FINANCIAL SYSTEMS IN NORTHERN THAI VILLAGES*

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Field research attempted to measure the risky environments, the information structures, the institutions, and the risk-response mechanisms of ten villages in northern Thailand. Various key features are then modeled in an abstract but realistic way, either with a full-information risk-sharing model or an information-constrained version of the same model. Observations from some of the villages seem consistent with one or the other of these models, but in many of the villages one is left with risk-response variations across households which suggest that Pareto improvements are possible.

I. INTRODUCTION

Field research attempted to measure the key features of the environments and the outcomes of ten poor, high-risk villages in northern Thailand. Various key features of the risky environments, the information structures, the institutions, and the risk-response mechanisms of these villages are uncovered. These features are then modeled in an abstract but realistic way, either with a full-information risk-sharing model or an information-constrained version of the same model. Observations from some of the villages seem consistent with one or the other of these models, but in many of the villages one is left with risk-response variations across households which suggest that Pareto improvements are possible. The paper identifies these villages and households along with the nature of the apparent inefficiency. More generally, the paper should be regarded as a prototype effort to integrate theory, measurement, and policy reform.

The key features discovered in this research effort are briefly enumerated.

1. The villages of the survey are poor, high-risk villages.
2. Sources of variation or shocks do not hit households uniformly.
3. Landholdings and household wealth vary enormously across households in a "typical" village.

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4. Responses to risk and income shocks vary considerably across household types in a given village.
5. There are apparent variations in farming practices across farmers, possibly even across farmers operating otherwise identical plots.
6. There are variations across villages in risk-response patterns.
7. Several of the villages display plot fragmentation.
8. There are variations in the adoption of new rice varieties.
9. There are variations in the existence and use of quasi-formal village organizations.

Are these facts consistent with the existence of a Pareto-optimal allocation of resources in the village or with a complete markets competitive equilibrium? At least one salient feature is consistent with the theory. Laborers and farmers are acutely aware of the risk in their environment and make efforts to smooth idiosyncratic and aggregate shocks. Still, the response patterns across households in many villages seem inconsistent with a Pareto optimum or complete markets equilibrium, although data on consumptions and labor supplies are needed for more precise tests.

Various private information models can be brought in to try to explain the anomalies. This is supplemented by direct efforts to measure what is or is not known in the villages and who is or is not communicating with whom. Although some of the observations are consistent with information as a constraint, the observations are also consistent with credit-insurance systems and the extent of information and communication both as endogenous.

The methods and conclusions of this research are related to some important contributions in the literature. Udry [1990] conducts his own field research in Nigeria and discovers risk contingencies in loan contracts and knowledge of local shocks. He argues that a complete markets equilibrium might be achieved with local credit institutions. Aleem [1990] sets out to measure directly what local lenders know about their borrowers in the Sind area of Pakistan. He documents that information is far from perfect and that borrower selection and monitoring can be quite costly. In micro level research anthropologist Wade [1988] uncovers enormous variation in organization and legal systems across nearby villages in southern India. He argues that institutions arise where they are most needed, in the most risky environments, but seems to suggest at times that the poor have difficulty organizing without the cooperation of the rich. Similarly, Hirsch [1990] takes

issue with the idea that villages are either well-organized collective entities as in Scott [1976] or individualistic and possibly inefficient as in Popkin [1979], studying in detail two villages in Thailand's western region.

Finally, economists Siamwalla [1991] and Siamwalla et al. [1990] have studied rural credit markets in Thailand. Siamwalla suggests that information may be complete at the village level, at least for local money lenders, although this information might be acquired at a cost. On the other hand, Siamwalla suggests that informal interest rates are high, not because of the absence of externally supplied credit, but because outsiders cannot acquire local information. Siamwalla concludes that "the key to successful government intervention in rural credit is institution building that is innovative and efficient in tackling the information problems involved in lending." This paper also identifies information as a potential constraint, but the picture is not uniform within villages and across villages. Efforts at policy reform need to take this variety into account.

This paper proceeds as follows. Section II describes the field research and statistical nature of an iterative theory-measurement-conclusion-theory process. Section III describes the environment of a more or less typical northern Thai village. Section IV takes the theory of an optimal allocation of risk bearing to that village and describes various apparent anomalies. These constitute one apparent "stylized fact." Section V describes a second apparent stylized fact: variations in institutions and outcomes across adjacent villages. Section VI describes a third apparent stylized fact: the decline of local insurance with entry into the larger market economy. Section VII modifies the theory to include private information and incentive problems and reexamines the anomalies relative to what households (or a central planner) might know about one another. This section also reports on efforts to document common or disparate data information sets by direct measurement. Finally, Section VIII offers conclusions and suggestions for further research.

II. Methods and Field Research

Unlike most empirical papers this one does not start with a well-defined data set and proceed to test a well-defined theoretical prediction. Instead, the paper reports on a process, starting with an initial hypothesis, moving on to data collection, going through a

number of steps refining the theory and finding data relevant to the theory, and ending up with an evaluation of the factors leading to a good financial system. In this sense, the research is close to the field research that some agricultural economists do, except that the economic theory being evaluated here is relatively sophisticated: the theory of general economic equilibrium and the theory of mechanism design. The paper is as much about this process of research, and the good that can come from it, as it is about tentative conclusions on the financial systems of northern Thai villages. The more standard empirical approach, theory-data-test, should be more fruitful when integrated with this kind of "pilot." Specifically, the tentative conclusions that are drawn here could be regarded as null hypotheses to be tested from a larger survey, as in the work of Udry [1990] and Morduch [1993] on risk sharing. More specifically, Section IV here is replete with apparent alternatives to the full risk-sharing hypothesis, almost all of which could be tested with sufficient data.[1]

This field research was carried out over a period of eighteen months, with various degrees of intensity. The first stage in the summer of 1989 consisted of site selection and the design of two questionnaires. The sites selected were judged to be poor and to be risky, that is, with low levels of income and erratic crop harvests due to erratic rainfall if not to diseases and pests.[2]

The three "counties" or amphoes selected were Maajam and Omgoi in Chiengmai province and Lee in Lampun province. Numerous trips were made to each of these areas. In each area an

1. The current paper is not the appropriate forum for a full discussion of the methodological issues involved with nonrandom sampling or the interactive process of observing, theorizing, and testing. Suffice it to note here that the fieldwork has both the strengths and weaknesses of "rapid appraisals" or other techniques that lie *between* informal modes of data collection which rely on intuition, experience, and common sense, on the one hand, and formal data collection methods such as cross-sectional longitudinal sample surveys, censuses, and experiments, on the other. See Kumar and Casley [1992], especially Chapter 1, for an excellent discussion of these issues. The major weakness is that these intermediate methods "do not generate data from which generalizations can be made for a whole population." The major strengths of these intermediate methods are that they can be carried out quickly at relatively low cost by limited staff and they "provide flexibility to the investigator to explore new ideas and issues that may not have been anticipated in planning the study, but that are relevant to its purpose." See also Deaton [1994] and Casley and Lury [1981] for extensive discussions of data collection in developing countries.

