

Risk, Insurance, and the Family
Edited, Revised Excerpts

SPECIFIC AIMS

1. to understand and quantify the role of the family, inclusive of extended family networks, in enhancing the welfare and well-being of individual members through risk reduction, e.g., buffering idiosyncratic and aggregate shocks in times of "typical" fluctuations and also in times of severe economy-wide recession
2. to do the same for the mobilization and allocation of productive credit for inputs and longer term investment; that is, the family and extended networks might be viewed as intermediaries for saving and borrowing, with this role potentially changing over the long run, with high economy-wide growth, and again in times of economy-wide financial crisis
3. to place the family and extended networks in the context of a larger set of varied institutions and markets - e.g. village funds (rice banks, production credit groups, rotating credit associations), national level institutions (commercial banks, a government savings bank, a government Bank for Agriculture) and to quantify the role that the family, networks, and these local and national institutions are playing in various episodes
4. to understand and test various hypotheses, e.g., with the rise of formal substitutes over the long term, the informal sector may be less essential, especially in developed regions, or, alternatively, the informal sector may continue to play a crucial role as a more flexible and fine-tuned complement to formal sector insurance and credit, especially in times of severe stress
5. to model formally the impediments to exchange which gives families, networks, and clusters of "collective groups" a role even in the context of larger economy-wide markets. Those impediments include private information, limited communication, renegeing and limited commitment, transaction costs, and exogenously incomplete markets
6. to address these theoretical and empirical questions concerning the family in the context of Thailand in three salient episodes: (1) the periods of dramatic growth of macro averages from 1976-1996, but with increasing inequality and uneven financial deepening at the household, village, and regional level, (2) the ongoing Asia crisis which began in Thailand in July 1997, concurrent with previously funded and ongoing field research, (3) and the hoped-for recovery on into resumed growth
7. to field (only) two more rounds of the annual cross-sectional survey and to continue (on a reduced scale) the ongoing monthly survey, in order to ensure sufficient data for statistical significance of the various tests and to see the Thai economy on into the period of recovery and resumed (high) growth
8. to conduct statistical/econometric analyses of these data - tabulations, statistical comparisons, fits to each one of the various theoretical/econometric models, and formal comparisons across the various models, including nonnested alternatives
9. to clean, thoroughly organize via an innovative Web-based archive, and prepare for public release: (1) the NICHD-funded project data including the initial May 1997 retrospective cross-sectional survey of households, their small businesses, village headmen, local financial institutions (with accounts), joint liability groups, and soil samples; the annual resurveys of 1/3 of that initial cross-section including the household, key informant, and institutional instruments; a comprehensive monthly survey of 16 villages fielded from July 1998 and ongoing (2) subject to permission, the pre-existing surveys which we have assembled as part of the previous grant -- all 8 rounds of the Socio-Economic Surveys (SES), all 5 rounds of the Community Development Department (CDD) village census, the Thai population censuses, the Thai labor force survey, and national and provincial level income data, (3) summaries of the theoretical and empirical literatures, key variables of these literatures, and their location in these NICHD and other surveys

BACKGROUND AND SIGNIFICANCE

The purpose of this research is to investigate the role of the family, inclusive of the extended family and networks of friends and relatives, in providing insurance and credit to its members, to understand and quantify that role in the larger village, regional, and national context, and to understand that role relative to that of more formal institutions, e.g., village-level funds and national-level banks. The specific investigation in Thailand takes advantage of recent and ongoing advances in economic theory and of substantial variation over regions, e.g., the semi-arid northeast versus the highly developed regions near Bangkok, and substantial variation over time, e.g., the high-growth period and the recession and recovery of the Asia crisis.

The idea is to study the family or an extended network as a collection of individuals gathered together into a “collective” organization which provides insurance and credit to its members, to understand the nature and boundaries of such collective organizations, and to understand the interaction of such collective organizations with each other directly, with other more formal institutions, and with the larger market. The family, community-level institutions, formal national-level institutions, and markets will be understood in the context of models with private information, limited communication, limited enforcement capabilities, transactions costs, and exogenously incomplete markets. We also seek to measure using the standards suggested by these models the welfare impact of these informal and formal organizations, and their evolution in the context of the larger national economy.

Insurance should be understood broadly to include self-insurance, but we emphasize here community or cross-household mechanisms which allow individuals to smooth consumption and labor supply in the face of idiosyncratic and aggregate shocks. Theoretical literature studying insurance has recognized that with complete markets, or an equivalent set of institutions, household consumption should move with group or community consumption and not with household specific shocks, e.g., Diamond (1967), Scheinkman (1984), and Wilson (1968). Empirical literature dates from Leme (1984), Mace (1991), Cochrane (1991), Altug and Miller (1990), and Altonji, Hayashi, and Kotlikoff (1992) for the US and with Townsend (1994) and Udry (1994) for developing countries. As with the empirical literature on the permanent income hypothesis which preceded it, the insurance literature is now rapidly expanding in both developed and developing country contexts -- e.g., Atanasio and Davis (US, 1996), Deaton (Cote d’Ivoire, 1994), Jacoby and Skoufias (India, 1997), Okagi and Zhang (Pakistan, 1998), Rai, Topa and Amin (Bangladesh, 1998), Rashid (Pakistan, 1990), and Sawada (Pakistan, 1996). Among these also, Morduck (1990), Altonji-Hayashi-Kotlikoff (1992, 1996), and Grimard (1997) concentrate respectively on castes in India, families in the US, and tribes in Cote d’Ivoire.

