find that in investigating borrowing constraints, food consumption growth for the latter two groups is affected by idiosyncratic shocks, while such shocks do not affect food consumption growth of the larger-scale farm households. Similar results are reported by Bhargava and Ravallion (1993), also for the ICRISAT sample. Again, disaggregation within villages thus appears to matter.

Ogaki (1991) and Ogaki and Zhang (2001) shore up evidence for full risk-sharing by moving in a different direction. Rather than disaggregating or using alternative data sources, they turn to specification error. Specifically, they consider utility functions that explicitly allow for 'subsistence constraints', $U(C) = [(C - s)^{1-\gamma} - 1]/(1-\gamma)$ where s is the subsistence parameter. Estimating using generalized method of moments techniques, they find that the more flexible specification yields stronger evidence of risk-sharing in the ICRISAT sample. The step is an important one, but the evidence would be even more revealing if the subsistence parameter could be imbued with sharper economic meaning. The parameter is not tied to an exogenous poverty line or other information on what it means to live at 'subsistence'. Rather, Ogaki and his co-authors remain agnostic about precise definitions.[9]

Ligon et al. (2000) take a different tack. They begin with the presumption that full risk-sharing does not describe the ICRISAT data adequately. They derive conditions expected to occur if contract enforcement is impossible. In that case, everything falls apart unless contracts are self-enforcing: the benefits to staying in must always exceed the benefits to reneging on obligations. The patterns that emerge will involve partial risk sharing with transactions that have features of loans. Where contracts are fully enforceable, we expect that each period will be treated like a one-shot game. Without enforcement, history matters, so if A helps out B in period 1, then in future periods B remains obligated to A until conditions change or 'debts' are repaid. The model

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8 Results have been mixed in other samples. Deaton (1997), for example, rejects the complete risk-sharing hypothesis in investigating consumption patterns in Côte d'Ivoire, using a framework similar to that of Townsend.

9 Other candidates for weakening are assumptions that leisure is separable from consumption in utility, that food is separable from other consumption, and that utility in different states and times is separable. All of these assumptions are reasonable, but they come at the cost of generality.

performs well against the alternatives offered by complete autarky, full insurance, and a static model of limited insurance (in which history does not matter). The model outperforms all three, and it has much to recommend it. As Ligon (1998) shows, however, asymmetric information can also undermine insurance in complicated ways. But incorporating both information asymmetries and imperfect enforcement in the same theoretical model is a difficult task. Deriving cleanly testable implications is even harder. More difficult still is finding a data set rich enough to deliver reliable results. At this point the ICRISAT set may have been stretched as far as it can go.

Considering imperfect information is, of course, just one path to pursue. Important (and very useful) simplifications are obtained by Ligon et al. (2000) by ruling out the ability to save or borrow. As Lim and Townsend (1998) and Chaudhuri and Paxson (1994) show, however, the detailed ICRISAT transactions files show that most insurance is obtained through building up and drawing down one's own buffer stocks of grain. Rosenzweig and Wolpin (1993) show how bullock purchases and sales appear to serve as risk-coping mechanisms as well – although Lim and Townsend (1998) fail to corroborate the evidence in the underlying transactions files.

Self-insurance, which is assumed away by Ligon et al. (2000), thus appears to be central in the raw data. Still, risk-sharing with others may in principle be critical on the margin, and their analysis takes us a step further in understanding a complex web of behaviors and constraints. As Ligon et al. (2000) conclude, figuring out how to take the blinders off with respect to self-insurance should be high on the list of research priorities.[10]

Youngjae Lim (1993) makes a start in this direction by attempting to disentangle risk-sharing models and the permanent income hypothesis under borrowing constraints. His test refines previous work by investigating how the unforecastable portion of consumption responds to unforecastable idiosyncratic income shocks. With no risk sharing (i.e. under self-insurance only), the factor structure of the income shocks should be detectable in the factor structure of consumption. But where risks are pooled, expectations errors are smoothed away and the patterns should not translate. Like others, Lim (1993) is able to use the ICRISAT data to show that there is a fair amount of risk-sharing, but that it is incomplete.

Jacoby and Skoufias (1997) offer some promising leads in how to sharpen predictions. But rather than considering changes in consumption, they consider decisions about the enrollment of children in school. Still, the framework draws heavily on the consumption literature; an important question is: do enrollment decisions respond to idiosyncratic income shocks? To get adequate variation, they consider seasonal data – like Chaudhuri and Paxson (1994) but unlike the other researchers mentioned above. Their innovation is to use seasonal data on rainfall to disaggregate shocks both as idiosyncratic vs. aggregate and as anticipated vs. unanticipated. The predictability of the rainfall data allow insight into the latter relationships and provides a handle for distinguishing between credit market failure and insurance failure. Insurance failure is detected by seeing responses to idiosyncratic shocks, whether anticipated or not. Self-insurance failure is detected by seeing responses to anticipated shocks, whether idiosyncratic or

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10 Chapter 2 of Morduch (1991), on the other hand, tests models of borrowing and saving under borrowing constraints, while keeping on blinders to risk-pooling. The tests of risk sharing and self-insurance are very close in form and identification comes from very similar sources of variation in the underlying data.

not. Jacoby and Skoufias (1997) find that school enrollments respond to risk. Pushing further, they reject both perfect insurance and perfect credit markets (especially for smaller farmers). Their evidence shows the importance both of disaggregation within villages and of explicitly modeling self-insurance as a risk-mitigation strategy in the ICRISAT sample.

9 Conclusion

Recent research has shown that rural households in developing economies use a wide variety of instruments to smooth consumption, some through the market and some through informal mechanisms. The ICRISAT studies have provided a rich source of data with which to probe the complexities of how this is accomplished. In doing so, their influence on policy and research has extended well beyond concern with South India or even the semi-arid tropics as a region.

The data have yielded many 'stylized facts', some of which have been replicated sufficiently to count as actual 'facts'. Most important: in these villages there is a lot of risk, but the bulk of idiosyncratic risk is mitigated. Second, poorer households are considerably more vulnerable than richer households. Neither complete autarky nor full risk-sharing are good characterizations of these villages.

None of this should be surprising, nor particularly comforting. The remaining idiosyncratic risk is not clearly innocuous, nor are risk-mitigating mechanisms necessarily inexpensive (Morduch 1999). Twenty years of work with these data offer little support for the contention that policy only needs to worry about limiting damages due to aggregate shocks since villagers seems to deal with idiosyncratic shocks on their own.

For the purposes of policy, it will be valuable to better target those households that are least able to cope with both aggregate and idiosyncratic shocks. The results shown here on risk-sharing by caste and previous work on risk-sharing by wealth take us a step in that direction.

Recent academic work on incomplete risk-sharing has focused on the role of imperfect enforcement. Enforcement problems are a key part of the economic environment in the ICRISAT study region, but they are insufficient to explain the patterns in the data. Most important, evidence on incomplete risk sharing may result as well (or, perhaps, instead) from imperfect information, heterogeneity in desires and ability to save and borrow, specification error, costly contracting, and a host of other factors including discrimination and social isolation.

While fundamental questions remain, it is remarkable how much we have answered in the process – and how much high-quality work has flowed from the use of these data. Sadly, the data remain the best available for many purposes, but they are starting to strain under the demands placed on them. With growing realism and subtlety of theoretical predictions, longer time series are required to put together with wide cross-sections. But it is the long time series that are especially critical. Remarkably, much fine work over two decades of development economics springs from evidence on just over 100 households. If this is a precent, creating similar data sets in other regions will surely repay the effort many times over.

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