2. This information was obtained from researchers at Payap University and Chiengmai University as well as from Thais involved in charitable organizations and army officers familiar with the area. Data from the Thai Socio-Economic Survey (SES) were not available to the author at the time of site selection, although this would be used to judge levels of poverty and income if efforts were continued in the future. Rainfall data were used to a limited extent.

attempt was made to pick three villages: one near the district center, one in a more outlying area, and one midway between.[3]

On a given trip to a given village this researcher and primary research assistant would try out some preselected questions and then add to this set in informal conversations with village residents at various income levels. These original and additional questions were then modified, based on perceived accuracy of responses, the amount of information obtained, and the effort and time needed to acquire it. This led in the end, after six iterations, to two separate questionnaires.

The first, the household questionnaire, gathers some asset and demographic information about the family, but its main intent is to measure the size of fluctuations in crop harvests or income and to find out how the household responded to these fluctuations.[4] The second, the plot questionnaire, solicits information on crop fluctuations and production, restricting attention to farmers.[5]

Both questionnaires seem to work well in practice. Farmers

3. Information on villages was gathered from district officials, specifically agricultural extension officers. Attention was restricted to Thai villages, as opposed to hill tribe villages; the latter get far more attention from the Thai and international donor community.

4. Specifically, the household is asked to pick the best and worst years in the last five; to name the years; and to give the amount of the harvest or labor income for those years. The household is then asked how it responded. The various possibilities include carryover of rice from good years to bad years; buying livestock and other assets in good years or selling these in bad years; working harder in the labor market or elsewhere in bad years; getting help in gifts or loans from friends, relatives, or organizations; or selling crops for cash and carrying this over to bad years. Under each response category is a series of more detailed questions attempting to document and quantify the response. There is also a separate section in the questionnaire on incidents of illness with possible adverse consequences for remaining household members. There is also a section that asks the given household if it is able to document the fluctuations of another household and how that household responded. Finally, there is a section that covers any possible use of village or district financial organizations. This structured household conversation, following the questionnaire, takes from one to one and a half hours to administer. (Subsequent to the design and administration of the survey, this author discovered Naponen [1990] who evaluates the Working Women's Forum of Madras along retrospective, risk-response lines.)

5. The farmer is asked to recall the best and worst year in the last five, naming the years and the amount of the harvest. The farmer is also asked to rank rain, diseases, and pests as sources of any fluctuations. In addition, the farmer is asked detailed questions about the number, size, and characteristics of land plots; benefits and problems of having spatially separated plots, if any; and types of seed and the adoption of new varieties, if any. There follows a rather long section that chronicles exactly how a particular crop and plot was farmed over the last season, with detailed questions on planting, weeding, and harvesting; on the use of pesticide, herbicide, and fertilizer; and on problems with water, pests, and the timing of operations. There is also a section that asks the farmer to compare his plot to one of another farmer nearby, and a section that asks the farmer whether he knows about the crop operations of such nearby farmers, of any friend, or of any relative. This plot questionnaire takes about one hour to administer.

enjoy talking about how they farm their plots and appreciate that the investigator is taking an interest. The more difficult household questionnaire is focused on a particular question—responses to fluctuations—and does not attempt to directly solicit detailed information about income. (Estimates were attempted ex post, but as is apparent, these are quite noisy.) No attempt is made to measure consumption with the exception that households were asked whether their consumption dropped in a bad year. Both incomes and consumption could be better measured in an altered survey along the lines of the Thai Socio-Economic Survey (SES).

In the second phase of the project, in the fall of 1989, these questionnaires were administered to households in ten villages, four in Maajam, and three each in Omgoi and in Lee.[6]

The third phase of the project began in the summer of 1990. The completed questionnaires were read one at a time, searching for possible patterns. In the end sketches with data summaries were prepared for each village.

The final stage in the winter of 1991 consisted of return trips to the villages.[7]

III. The Environment of Yang Pieng

In a Thai village such as Yang Pieng one must dismiss the image of a village consisting of typical households, all more or less the same. Among the ten household survey respondents, for example, there are three with no land at all and two with two rai (a

6. The target number of households was 5 percent of the households of each village for each questionnaire. In some villages this target was not met, in one instance because one village was in fact two separate villages. In most villages the number of household questionnaires fell short of the number of plot questionnaires. Finally, household participation was solicited by the headman at least one week in advance of the arrival of the enumerators, but participation was voluntary. The sample of households in each village is sometimes too small and may be biased. In particular, one might imagine that households more closely connected to the headman were included, and the extent of this bias might vary across villages. Since measurement of "connectedness" is a primary goal of the research project, this is a potentially grave problem. It could be remedied by committing to stratified random selection as in a larger survey. As it stands, the interviewed households are grouped into commonly observed cases.

7. In six of these we stayed for three to four days, living and eating in the house of the headman, or in two instances, in the house of the assistant headman. This was an opportunity to check on the village summary; fill in missing information; interview several more households on an informal basis; and to acquire detailed information from the headman or the relevant committee on the functioning and use of investment funds and other community organizations. These institutions attracted increasing attention as the research progressed. Unfortunately, the survey was not designed with evaluation of these institutions in mind. This could also be remedied in future efforts.