Yet we are left with many unanswered questions. Typically, only income and consumption data are used, and one is left wondering if the insurance mechanism actually operates at all, or rather if the empirical results are due to spurious effects or measurement errors. See the concerns expressed in Alderman and Paxon (1992), Deaton’s 1994 book, and Ravallion and Chaudhuri (1997), for example. If the insurance mechanism does operate, then how large is its actual role in transactions viz a viz the other forms of insurance? Against which shocks does it operate and for which households; that is, is there variation by income, wealth, or geography? What are the important features of those extended-family networks as risk-sharing institutions, and how does such a network actually function?

Even in “normal” times, a misnomer no doubt, households and the business they run suffer from the incidence of human illness, disability, death, crop diseases, droughts, floods, and fluctuating input and output prices. The project is documenting and quantifying the nature, frequency, and the magnitude of these shocks. Good years and bad years are not coincident as in the Thai Socio-economic Survey (SES) at the county (amphur) level (see Townsend (1995a)), though the SES is not a household panel. The NICHD-funded annual and monthly panels are measuring these events as well rainfall and soil moisture through physical instrumentation. It seems clear from the SES and NICHD Thai data that there is much left to insure; that is, there are many nontrivial shocks, and because shocks are not coincident across households, insurance is possible in principle. In this project, we have the opportunity to see what actually happens in practice, not only with consumption and income data, but also with all the transactions that make up the difference between the two, the deficit. The project thus extends the earlier-funded research of Lim and Townsend (1998), for example. We also have the opportunity to inquire directly into the functioning of the underlying institutions, mechanisms, and markets, not as isolated case studies as in the earlier research of Townsend-Mueller (1998), for example (see also Banerjee and Duflo (1998) on Indian software contracting, and Bigsten et al. (1998) for African manufacturers), but here integrated with a substantial panel.

Recently, times have not been “normal.” After the initial May 1997 cross-sectional survey, Thai households and the small businesses they run suffered from a severe aggregate shock. The recessions of the Asia crisis began in Thailand with the devaluation of the baht in July 1997. According to the pre-crisis cross-sectional data of May 1997 and to a post-crisis round in May 1998, funded in part by the Ford Foundation,

complaints of loss of income due to unemployment and unpaid wages, and complaints of lower output prices and higher input prices reflecting the devaluation and the recession, are frequent in all four of the surveyed provinces. Consistent, however, with more 'normal' times, many households report low income due (primarily) to droughts, floods, crop disease and some to human illness. Neither are shocks uniform. Of the two semi-arid surveyed provinces of northeast, only Buriram suffered severely from El Nino related droughts. More generally, and consistent with the possibility for insurance, 24% of households in these central and northeast regions reported a year of increased income and 31% no change.

Borrowing and gifts from friends and relatives is a frequent response mechanism for those suffering adverse shocks, reaching 21% in Lop Buri in the 1998 resurvey. Our rough (preliminary) indicators show that in the crisis, reliance on informal sources of credit increased and the use of networks in food-sharing increased (though money-sharing declined). There was an impact of the crisis on net. In the areas near Bangkok, many households say they dropped consumption, worked harder, and reduced productive inputs. In the northeast, in contrast, these impacts were attenuated, apparently. Many households say they used rice in storage to smooth. Yet others in the northeast and central areas mention in addition to friends and relatives, financial savings, livestock sales, the use of money lenders and "help" from the Bank for Agriculture. Clearly one can take research advantage of Thailand's unfortunate circumstance and the detailed nature of the theory-based questionnaires to understand the insurance role of the family and networks, and to understand alternatives to the family and those networks. There is an emerging policy literature which argues for enhanced safety nets for the poor, particularly in times of unusual stress, e.g., Foster (1995), Jacoby (1994), and Lipton-Ravallion (1995), but much of this proceeds without much theory or adequate measurement—see the review in Zeller (1999), for example.

Extended families and networks of friends and relatives also play a role as "intermediaries," with the labor, equipment, and money of some members being reallocated through those networks to other members. Clearly this can be important for income and productivity and hence for the health and well-being of members generally. Conceptual extensions of Benjamin (1992) and Feder et al. (1991) would argue that extended families and networks should be farming identical plots or operating identical business technologies in the same way, so that the number of household members or access to credit should not matter for individual members within a network. Some literature also emphasizes the role of informal financing in starting businesses and for investing in existing businesses via trade credit, but little of this is explicit about family-related informal sources of finance. Recent work indicates that family connections and networks do have some impact on production and credit -- Fafchamps and Minten (1998), Huck, Rhine, Bond, and Townsend (1999), McMillan and Woodruff (1998), Peterson and Rajan (1997), and Grief (1993) -- but we can only begin to imagine how these family/business networks actually function and why they might vary over time, space, and ethnicity.