TABLE I
PLOT CHARACTERISTICS: YANG PIENG

House-hold code	Land-holdings (in rai)	Distance and direction from village	Commuting time	Crop (wet season only)	Soil type	Slope	Upland/ lowland	Irrigation status
P-35	5	S	2 Hrs.	Rice	Bad	Slight	Paddy	Rain-fed
P-36	7	2 Km N	—	Rice	Bad, sandy	Slight	Upland	Rain-fed
P-37	3	300 m S	5 Min.	Rice	Bad	Slight	Paddy	Rain-fed
P-38	3	2 Km S	1 Hr.	Rice	Bad, sandy	Slight	Paddy	Rain-fed
P-39	5	2 Km N	—	Rice	Bad, sandy	Slight	Paddy	Rain-fed
P-40	1	500 m E	15 Min.	Rice	Ok, sandy	Slight	Paddy	Stream
	1-1/3	600 m E	15 Min.	Rice				
P-41	5	4 Km S	1 Hr.	Rice	Good, black clay	Flat	Paddy	Stream
	3	4 Km S	1 Hr.	Rice	Ok, sandy	Slight		Stream
P-42	4	1 Km N	1 Hr.	Rice	Good, bad	Flat	Paddy	Rain-fed
	3	500 m S		Rice				
P-43	9	2 Km S	1/2 Hr.	Rice	Ok	Flat	Paddy	Stream
	9	4–5 Km E		Rice				
P-44	8	1 Km N	15 Min.	Rice	Bad	Slight	Upland	Stream
P-45	4	1/2 Km N	10 Min.	Rice	Ok	Slight	Lowland	Rain-fed
	5	4 Km S		Rice				
P-46	3	1 Km N	30 Min.	Rice	Ok, sandy	Flat	Paddy	Stream
P-47	7	4 Km SE	1 Hr.	Rice	Ok, sandy	Flat	Paddy	Stream
P-48	5	S	15 Min.	Rice	Bad, sandy	Slight	Paddy	Rain-fed stream
P-49	5	1 Km S	10 Min.	Rice	Bad	Slight	Upland	Stream
P-50	5	3 Km S	1 Hr.	Rice	Ok	Slight	Paddy	Stream

rai is a unit of land equivalent to two-fifths of an acre). In contrast, there are two households with 25 and 10 rai, respectively, and one more with 4 rai (there are other "middle-level" holders). Landholdings are correlated with crop income, and one suspects with status in the village. Total income inclusive of labor earnings partially overturns this correlation, and adjustments from family size seem to wipe it out altogether. As noted, however, the survey was not designed to accurately measure levels of income. Thus, we shall continue to refer to large landholders as relatively wealthy (see the earlier working paper [Townsend 1993b, Table 2B]).

Households do not necessarily hold all their land in one spot (see Table I). Of the sixteen plot respondents in Yang Pieng, eleven hold one plot only, but five hold two. Furthermore, land plots vary by size, from one to nine rai; by distance and direction from the village, from one half to four kilometers; by commuting times, from five minutes to two hours; by soil type, from bad and sandy to good

black soil; by slope, from flat to land with a slight slope; by elevation, that is, paddy versus upland; and by irrigation status, rain-fed versus stream-fed. On the other hand, all sixteen plot respondents report rainy season glutinous rice as their principal crop, and much of this is for subsistence, that is, for home consumption (see below). Tomatoes are an emerging cash crop in Yang Pieng, but this fact was not picked up in the survey.

Despite apparent uniformity in crops, there is great variation in the use of rice varieties. Eleven out of the sixteen plot respondents mentioned a combination of traditional Muenong with new varieties, for example, rice from a crop institute, Sampatawng, or Mali rice. Five of these respondents use all three varieties together. Mean yields on new rice varieties are said to have increased by 80 to 100 percent from traditional varieties, but all those who adopt are explicit that it is risky to rely on only one kind of seed.

Otherwise, farming is relatively simple in Yang Pieng. Use of herbicides and pesticides is rare; fertilizer is occasionally mentioned. Local tractors (motorized tillers) are rented within the village; most mention of "hired" labor is exchange labor. Apparently, inputs and outputs can be bought in a district town about twelve km away. Rice is valued at 30 baht per tang (the term tang meaning basket is a standard unit of measurement equivalent to twenty liters. There are approximately 25 baht to one U. S. dollar). Fertilizer can be bought at 28 baht per bag, a tractor can be rented for 700 baht per day, and so on. Below we shall ignore transportation costs and act as if the village has perfect access to outside markets at fixed prices.

Output (and income) from rice production is not stable. Rather, there is great uncertainty on two dimensions; see Table II. First, the extent of fluctuations is large. The average difference between good and bad years in the last five is about 60 percent. Second, good years and bad years are not coincident across farmers. In fact, occasionally farmers will trade places, for example, with 88, 86 a good year, bad year sequence for one farmer replaced by 86, 88 for another. More generally, 6, 2, 2, and 2 farmers claim 88, 87, 86, and 85 as their best year while 2, 2, 6, 2, and 1 claim 88, 87, 86, 85, and 82 as their worst year. There is some tendency for recent years to be best years, but this is not uniform in the sample. (Incomes of northern Thai farmers have increased on the average of 6.3 percent per year from 1975–1988 according to Thai SES data.)

The implications of this risk are twofold. First, there would

TABLE II
FLUCTUATIONS IN HARVEST YIELDS: YANG PIENG–RICE (IN TANG)

Household code	Best year	Harvest amount	Worst year	Harvest amount	Fluctuation in percent
P-35		100		60	
P-36		250		100	
P-37		150	1986	40	1.16
P-38	1988	100	1986	60	0.50
P-39	1988	120	1986	70	0.53
P-40	1985	420	1987	240	0.55
P-41		300	1985	200	0.40
P-42	1988	115	1986	50	0.79
P-43	1987	450	1982	250	0.57
P-44	1987	120	1988	80	0.40
P-45	1988	180	1986	100	0.57
P-46	1988	70	1984	50	0.33
P-47	1986	255	1987	180	0.34
P-48	1986	150	1988	70	0.73
P-49	1988	130	1985	70	0.60
P-50	1985	250	1986	100	0.86

seem to be an enormous need for each farmer to smooth fluctuations in some way; otherwise, consumption would have fluctuations. Second, because fluctuations are not uniform in years across farmers, there seem to be ample possibilities for smoothing across farmers in a village in a given year, that is, for some kind of informal or quasi-formal community insurance system. We shall come back to this in Section IV below.

As to the cause of fluctuations, fourteen out of seventeen farmers in Yang Pieng list water as the dominant problem, two list insects, and one lists plant disease; see Table III.[8] Yet water problems are not uniform. Some, but not all, say there can be too much water in a good year, and some, but not all, say there can be too little water in a bad year. It seems variation of slope, the upland-lowland status of plots, and water flows in mountainous areas can cause variations in performance over plots even if the rainfall is uniform. Meanwhile, diseases and pests are listed explicitly as secondary or tertiary sources of variation, but the

8. The response "used fertilizer" is, of course, not a source of fluctuations. It is indicative of the potential productivity of some inputs and the potential for growth. One cannot clearly separate growth from fluctuations with retrospective questions.

TABLE III
SOURCES OF FLUCTUATIONS: YANG PIENG

House-hold code	Rank order of risk source			Why good year	Why bad year	Too much water in good year (how many years)	Too little water in bad year (how many years)
	Water	Crop disease	Insects				
P-35	1	2	3	Rain	Rain	Yes—1 year	No—1 year
P-36	1	2	3	Rain	Water	No	No
P-37	1			Rain	No water	No	No—1 year
P-38	1	2	2	Good water	Not enough water	Yes—each year	Yes—each year
P-39	1	2	3	Water	Insufficient water	No	No—1 year
P-40	3	2	1	Water	Insufficient water	No	No—1 year
P-41	1	2	3		Dry	No	Yes—almost every year
P-42	1	3	2	Using fertilizer	Lack of water	Yes—almost every year	Yes—every year
P-43	2	1	1	Rain	Disease	Yes—2 years	Yes—2 years
P-44	1	2	2	Water	Not enough water	No	Yes—5 years
P-45	1	2	2	Rainfall	Not enough rain	No	Yes—3 years
P-46	1	2	3	Water	Not enough water	Yes—1 year	Yes—1 year
P-47	1	3	2	Good water	Disease	Yes—1 year	Yes—almost every year
P-48	1		2	Rainfall	Rainfall	No	Yes—1 year
P-49	1	2	2	Water	Not enough rain	No	Yes—every year
P-50	1	2	2	Rain	Insects	Yes—2 years	Yes—3 years

effect of either can be devastating in a particular year for a particular household.

Farmers with two plots in Yang Pieng can identify mean yields as higher on one plot than another, due perhaps to variation in land quality. More to the point, yields are said to go up and down together, so risk diversification appears not to be the motivation. Still, farmers complain about within-day commuting times and inattention to plots. Benefits, other than risk diversification, which might account for fragmentation and counterbalance these costs, remain to be found.

From this description of farming practices and outcomes in the village of Yang Pieng, one can write down in explicit notation an agricultural production function for each type of plot, mapping labor, fertilizer, and other inputs at a given season or date into rice output at a subsequent harvest date as a function of idiosyncratic

and aggregate shocks. One thus has costs in one season and gross revenues in another (see Townsend [1993b, equation one, p. 11]).

Livestock can be a source of income for some farmers in addition to farming. Pigs are bought at prices ranging from 300 to 600 baht and sold at prices from 900 to 1500 baht, with higher prices for older, more mature animals. Pigs require some upkeep in terms of feed and labor, although numbers were not obtained in the survey. All four landless and small landholders buy and sell pigs in amounts ranging from one to two animals. The livestock holdings of these farmers are similarly small. Among the three larger landholders, though, two buy and sell three pigs each year, and one mentions five head of cattle. On the asset side these same farmers hold from 1 to 4 pigs and 4 to 57 head of cattle, much larger numbers than indicated in the flows.[9] Again, one has costs at one season and revenues at another. But net purchases (or sales) at a given date contribute to variations in net earnings at that date. This, of course, allows households to sell and receive revenue from livestock when other sources of income are low. Whether or not this is done is something the survey attempts to measure.

The members of a typical household in Yang Pieng can be thought of as endowed with time that can be used for leisure and for various production activities. Among the latter, one would include some work in the local village economy or the local district economy, at wages of 30 to 35 baht per day. This kind of labor supply seems to vary over households depending on the household's holding of land. For example, landless laborers seek full-time employment out of the household all year. For others, labor employment can be an important source of income in the dry season. In Yang Pieng, with virtually no within-village dry season crops, many households are not present in the village in the dry season. They have migrated to Chiengmai for construction at wages of up to 50 baht per day. Dry season labor income may smooth what otherwise would be seasonal variations in income and consumption (see Paxson [1993]).

Out-of-household employment is neither regular nor predictable, however. One shock to labor supply is sickness. This can

9. Again, one can write down livestock production functions mapping animal types of given ages along with labor and other inputs at a given date into more mature and valuable animals at a subsequent date, subject again to idiosyncratic and aggregate shocks (see Townsend [1993b, p. 15, equation (2)]). Consistent with neoclassical analysis, this function is assumed to have constant or diminishing returns to scale, although in some data there appear to be increasing returns over the early ranges of output; see McIntire et al. [1992].

reduce an individual's time endowment or draw members of the household who would otherwise work into health care activities. In Yang Pieng two of ten household respondents claimed an incident of sickness in the last five years which lowered household income substantially.

In principle, demographic shocks such as births, deaths, marriages, and migration can induce changes in a household's consumption requirements and labor supply possibilities. Due perhaps to ambiguously worded questions, the survey was not successful in determining the effects of such demographic events nor in tracing out potential networks of friendship and assistance to which a given household might have access.

In addition to "regular" labor market activity, one should stress also employment and income-generating activities associated with northern Thai forests. Some households in Yang Pieng note additional income from gathering bamboo and mushrooms. More generally, illegal logging can be a source of income, although this is increasingly difficult in the face of increased enforcement by forestry officials. One can of course model production in the forest as a source of income in bad years.

In addition to variations in livestock, labor supply, and forestry activities, there are other mechanisms for smoothing income. One of these is storage of rice. There are households in Yang Pieng who begin to store rice at the harvest date of the rainy season. Not a small number run out of rice from two to twelve months after harvest. Some households in a good year make it to the next harvest, that is, have carryover, and a few households may sell rice at harvest or sell out of stocks. But rice storage is not costless. Households in Yang Pieng note a loss of rice due to rats and mildew, on the average of 3.2 percent per year.

A typical household can also transfer resources to the future by saving. Yang Pieng has access to a somewhat distant savings bank with nominal rates of interest of 12 percent per year (at the time of the survey). An alternative of course, is to store cash and incur losses due to inflation, estimated at 9 percent per year during the years prior to the survey.

In contrast, Yang Pieng has virtually no place to borrow outside the village, neither from the Bank for Agriculture and Agricultural Cooperatives (BAAC) nor from an Agricultural Cooperative. Also, there is little provision of insurance from outside the village. An exception concerns a recently established health care and insurance plan. Under this, households contribute premiums

payable in advance, and these entitle households to a specified number of "prepaid" treatments for sickness during the year. More on this momentarily.

One can also include in this description of the environment several of Yang Pieng's more prominent internal, village-level institutions. These include a rice bank, a housewife fund, and the health care fund just mentioned.

The rice bank was established by an initial outside donation of rice several years ago. The interest rate for one-year loans (or less) is 50 percent per year for first-time borrowers and 25 percent thereafter, with five for every 20 tang due in interest at harvest time. There is also a housewife fund under which periodic, regular savings are funneled to the outside savings bank. Meanwhile, externally provided funds from a YMCA in Chiengmai are re-lent to members in the village at an interest rate of 2 to 3 percent per month. Finally, within-year premiums from the health care fund are recirculated within the village, one portion for lending for herbicide, a second portion for emergencies, and a third portion for health and sickness. Loans are granted under the first two purposes at 2 percent per month, eagerly absorbed by willing borrowers.