The initial 1997 cross-sectional round shows that the use of networks in labor and equipment is stronger for relatives than non-relatives, especially for equipment (49% vs. 44%). Similarly, the use of networks in labor and equipment for relatives and non-relatives is higher in the northeast than in the central area, for every category, particularly so for labor-sharing among non-relatives (78% vs. 59%). Related, among all loans taken out in the past 12 months, informal loans are shown to be a large share of the total, 39 percent overall, and, a surprise perhaps, an even more substantial 43 percent in Lop Buri near Bangkok. Loans from family and friends are particularly important for education, consumer durables, and business investment. Ironically, new business formation was apparently one of the key household responses to the crisis itself. In summary, reciprocal arrangements, borrowing, and lending in the informal sector, not typically measured in national-level data, can be quite important in Thailand.

In what follows below, we consider these questions concerning insurance, credit, and the family in more detail. We begin with the most basic collection of individuals, the nuclear family as a unit, then extend the discussion to include networks, and finally include alternative village- and national-level institutions.

The nuclear family is understood in the literature to be capable in principle of providing insurance through the diversified income sources of its individual members. Indeed, migration can be understood as in Rosenzweig and Stark (1988) for India and in Paulson (1994) for Thailand as an insurance device, with individual members seeking income sources which are not covariate with the home base, sending more remittances home at times of increased shortfalls at home or windfalls at sources of employment. Related literature argues that migration and remittances may be an important risk reduction strategy but allows as well other motives that need to be sorted out empirically; see, for example, Lucas and Stark (1988), Massey (1996), and Stark and Bloom (1985). Migrants are on average younger and more highly educated (talented) than remaining members, with implications for the entrepreneurship and social security of the remaining members at home. Yet reverse migration is possible. Indeed, it was estimated that in the Thai crisis up to two and one

half million urban workers would return to their village origins. The spatially-diversified Townsend Thai data allow us to measure well the actual extent of this phenomenon. Preliminary results indicate a much more moderate response, and there is a similar surprise, apparently, in the Indonesian FLS data. (These two data bases are complementary with one another).

The intergenerational family can also play a role in finance. Generally, in the empirical literature, there is a positive association between wealth and entrepreneurship--e.g., see Evans and Jovanovic (1989) and Holtz-Eakin, Joulfian, and Rosen (1994). In the Thai data, even controlling for wealth, households with increased inheritance from 5-9 years ago were more likely to have started a business in the last five years (for more detail see below, and see Paulson and Townsend (2001)).

The family can be placed in a somewhat larger context, even locally--for example, within a village. A typical pattern in Thailand is for daughters to marry and bring their husbands to live in an extended family compound consisting of separate individual structures. We study these compounds as units with the continuation of the Townsend Thai monthly survey. More generally, one can consider networks for insurance and credit within villages. As noted, in the Thai annual cross-sections, we ask about the sharing of rice, money, equipment, and labor and can relate these to the other variables of the annual surveys. In the monthly survey of the 16 villages, we can do an even better job. We are recording in each monthly interview the name, relationship, and location of all transaction partners (for example, in gifts, asset sales and purchases, labor exchange, and borrowing-lending, among other categories), and we can identify household membership and village structures from an initial census. In five of the 16 villages, we are interviewing every single household, and this, with the rest of the data, gives us an unusual opportunity to document and understand networks, especially within and across villages.

Recent economics literature on networks includes Fafchamps and Lund (1998), Fafchamps and Minten (1998), Barr (1998a,b), for example, and, of course, there is long tradition in sociology. Perhaps closest to our own efforts is the work of Rinfus in 70 villages in Nang Rong ampheur in Buriram province, also one of our own survey provinces. The Nang Rong project takes a census of all individuals and households in the ampheur and identifies those in a network according to labor exchange, equipment sharing, kinship, and common use of a rice mill or community property. On the other hand, we measure networks in additional ways, not just initially, but also from responses in the monthly panel data. The two studies are, thus, complementary. The Nang Rong study allows greater local cross-village analysis. Our monthly panel data along with our theory-driven measurement of actual and potential networks provide us with an unusually rich, detailed data base and the possibility of an explanation of why networks form.

An alternative hypothesis is that the village itself as a unit may represent a "natural" risk-sharing and intermediation unit, that insurance and credit within a village may be good for the diverse families within it, better perhaps than for families in a network connected across villages. See Deaton (1990) for example. Related, one wishes to understand the extent of intermediation and risk-sharing across diverse areas of a state or province, e.g., in this project the 12 subcounties (tambons) of each province of the annual cross-sections. Here we have the opportunity to do an unusually good job -- these tambons were chosen in a stratified random sample via a factor analysis of satellite imagery to have diverse land covers and hence are likely to suffer the ups and downs of income fluctuations at distinct years (see Binford, Lee, and Townsend, 2001). Similarly, we can measure the extent of intermediation and risk-sharing across four provinces -- two of these are in the northeast and two in the central area near Bangkok, quite diverse areas of the country. Again, this contrast was deliberately chosen.

Related, income, consumption, and assets can be rank-ordered from low to high as one goes from the northeast to central areas, and it is plausible that risk-sharing and intermediation within regions vary with these characteristics. It is sometimes asserted that informal networks decline with the level of development, and the work of Altonji-Hayashi-Kotlikoff (1992, 1996) suggests that families play little role in developed economies like the U.S. But preliminary analysis of the NICHD/NSF finance data from Thailand, a middle-level income country, suggests that cross-regional patterns in risk/response and credit are more complicated.

An alternative to spatial decompositions is to focus on the quasi-formal and formal institutions which service some but not all households. Some villages have local institutions such as rice banks, ROSCA's, or PCG's (something like a village-level savings and loan facility), and some do not. But little is known about these institutions, especially their impact. From the Townsend data, we have information on credit, savings, risk contingencies, customer selection, and operating procedures, both from the household interviews and from institutional interviews -- and copies of all local accounts and records. See Kaboski and Townsend for an evaluation of these institutions and their policies.

Some villages have households that borrow from commercial banks, though we turned up only 125 commercial bank customers out of 2880 households of the cross-sectional survey. Savings in formal financial

institutions are more prevalent, in commercial banks or the government savings bank. The government-operated Bank for Agriculture and Agricultural Cooperatives (BAAC) is a much more evident institution, with 28% and 23% of all borrowing and savings, respectively. We have the cooperation of the Bangkok headquarters of the BAAC and access as well to the branch office of the county (amphur) of the four provinces of the monthly survey. Preliminary work of the principal investigator and ongoing work with Jacob Yaon of the World Bank indicate that the BAAC has an interesting set of risk-contingencies embedded in the operation of its system. See Townsend and Yaron (2001) for details.

More specifically, the family, networks, and each of these institutions can be evaluated using the standards suggested by the optimal allocation of risk-bearing and fully neoclassical production models. Those are the obvious benchmarks. Still, these standards may be too high. Informal and formal institutions may each be playing some role, individually and in conjunction with one another, but these roles overall may be limited nevertheless. To that end, permanent income, buffer stock, and mechanism design models are brought into play.

The standards for performance suggested by permanent income and buffer stocks models are well known, e.g., Banks, Blundell and Tanner (1997), Deaton (1989), Flavin (1983), Hall (1978), Hansen and Singleton (1983), Lim (1993), Paxon (1992), Wolpin (1982), and Zeldes (1989), just to name a few. Empirical tests of the literature can be extended with the Townsend Thai data. We note in particular that saving for emergencies is reported as a dominant motive in the initial cross-sectional survey, lending some support to the savings-as-buffer-stock hypothesis; related is the use of rice stocks and financial savings in the crisis, as noted earlier. Some literature, including earlier work of Lim and Townsend (1998) and Morduck (1993) with ICRISAT data, suggests variations in the ability to pass model tests by household wealth -- typically the poor appear to have limited access. One is also interested in demographic characteristics -- e.g., female-headed households constituting 23% of the initial survey and age of the head. Again, one is interested in geography -- village, province, or region. Earlier work with the ICRISAT data suggests that credit markets may deteriorate for the less developed villages. Finally, there may well be correlations with specific institutions and the passing of model tests -- institutional identification is not typically part of household/business surveys.

Related, the Townsend Thai surveys allow one to measure (with some noise) how the deficit, the difference between consumption and income, is actually financed, with a breakdown by each of the various possible components -- sale of real capital assets and/or livestock, net borrowing, the running down of accumulated currency, the use of crop inventory, and gifts. The literature typically focuses on one mechanism, either with or without complementary measurement. For example, primarily with ICRISAT data, Rosenzweig and Stark (1989) and Rosenzweig (1988) study remittances and the role of the family; Jodha (1978) studies credit markets; Walker, Singh, and Jodha (1983) study crop and plot diversification; Rosenzweig and Wolpin (1993) study bullock purchases and sales as do Fafchamps, Udry, and Czaks (1998) in Africa; and Behrman, Foster, and Rosenzweig (1997) study financial savings. One exception is the Lim and Townsend article (1998) where the decomposition is complete, made possible by the large ICRISAT transactions file. Here we can do even better -- when these response mechanisms involve an institution, we have our own data from the institution to verify the claimed household response. Similarly, we can measure "liquid" wealth on the one hand, and investment and productive inputs on the other, and see whether the household is a net debtor or lender, and also which informal or formal financial institutions are used for this credit or saving, respectively.