IV. Taking the Full-Insurance, Full-Information, Full-Commitment Model to Yang Pieng

To begin, consider the three larger household respondents in Yang Pieng. Each has current year income in rice of 340, 600, and 200 tang, from 25, 10, and 4 rai, respectively. The difference between good and bad years is 190, 450, and 40 tang, respectively, confirming large if not extraordinary fluctuations. The principal response of two of the three is to sell livestock, and in fact all three have herds of buffalo ranging from 4 to 30 animals, as well as pigs. One of the households lists storage as a secondary response, and in fact all three have carryover after a good year. Two of the three run out of rice in a bad year, after ten to eleven months, relatively late, and one household never buys rice at all. Indeed, two of the three sold some rice in the current year. Only one of the three lists working harder as a response. None of the three larger farmers got help in gifts or loans during bad years, neither from friends and relatives nor from a village institution. One household head did lend 20 tang to his mother in his best year, however.

One can compute from the questionnaires the net inflows from

storage, livestock sales, and so on in the bad year, and net outflows to savings of various kinds in the good year. These are no doubt measured with much error. Still, one can see whether net inflows in a bad year or net outflows in a good year are equal to half of the measured fluctuation in income. If this were true, then a given household may be said to have the capability to keep consumption steady. This was not true of any of the relatively rich households surveyed in Yang Pieng.

Now suppose that the three households, or a larger group of which they are supposed to be representative, were solving a programming problem of maximizing weighted sums of utilities subject to a resource or adding-up constraint on household consumption. This delivers a Pareto optimal, full risk-sharing allocation for the group. As is now well-known, it has the property that weighted marginal utilities should be equated with a common Lagrange multiplier. That is, ignoring shocks to preferences or other demographic shocks, household consumption should be determined by group average consumption. Beyond the aggregate risk captured by group average consumption, household consumption should not move with household income. (See Abel and Kotlikoff [1988]; Altonji, Hayashi, and Kotlikoff [1992]; Altug and Miller [1990]; Cochrane [1991]; Deaton [1990]; Mace [1991]; Townsend [1994]; Rashid [1990]; and others.)

From the data it appears that a relatively rich household's consumption tracks its own income. For this to be consistent with an optimum within the group, household incomes would have to be moving together. That way, consumptions would be moving together. However, the survey data also indicate that good and bad years are not coincident across these households. The inference, then, is that consumptions do not comove and that the allocation of risk is not Pareto optimal. In order for these relatively rich households as a group to achieve a Pareto optimum within the group, households would have to be linked up to one another by gift giving or some other mechanism allowing cross-member reallocations. Storage and livestock transactions on their own are not sufficient devices to achieve a Pareto optimum within the group.

A similar but not identical analysis applies to the relatively poor. As noted earlier, four household respondents in Yang Pieng get their basic income in rice from either small landholdings, e.g., two rai, or from labor income. The four list their current income at 104, 100, 70, and 50 tang, respectively. The difference between their best and worst year is 24, 20, 0, and 50 tang. Thus, all but one

of these small, lesser households experienced fluctuations on the order of 20 to 40 percent. The claimed principal response to these fluctuations by all but one household of the group is to work harder. Three of the four list hunting for plants in the woods as a secondary response. Two list getting help in gifts and loans as a secondary response. Actually, all four borrowed in their worst year, either from relatives or from the rice bank or housewife fund. These loans ranged from 20 to 45 tang in rice, or 300 to 500 baht. Two of the households acknowledge lending to relatives in their best year, from 100 to 500 baht (at 0 and 2 percent interest per month, respectively). (Conversations in the village confirmed that some households go first to relatives for help. Yet others go only to one of the village institutions.) Borrowing and lending alone would appear to be enough to cover at least half the income gap, sometimes more than enough.

If these lesser households were solving a programming problem for the determination of Pareto optimal allocations within the group, household consumption would comove at most with group average consumption. Because it appears from the survey that there are enough mechanisms for households in the group to smooth consumption completely, the inference is that the consumption allocation may be Pareto optimal. Individual and group average consumption may be steady.

However, the allocation of work effort (leisure) may not be Pareto optimal even among households within the group. If these relatively poor households are working harder in their bad years, and bad years are not coincident, then leisures are not comoving. Again, the solution to the Pareto problem for the group would predict that weighted marginal utilities of leisure should be equated across all individuals, and this implies (apart from shocks and binding corners) that leisures should comove. This holds as well if leisure and consumption both enter the utility functions nonseparably. There are measurement problems, however. None of the relatively poor are actually able to document differences in days worked in good and bad years. When asked in detail, they say they work harder every year, although this question may have been posed inappropriately.

If we consider the larger collection of households constituting the village economy, that is, the relatively rich and the relatively poor together, then there is further evidence against an optimal allocation of risk bearing. Specifically, if the relatively poor have stabilized consumption, while the rich have not, then the poor

should be induced to coinsure some of the residual aggregate risk. Again, apart from special cases of risk neutrality, everyone's consumption should comove. Similarly, if the relatively poor were not to have stabilized labor supply, even as a group, then the relatively rich should be induced to work harder in bad years. That is, being better off, the relatively rich may work less hard on average, but they should share fluctuations in labor supply in some proportion. Apparently, one needs to modify the theory to include some fixed costs to labor supply, perhaps to out-migration, which might keep the relatively rich above some threshold.

All four of the smaller households hold livestock, although three of the four have pigs that they claim to buy and sell in equal numbers every year. Only one of the four has rice in carryover after a good year, and all four run out of rice in a bad year, at 4, 8–9, 9, and 5–6 months after harvest, respectively, relatively early. Thus, some have rice to get through the subsequent dry season, while others may get partway through the subsequent rainy season. None reach the next harvest.

That relatively poor households do not smooth income fluctuations with asset transactions is not necessarily inconsistent with an optimal allocation of risk bearing. Suppose, for example, that the entire village were to pool resources and face a common villagewide budget constraint with the outside district economy. This would happen if either the village were solving collectively a Pareto problem or there were complete markets. Then it would be as if all consumption goods and inputs were purchased in the district market and this use of funds were balanced with receipts from outside labor supply and from net profits from crop, livestock, and forestry activities. Any gaps or deficits would need to be financed with livestock sales, with rice carryover, or with currency decumulation. In this case, in a Pareto optimum, every household's weighted marginal utility of consumption at any date and history of states would be equated to a common Lagrange multiplier so that households' marginal rates of substitution over states are all equated with one another, as would be natural under full insurance. The common Lagrange multiplier is the shadow price on the balance-of-payments constraint; that is, a common marginal utility of income times the external price of consumption. Similarly, in a Pareto optimum every individual in every household would have a marginal utility of leisure at any date and history of states that would be equated with a common shadow price on the balance-of-

payments constraint times the wage (see Townsend [1993b, p. 24; equations (16) and (17)]).