Contract theoretic mechanisms will also receive special consideration, drawing in part on an earlier literature, e.g., Aghion and Bolton (1994), Braverman and Stiglitz (1982), Fellingham et al. (1984), Gjesdal (1982), Green (1987), Grossman and Hart (1983, 1982), Harris and Raviv (1979), Harris and Townsend (1981), Holmstrom (1979, Mirrlees (1975), Myerson (1982), Piketty (1994), Rashid/Townsend (1994), Shavell (1979), Spear and Strivastava (1987), and Townsend (1979). Such models and exogenously-limited alternatives, e.g., simple borrowing with bankruptcy as in Stiglitz and Weiss (1981), for example, have implications in a stationary environment for cross-sectional data, i.e., the distribution of consumption, borrowing, and outputs in the population and also, in a panel, transitions in the levels of these variables over time. Lehnert, Ligon, and Townsend (1999) analyzes how well one can match these histograms, but uses data generated from the models themselves. Here we go further and use the Townsend Thai data. We can pick a credit/insurance regime which matches reasonably well the institutional characteristics as suggested by theory and recorded in institutional-level and household data. The annual cross-sectional survey instruments for institutions and monthly surveys for households have questions concerning risk contingencies as in the risk-sharing literature, control over credit and credit-financed inputs as in Holmstrom (1979, 1982), Holmstrom

and Milgrom (1990), and Pandey (1998); control over assets and intertemporal borrowing and lending, in Atkeson and Lucas (1992), Green and Oh (1991), Phelan and Townsend (1991), Rogerson (1985), and Townsend (1982); interim communication as in Melamud and Reichelstein (1986) and Prescott (1995); costly state verification as in Townsend (1979), Gale and Hellwig (1985), and Bernanke and Gertler (1990); and renegotiation and renegeing as in Ligon, Thomas, and Worall (1956), Kocherlakota (1996), Fafchamps (1998), Coate and Ravallion (1993), Hart and Moore (1994, 1988) and a related and growing literature in finance. Townsend and Mueller (1998) offers a review of the theory and this list of characteristics, with a specialty questionnaire applied to cropping groups in one of the ICRISAT villa ges. Unfortunately, that institutional material cannot be joined with the ICRISAT panel. In Thailand, we remedy that deficiency.

Given the interest in the family and networks as endogenous institutions, the mechanism design literature has implications for the existence and use of "collective" institutions. Topics include screening as in Rai (1997), Ghatak (1998), Becker and Murphy (1994), and Varian (1990), internal risk-sharing as in Holmstrom and Milgrom (1990) and Itoh (1988, 1991), moral hazard and monitoring (Stiglitz (XXXX) and Banerjee, Besley, and Guinnane (XXXX)), and reallocation of labor across plot or technologies. Prescott and Townsend (2001) is one example of theoretical modeling making group formation endogenous. On the empirical side, the NICHHD Thai surveys continue to provide the measurement, with theory-driven questions asked of BAAC joint liability groups; for example, see Ahlin and Townsend (2001).

In summary, to return to the big picture, the proposed project uses theory, measurement, and analysis to add to our understanding of the welfare impact of the family and networks, and more formal alternatives. It seeks to innovate where feasible and appropriate on the theory side, and to use existing and new theories in the requisite measurement, in substantial, thorough, and large-scale surveys. Theory and econometrics are brought together where possible in the analysis of these data.

PROGRESS REPORT/PRELIMINARY STUDIES

The aims of the previously funded project can be abbreviated here: (1) to develop general equilibrium models and to study family in that context, (2) to derive implications for resource allocation and institutions,(3) to design and administer a household and community survey, (4) to work with Production Credit Groups (PCG's), the Bank for Agriculture and Agricultural Cooperatives (BAAC), the Community Development Department (CDD), and the Credit Union League of Thailand (CULT), and (5) to conduct tests of credit and insurance with respect to the family and networks, village institutions, the BAAC system, and joint liability groups.

Townsend (1995b) reports on the initial field research in northern Thai villages, noting great variation within villages by land class and variation across villages, with a hint that development may hurt indigenous arrangements. Nothing like the within-village panel nor the large cross-section of villages was possible at this stage, but this work played a key role in the vision of the eventual NICHHD-funded study. Village- and national-level organizations were also put on the agenda after this work. Similarly Townsend (1995a) used the existing Thai Socio-Economic Survey (SES) data to test for risk-sharing by counties, noting variation in results by region. Both these papers were written subsequent to the Townsend (1994) paper in *Econometrica* which used ICRISAT consumption and income data to test for full insurance, and has been awarded the Frisch Medal in 1998.

The ICRISAT villages of India were then used for a variety of prototype efforts, of interest in their own right, and also in preparation for the questionnaires and empirical tests of the Thai surveys.

The paper with Lim (1998) basically attacks head on the question of how households in these three Indian villages achieved something close to the standard suggested by a fully optimal allocation of risk bearing. However, even with models and ICRISAT panel data, one is left with puzzles and in search of transactions costs or other impediments to trade. The plan is to conduct in Thai villages these kinds of tests, document anomalies, and then go on to understand anomalies with additional theory and additional data (the initial Thai surveys already include measurement beyond ICRISAT). This strategy is the key to understanding the overall design of the Thai NICHHD surveys.

With Lim, the ICRISAT transactions and production files were used to create measures of the use of currency and crop inventory as well as changes in real capital assets, livestock, and net indebtedness. Note that some of these are self-insurance devices while others imply 'community' credit/insurance arrangements. An important advance in measurement came with the insight that (noisy) indicators of currency use could be created. Basically, the use of currency can be inferred from the transactions file, since a barter transaction enters the file as if it were two separate but simultaneous monetary exchanges. (The Thai data also carefully distinguish for each transaction monetary payment from payment-in-kind.) The use of crop inventory is inferred from lags between dates of production and dates of sale. (The Thai data do this and also keep track

of inventory separately). Purchases and sales of real capital assets and livestock and the all-important transactions involving insurance/credit/gifts are available from the transactions file directly (and measured in Thai data too.)

These ICRISAT asset data were used with the original monthly and the aggregated annual income/consumption data to answer the obvious questions: how do these Indian ICRISAT households do so well in smoothing shocks? The answer is as simple as it is striking: The risk sharing apparent in monthly and annual data is achieved by the buffer stocks of currency and crop inventory, also “community” institutions providing credit and insurance, but not at all by the purchase and sale of real capital assets and livestock. The buffer stock result complements the related analysis of Chadhuri and Paxon (1994). The use of credit and gifts lends support to the notion that households are not, however, entirely on their own but rather, are linked to one another. The nonuse of livestock and real capital assets contradicts the supposed underpinnings of Rosenzweig and Wolpin (1993). In the Thai data, we have income and consumption data and the use of all the mechanisms just enumerated. Again, the gap or deficit should be financed by one (or several) of these devices and a mean square error criteria can be used to determine which device or combination of devices tracks the best.

The paper with Lim goes on to use the asset, income, and consumption data to judge the goodness of fit of three models: complete markets or an equivalent set of institutions, exogenously incomplete markets, and endogenously incomplete mechanism design models with moral hazard. Regressions allow an inference of whether the smoothing of aggregate and idiosyncratic shocks was being accomplished by the asset in question. Much effort was devoted in the paper with Lim on replicating Zeldes’ (1989) tests of the permanent income and buffer stock models, essentially finding whether observed income was a significant variable in an Euler equation, in contradiction to permanent income theory. Also, earlier work of the mechanism design models of Ligon (1993) was used in this paper with Lim to sort households by whether they were more likely to be private information constrained or permanent income households and then to examine whether that stratification is related to the actual use of the various assets and smoothing mechanisms. Ligon succeeded, under stringent assumptions, in nesting these two models (and that too will be described in more detail in the methods section below.)

Still, by the more exact standards of full econometric tests and a priori plausibility, none of the models seems to represent a satisfactory abstract picture. The complete markets model and permanent income/buffer stock models do move us in the right direction, consistent with the ICRISAT data, but are rejected overall. The private information model fits much of the consumption data reasonably well, but it suggests a community control over assets which, though receiving mild support in the data, deserves further consideration.

Apparent in the ICRISAT data are salient facts which should be verified to be true (or not) elsewhere, e.g., Thailand, and used in subsequent model construction. The relatively rich tend to be high users of crop inventory, and these and other such users of crop inventory are more likely to pass full insurance, permanent income, and private information tests. The relatively poor tend to be high users of currency, but these and other such users of currency are more likely to fail private information if not other model tests. The villages display both barter and monetary exchange. While virtually all households have access to credit and insurance, the efficiency of the credit/insurance market varies by land class, is better for the larger holders, varies by village, and is worse for the more traditional village. These village economies also vary in their interaction with the larger national economy. (The Thai data naturally include variations in households by wealth, both within and across villages, and the Thai data cover many more villages -- for example, 48 villages in the annual resurveys (as now constituted) and 16 villages in the monthly panel. These villages and regions also vary in “development”, specifically in proximity to district centers and to Bangkok.

A companion paper of the PI with Rolf Mueller takes a mechanism-design approach toward understanding one salient village institution. A cropping group in the ICRISAT village of Aurepalle is an institution in which multiple tenants pool risk and resources and jointly farm the land of a single landowner under either a fixed- or share-rent contract. Typically, in a share-rent cropping group, the landowner himself will enter the tenant group as a fellow worker, often providing credit. Typically, in a fixed-rent cropping group, an outside financier will play an important role. This Townsend-Mueller paper utilizes specialty data, with the questionnaires on cropping groups and on a closely related spot market in bullocks, designed by the authors and implemented by ICRISAT. See Prescott and Mueller. We counted 13 groups in total, and 8 were picked for detailed monthly interviews throughout the 1990 Kariff (wet) season.