Thus, all asset transactions should equate the common marginal utility of income this year with the expected marginal utility of income next year. That is, consider any household that might take income this year and purchase rice for storage, purchase livestock as investment, invest in a savings account externally, or hold income as currency. The return next year would then be the random return to depreciated rice storage, the random but positive yield on livestock sales next year, the guaranteed (nominal) return on the one-year savings account, or the depreciated (real) value of currency next year. All households that engage in these transactions should drive present costs into equality with expected future returns, with the exception that current year assets may be driven to zero, in which case there is an obvious inequality.

The point is that *any* household using these "storage" technologies faces *common* costs and returns, so storage and asset decisions separate from household consumption and leisure decisions. This is, of course, nothing other than the usual neoclassical separation theorem. (See Krishna [1964] for a more extended discussion in an agricultural context.) Households may be assumed to maximize income first and then to maximize utility subject to an enhanced budget line second. Indeed, the model makes no prediction whatever about who is doing the storage. Everyone need not engage in storage and asset transactions. The underlying presumption, however, is that all households are linked up to one another either via risk sharing and credit networks or via markets. The relatively poor respondents of Yang Pieng are all linked to local loan markets via savings and borrowing, so in principle they have access to the storage being provided by others. That is, in a bad year they may borrow from this storage, and in a good year invest in storage. The lenders themselves may view storing and lending as alternative means of smoothing. However, this analysis does require that the relatively rich and those engaged in asset transactions also be engaged in credit markets, and in Yang Pieng this may not be the case unless the interviewed, relatively rich households were concealing their lending activities.

In summary, part of the case against the predictions of the theory is the apparent absence of a village mechanism to intermediate funds from the relatively rich to the relatively poor. One farmer in the village informed us that eleven or twelve larger landholders were still involved in personal lending. The sampling scheme here,

unfortunately, was not designed explicitly to include or scrutinize lenders, and in practice the existence and identity of lenders can be hard to determine. Still, suppose that the number of lenders in Yang Pieng is as high as twelve. From tax records held by the headman, we determined the number of households with landholdings over five rai. Among these there are 35 holders with at least ten rai and 86 more with between six to ten rai. It thus seems unlikely that all three of the interviewed relatively rich households of the survey here, out of 86 to 121 possibilities, represented one of the twelve lenders. None may be lenders, in fact, and if so the lack of intermediation from rich to poor remains an apparent fact.

From the point of view of village aggregates, villagewide storage and savings levels appear anomalous. As noted, all asset returns should be driven to equality with costs, apart from binding corners. Yet some of the relatively rich are saving funds in a nearby district town at 12 percent per year. At the same time there is not a small amount of year-to-year storage of rice in the village, held either by individual households or by the village rice bank. Again, rice depreciates in storage at 3.2 percent per year on average, while inflation has run at 9 percent per year on average in years prior to the survey. So the theory as it stands seems to predict one form of savings, presumably outside lending. Transactions costs, trips to the savings bank, and great uncertainty in relative and nominal prices are needed to explain away the anomalies. (Rates of return on livestock transactions were not calculated, unfortunately.)

Internally, in the village the rice bank as an institution offers nominal year-to-year returns. That is, rice bank loans can be rolled over at harvest time, with payment of the principal deferred up to two years. An additional loan can be taken if interest is paid on the first, but loan privileges are suspended beyond two years of deferral. Further, there is some provision of insurance. If there is an insect problem, flooding, a bad crop year, or fire in a private residence, then the terms of the loan can be modified, including the provision to charge interest. This scheme resembles the insurance indemnities predicted by theory and is of potentially great importance.

The interest rate on simple year-to-year rice bank loans within Yang Pieng should equate current costs to expected future returns using the previously described common marginal utilities of current year and future year incomes. That is, the internal village-level shadow price on consumption loans should be equated with the external, district-level price. As it stands, internal rates of

interest of at least 20 percent per year are too high (unless villagers are constantly anticipating great appreciation in the relative price of rice). Put another way, households who currently save externally should on the margin save in the rice bank (if it were permitted) or lend money locally at what must be a high internal shadow price. For that matter, outside investors should be attracted to Yang Pieng's high internal rate of return.

Insurance premiums and indemnities may partially explain the anomalies. The relatively high rate of interest may reflect two pieces: one is the return on simple, year-to-year loans; and the other is a premium payable in arrears, a premium entitling the holder of a loan to the indemnities described earlier.

Within-year transactions in Yang Pieng are subject to a similar analysis. Simply extend the model described above to distinguish seasons within years, e.g., wet and dry seasons. Then, marginal utilities of consumption and leisure should be equated with common Lagrange multipliers times prices, season by season. The village would also have a season-by-season balance-of-payments constraint.

This makes some within-year asset and labor supply transactions anomalous. For example, relatively poor households claim to work harder when they forecast that their rice in storage is insufficient to get to next year's harvest. This links increased labor supply to decreased individual storage in a way that is inconsistent with the predictions of theory. The theory supposes the existence of a loan market, or gift-giving mechanism, which intermediates storage over households in such a way as to make labor supplies comove.

A related anomaly is the relatively constrained nature of rice bank loans. Interest on a rice loan is due at harvest independent of the time when the loan is taken and independent of early repayment. But if relatively poor households are running out of rice and forced into the labor market, then there should be incentives for early repayment.

Likewise, the theory suggests that profit-maximizing production decisions would be separated from consumption decisions. That is, all land plots of a given type should be farmed the same way independent of landholdings, wealth, assets, labor supply, or the risk and responses of the households who own the plots. For labor use, for example, any household with a land plot of a certain type would use hired or household labor in such a way as to equate the wage with the value of the marginal product, that is, equate the

within-season cost of labor, the wage times the marginal utility of income, to the expected marginal productivity of labor in crop output, output valued at crop prices times the marginal utility of income (see Townsend [1993b, p. 27, equation (23)]). Yet the questionnaire for Yang Pieng picks up differences in farming rice plots, specifically, as in Table IV, the use of buffaloes rather than motorized plows. There is great variation in the depth of plowing and seed planted per rai. Most farmers weed twice, but labor used per rai is not uniform. Most, but not all, complain of some damage from weeds. On the other hand, variations in water levels over plots might suggest that there is insufficient control for various land types; responses to water problems after seeding are quite mixed. Yet virtually all complain of rain which delayed or damaged the rice harvest. The use of pesticides, herbicides, and fertilizer is not uniform over rice plots, as is apparent in Table V. Striking, in particular, is the use of pesticide (one out of sixteen), little use of herbicide (three out of sixteen), and mixed use of fertilizer (ten out of sixteen). When used, the amounts of fertilizer and herbicide per rai seem to vary.

The main worry with respect to drawing conclusions from variation in farming practices is unobserved land quality. (See Deaton [1994, pp. 76–77] and Benjamin [1994].) Farmers in the survey suggest that variation in farming practices may be due to financial constraints, not variations in land quality, but it is difficult to control for land quality in multistage crop production and uneven water flow.

The plot questionnaire does ask whether a given household would be willing to borrow more (presumably at prevailing interest rates) to finance labor, fertilizer, or herbicide; that is, would profits be increased? Here eight out of twelve farmers in Yang Pieng say yes, they are "credit constrained": three say they fear debt; two say they are not brave enough for the risk; two cite no place to borrow or lack of money; and one cites lack of experience in inputs. The theory allows implicit or explicit insurance indemnities. This prices out all risks in the village (as if the crop were sold forward under all contingencies) and makes profits a sure thing. The responses to this problematic question thus seem inconsistent with theory if the market rate the respondents had in mind was the village rate. On the one hand, the village as a whole cannot get state-contingent loans from the outside, and this may be constraining. Again, funds from the relatively new health care fund are easily absorbed by willing borrowers for herbicide, a little used input.

TABLE IV

VARIATIONS IN AGRICULTURAL PRODUCTION: YANG PIENG (RICE)

House-hold code	Plow type	Depth	Plow timing problems	Type of seed	Amount per rai	Too much water	Germination problems	Short stems	Water problem of any kind	Times weeded	Person days per rai	Weed damage	Rain at harvest
P-35	Tractor	5.5 cm	No	M-Y	0.80	No	No	Yes	Yes	2	6	Yes	Yes
P-36	Tractor	1/2 Elbow	No	M-Y-L-O	0.43	No	No	No	No	2		No	Yes
P-37	Buffalo	11 cm	No	M	1.33	No	No	No	No	2		Some	Yes
P-38	Tractor	10–15 cm	No	M-Y		Yes	Yes	Yes	Yes	2	5.8–8.3	Yes	Yes
P-39	Tractor	Don't know	No	M	1.0	No	Not much	Not much	No	2		Little	—
P-40	Tractor	15 Cm		M-Y	4.5	Yes	Yes	Some	Yes, too little water	2	10	Yes	Yes
P-41	Tractor	10 Cm	No	M-Y	1.0	Yes	No	Yes	Yes	1	1.25	Yes	Yes
P-42	Tractor	10 Cm	No	M-Y-L	0.43	Yes	Yes	No	Yes	2	1.71	Yes	Yes
P-43	Tractor	20 Cm	No	M-Y	0.28	Yes	Some	No	No	2	0.33	Yes	Yes
P-44	Tractor	25 Cm	—	M-Y-L	0.38	No	Yes	No	Yes, too little water	2	0.75–1	Some	Yes
P-45	Tractor	10 Cm	Yes	M-Y	0.78	No	Some	No	No	2	3.33	Some, bad health	Yes
P-46	Buffalo	10 Cm	No	M-Y-L	0.83	No	Yes	Yes	Yes	2	5	Yes	Yes
P-47	Tractor	15 Cm		M-Y-L	0.85	Yes	Yes	Yes	Yes	1	2	Yes	Yes
P-48	Tractor	—	No	M-Y	1.4	No	No	Not much	No	2	4	Not much	Yes
P-49	Tractor			M-L-Y-O	1	No	Very few	Yes	Too little water	3	7	No	Yes
P-50	Tractor			M-L-Y	0.6	No	Yes	No	Yes, too little water	2	0.6–2.4	Yes, wait, sick	Yes

M = Muenon.
Y = Yellow.
L = Lia.
O = Other.

TABLE V
INPUTS AND SOURCES OF FINANCE: YANG PIENG (RICE)

Input/source	Market	Agriculture ext. officer	No response	Did not use
Fertilizer	5	4	1	6
Pesticide	0	1	0	15
Herbicide	3	0	0	13

The rice bank and health care fund display sufficient repayment at these high rates so as to cause internal equity to grow at a high rate. This again begs the issue of why Yang Pieng's funds are not attractive to outside investors.

V. VARIATIONS ACROSS THREE NEARBY VILLAGES

Thus far, we have regarded institutional and market arrangements as given. An intriguing stylized fact from the field research is substantial variation over villages in these arrangements and in the ability of these arrangements to achieve a Pareto optimal allocation. This is no more apparent than in amphoe Maajam where the three villages of Mae Wak, Sop Wak, and Maanajohn lie only a few miles from one another, all within walking distance of one another, but yet differ substantially on key dimensions.

Specifically, Mae Wak is loaded with institutions; Sop Wak, down the road, has difficulty with the same funds; and Maanajohn has few institutions of any kind.

Mae Wak is perhaps the most well-organized village of this survey in terms of quasi-formal village organizations. Differences in household responses to risk show up again in the questionnaires: some have livestock and carryover, and some do not. Yet, unlike Yang Pieng, every single household in Mae Wak was contributing at least a small amount, often more, to the village savings fund. All households in the village are linked to one another through the fund. This represents a key institutional mechanism that may allow cross-household intermediation.

Two features of the savings fund present barriers. The first is that the fund is not to be used for consumption smoothing. Still, as is apparent from the theory, funds for consumption smoothing and for productive investments are fungible within the household budget. In particular, some consumption smoothing is allowed even with this restriction.

The second constraining feature of the fund is that nominal borrowings are limited to 50 percent of a given household's savings, though all funds can be withdrawn on demand. Apparently, though, more can be borrowed from the fund if there are cosigners. Thus, in a given year a given household may be a net debtor, as the theory requires. This is essential to achieve a full allocation of risk bearing if there is diversity across households in income fluctuations.