Some of these ICRISAT cropping groups consist largely of relatives, but even when they do not, the clustering of individuals into such “collectives” begs the issue of what groups can accomplish apart from individual members acting separately. As the family might be thought of in this way, the Townsend-Mueller

work is an important step in the direction of understanding one potential role of the family and extended networks. More generally, one can envision a coupling together of theory-driven institutional measurement with the more standard panel that ICRISAT represents. Unfortunately, the two ICRISAT databases were not integrated and do not overlap.

The major findings in the Mueller-Townsend specialty data are as follows. First, as theory might predict, sharecropping contracts have implicit and explicit risk contingencies. The landowners in share-rent contracts were understood by landowners and tenants alike to be willing to accept a lower share from crop failure due to drought, pests, diseases or low yield associated with low well water or electricity shortages. Landowners in fixed-rent contracts also have some contingencies, though groups with an outside financier said he was to be repaid in full despite losses.

Second, as theory might predict, credit-financed inputs and crop operations are sometimes under the control of a landowner or single outside creditor. In two of the share-rent groups with an active landowner and two of the fixed-rent groups with an single outside financier, the landowner or financier provides seed, fertilizer, micronutrients, pesticides, and in-kind wages and also was said to make most input decisions. One should not take for granted unobserved side exchange or unrestricted access to credit markets.

Third, as theory and the revelation principle might predict, interim plot and crop conditions are communicated to participating landowners and to outside creditors on a regular basis. Shocks such as human illness and the state of the plot at the time of planting, fertilizing, and weeding were reported, with the last conversations typically dated only days before the monthly interview.

Fourth, there is indirect evidence for information-incentive problems, and attempts to control them via costly state verification, in that there is physical monitoring of plot and crop operations by participating landowners. Despite prior agreements, these landowners were not always on the plot, consistent with the direct answers to questions on landowner absences and indirect inferences based on the use of permanent servants. Still, landowners almost always inspected the plot before and after operations, and often during operations. However, monitoring by outside creditors was rare.

Fifth, and related to communication and monitoring, ex-post information sets of participating landowners are close to but are slightly less accurate than the information sets of tenants throughout the cropping season. Tenants and landowners were in rough agreement also about the cause of problems: shocks due to nature, credit/inputs not available as if there were rationing or stock-outs, and problems with bullocks or limited household time. They were also in rough agreement about the impact on the timing of operations or on desired quantities or types of inputs.

Sixth, income risk, the risks of sickness and unemployment, and productive inputs all appear to be shared within groups. Sickness accounted for 25-31% of all tenant absences, but within limits ex ante agreements as to the sharing of profits (or losses) were not altered. Gifts and loans for food purchases and medical expenditures are recorded in the data. Of course, systematic econometric tests of risk-sharing in consumption and labor would be possible with panel data. This is not available for the tenant members of cropping groups as, again, the specialty data does not overlap with the standard ICRISAT panel. Group members tend to work together much of the time (except for those absences for illness, etc) and thus presumably have good information about one another. This according to the Prescott-Townsend formal model is what would allow them to enter into a group contract which, despite collusion against the landowner or creditor, is beneficial for all in risk and input reallocation. In such a model, groups are more likely when the shocks on individually operated plots (as in standard agency contracts) are independent, and this is consistent with the questionnaire responses on soil types and with actual physical measurements of the timing and extent of rainfall. (Rainfall and soil moisture are also being measured in the Thai project.) In such a model, groups are also more likely at extremes of wealth of the landowner relative to the tenants and with heterogeneity in wealth among tenants, and this is consistent with the observed large relative dispersion in landholdings and agricultural equipment in the database. In preliminary work, we observe this in the Thai data. See Ahlin and Townsend (2001) for details.

Seventh, owner-operated, single-tenancy, and group plots all coexist with each other. Insurance may be better within groups than across groups, or better for groups than for owner-operators, but in one alternative land-allocation model of Prescott and Townsend (Working Paper 1999), this insurance comes at a cost, and so the optimal allocation of land allows the coexistence of various arrangements. In fact, this alternative land-allocation model predicts that there should be more uniformity in wealth or assets within groups than across groups. The evidence in the ICRISAT data is consistent, with statistically significant fixed effects in land ownership across groups. That this evidence is inconsistent with the first model outlined above suggests that, in principal, the two models can be distinguished on this basis with sufficient data.

Eight, some landowners do pay close attention to intertemporal asset movements and debt positions of tenants, but some do not. Long-term relations seem governed in part by explicit intertemporal tie-ins, as suggested by explicit multi-period mechanism design models, but limited commitment, turnover and reputation also seem to play an important role.

As mentioned, the theoretical work with Edward S. Prescott (1999) has been motivated by these observations on cropping groups and earlier thinking about family networks in Thailand. It studies the boundaries and interactions of collective economic organizations that share risk and mitigate moral hazard. Organizations are identified with different characteristics of allocations. In one model, outlined above, the defining characteristic is cooperation or collusion. In another model, also outlined above, it is joint operation of a technology. Each type of organization is identified with a set of information and contracting possibilities. A mechanism design or agency problem is then solved to determine the optimal organization structure. Prescott and Townsend also extend their analysis to the larger general equilibrium context. While starting with small economies with a principal and two agents, the small economies are embedded into a larger economy with a continuum of agents and a finite number of agent types. Both the Pareto program to determine optimal allocations and a limited form of decentralization are used to analyze the latter economy. Equilibrium distributions of organizations are studied as a function of the underlying primitives. Again, the distribution of wealth is shown to be critical. See Prescott and Townsend (2001).

Related to Townsend-Mueller is the theoretical work of the Rai and Bond Chicago Ph.D. dissertations. Rai in "Efficient Audit Mechanisms to Target the Poor" (1997) combines costly state verification and implementation theory to predict the use of joint liability groups. Bond in "Joint Liability and the Structure of Financial Intermediaries" (1998) uses costly state verification and delegated monitoring to show that the intermediation contracts of the literature, e.g., Diamond (1984) and Krassa and Villimil (1992) can be dominated by tiered liability schemes in which banks go back and renegotiate with their client-borrowers before they bear the costs of renegotiation with client lenders/depositors. Perhaps networks function as do the groups and intermediaries of Rai and Bond.

Prescott-Townsend (1999), Townsend-Mueller (1998), Ahlin and Townsend (2001), Rai (1997), and Bond (1998) are making connections between institutional arrangements and data. The organizational structure is potentially quite rich, but for the most part the analysis is static. We are to imagine that the data are generated as if by a sequence of these static agreements. One step further is the class of explicitly dynamic models of credit regimes that generate panel data and the consequent econometric tests as in Lehnert, Ligon, and Townsend (1999). That is, one can take a guess at a credit regime presumed to be in place, using for example some of the institutional, contract description data, estimate the parameters of technology and preferences from cross-sectional and/or panel data, and then repeat the estimation for alternative regimes.

One issue settled in Lehnert, Ligon, Townsend (1999) is that the usual liquidity constraint question of many surveys -- namely "Is this household or business constrained in the use of a productive input due to limited access to credit at prevailing interest rates?" -- is a potentially bad proxy for the possibility of welfare improving interventions. If credit is part of a larger information-constrained incentive scheme, then input use may well be distorted away from the first best. But households and firms, in certain well-defined circumstances, may, at the true interest rate or opportunity cost of credit, desire to borrow more (or less) than the assigned level of credit. In other more constrained regimes, firms and households would say they do not want to borrow more (or less), but these regimes are decidedly suboptimal, though the magnitude of the loss does depend on parameter values.

More generally, Lehnert, Ligon, and Townsend (1999) established empirical methods that allow a researcher armed with enough data (and computer time) to estimate parameters and to distinguish regimes. Five multi-period contractual regimes are considered: (1) a full information, full insurance regime, (2) a so-called moral hazard credit-control regime in which a lender could restrict and control the use of credit-financed inputs but not labor effort, (3) a no-credit-control regime in which credit-financed inputs are at best recommended, (4) the latter regime but also precluding default (inability to repay principal and interest) and (5) a pure debt regime, but one allowing default. All five regimes are nested in the sense that each is a solution to a common optimization problem, a linear programming problem in which the appropriate constraints depend on the regime.

The dynamic steady state of each regime is computed numerically, yielding stationary cross-sectional distributions of consumption, output, and credit use and yielding transitions among households in these variables from one period to the next. These regime-specific histograms are then compared to each other.

Up to a point, the welfare ordering among regimes is as predicted. The Pareto frontier of the full-information regime Pareto dominates the moral hazard credit-control regime, which in turns dominates the

no-control regime with default, which in turn dominates the no-control regimes without default. The pure debt regime (with default) may not do well. It induces under some parameter values extraordinary fluctuations in the agent's consumption. On the other hand, it is not necessarily the worst regime. For other parameter values and in certain ranges of the agent's utility, it does better than regimes (3) or (4).

Again, one can generate data from a regime at specified parameter values as if it were the "truth", and then one can estimate regimes and parameter values using this data and the histograms generated by alternative regimes at all possible parameter values. The goodness-of-fit criterion is the mean square error criterion -- the sum of differences in the fractions of the population piled up at various states (or transitions). This abstracts away from finite sample size and measurement error, but allows one to address identification issues. An example technology illustrates that if the true regime is full-information and the guessed regime is either (2) or (4), then the risk aversion parameter is pinned within a fairly narrow interval but the parameters of technology can be way off. Similarly, if the true regime is (2) and the guessed regime is (1) or (4), then the risk aversion parameter is driven to extreme values, low or high, respectively (and technology parameters may also be off). Fortunately, the true regime at true values always does best. On the other hand, measurement error and small samples will compound the problem.

Pandey's 1998 Chicago Ph.D. dissertation and field research "Explicit and Implicit Contracts in North Indian Villages: Effects of Technology on Incentive Design" is related, using a principal agent model with effort and a productive input to estimate alternative technologies and alternative share-cropping arrangements, as one moves from less developed to developed regions in Uttar Pradesh.