Measured fluctuations in Mae Wak seem less severe. Granting that, one can still set out in search of explicit or implicit insurance provisions in the various financial funds. Here a key feature emerges: there are multiple funds, and two of them have state-contingent returns. In particular, the savings fund pays off members' savings by computing returns per unit share. In the year prior to the survey the return was 15 percent. A housewife fund also pays off in earnings per share with a prior year return of 19 percent. The inference is that both returns are variable and contingent on project outcomes in the loan portfolio. There is also a fund to finance the purchase of pigs, and there is a fund to finance the purchase of fertilizer. Both have fixed rates of interest but some provision for rollovers. Finally, there is a rice bank. If there are as many funds with state-independent returns as there are states of the world, then market structure is complete. This leaves us with the possibility of counting states, which certainly must exceed five by a large margin, or alternatively of asking again what implicit provisions for insurance there are in the fixed loan funds.

As to the predictions of the theory that all farmers in Mae Wak should farm plots of a given type in the same way, the sample is too sparse to say much at all. However, respondents seemed to indicate that they would not borrow more at prevailing rates. The headman assured us he was not interested in additional outside funds at 2 percent per month. The reason is that not all internally generated funds are placed out in loans. Indeed, Mae Wak allows out-of-village residents to borrow from its rice bank, savings fund, and housewife fund if a village resident cosigns the loan. The total amount of such loans was estimated at 20,000 baht, out of 160,000 in loans total. The survey itself seems to pick up one household in Maanajohn engaged in such borrowing from Mae Wak, and farmers in Sop Wak and a hill tribe village up the mountain confirmed in conversations that they visit Mae Wak for loans. Mae Wak thus represents a rare exception to the apparent lack of intervillage intermediation.

Sop Wak, down the road, offers an interesting contrast with Mae Wak. On the surface its institutional structure is similar. It has a series of overlapping committees and funds dating back to an army counter-insurgency program some six to eight years before. But there are problems. Perhaps the most serious of these is default, with several people defaulting on rice bank loans in the year prior to the survey. One of these households had left the village, leaving some relatives behind. The rice bank committee was currently negotiating with the others in default. (Default needs to be distinguished from the rollover, a practice that is common in both Mae Wak and Sop Wak.) Similarly, the investment fund in Sop Wak suffers from problems. One is getting members to contribute regularly, as promised, and the second, like the rice bank, is default. As a result of earlier defaults, the current rules in Sop Wak restrict a member's borrowings to 90 percent of prior savings, with four cosigners for each loan. As for repayment from past defaulters, the response from the committee was straightforward: "What are we to do? These are our friends."

In contrast to Mae Wak and Sop Wak is the village of Maanajohn. With the exception of a death benefit fund and health care fund, Maanajohn has no quasi-formal village organizations. A natural question to ask is whether quasi-formal organizations are needed, whether traditional systems are good if not better.

Maanajohn was said by its headman to have two or three lenders, merchants willing to lend at 5 percent per month and to have little other borrowing. Yet the sample picks up what appears to be a nontrivial and more diverse internal credit market. Six out of 13 respondents to the household questionnaire borrow in bad years, and two of these along with a third lend in good years. Six of these nine transactions have open-ended repayment, that is, with no time limit for repayment, or have provisions for rollover. In the context of Maanajohn's risky environment, these loans may have the necessary insurance contingencies. Loans are nontrivial in amount, up to 3000 baht.

Still, the informal market in Maanajohn has its limitations. Although participants also use currency, rice stocks, and livestock and are able to smooth their fluctuations somewhat, the degree of insurance remains in doubt. Curiously, the interest rate for informal loans varies considerably across households, ranging from a 0 percent loan to a sister or parents and up to 10 percent per

month to nieces and nephews.[10] Loans at interest of 3 to 5 percent per month to relatives, not just friends, are not uncommon, leaving the impression that interest rates are not low in the informal credit market of this village. High nominal rates, however, seem inconsistent with consumption asset pricing, unless these loans are coupled with insurance premiums and indemnities.

Beyond local credit market participants, the sample picks up four small landholders or landless laborers who finance fluctuations by working harder. These individuals are on their own and not linked to lenders or to anyone else. As earlier in Yang Pieng, this would seem to be inconsistent with an optimum, with the difference that here it is the smaller households who remain unlinked, not the larger ones. The existence of small unlinked households supports the idea that rice banks promoted from the outside may help, that is, offer a Pareto improvement: idiosyncratic, if not aggregate, labor market fluctuations may be smoothed.

As far as the investment of funds is concerned, Maanajohn farmers complain of a shortage of credit. Loans for fertilizer, herbicide, and pesticide are available from an Agricultural Cooperative, but many do not borrow for pesticide and herbicide. All use fertilizer in some amount, either from the agriculture extension officer or the Cooperative, but ten out of twelve say profits would go up with yet more fertilizer (three and two farmers say the same for labor and herbicide, respectively). As for the reasons for not borrowing, seven farmers say they do not want to brave the risk; one says he fears debt; one says credit from the Cooperative is limited; one says there is no place to borrow; and one says he just started using inputs.

Interpretation of these "liquidity-constrained" responses is more problematic here than in the village of Yang Pieng. Specifically, Maanajohn can borrow funds from the Agricultural Cooperative with the restriction that funds must be supported by evidence that inputs were actually purchased. The Lagrange multiplier on this restriction would make the implicit (common) internal village interest rate greater than the measured external rate, no doubt fueling complaints about a shortage of funds[11] (see Townsend [1993b, p. 26, equation (22)]). Still, as before, the internal village market should price out all risks so as to make beginning-of-season

10. Variation in ex post rates is to be expected if loans are state contingent.

11. It is possible of course that these funds are fungible in the household budget in which there is no additional restriction.

profits a sure thing. Likewise, there should be no variation in production across households with identical plots. All are subject to the same implicit shadow prices for credit-financed inputs. If one failed to account for this shadow price, then the marginal revenue products of credit-financed inputs would appear to exceed their costs. But this distortion is uniform over all households, so that all households with the same plots should be farming in the same way (see Townsend [1993b, p. 28, equation (25)]).

Almost no one in Maanajohn has taken on the risk of new rice varieties. Virtually all retain the low but stable-yield traditional variety, and plot diversification, quite marked in this village, seems costly. If diversification over land is a way to accommodate risk in the absence of improved institutions, this would be inefficient.

VI. Deterioration of Indigenous Insurance with Growth?

A final village is of some interest. Ba Pai in amphoe Lee lies along both sides of a major highway to Bangkok, and it is much more involved in the commercial economy of Thailand than any other village in this field research. Its institutions and internal markets are also different.

As usual, landholdings and income are not uniform. But all Ba Pai farmers in the sample hold one plot only; there is no fragmentation. In contrast also with other villages, the dominant rainy-season crops are all cash crops: peppers, corn, and soybeans. Lamyai is a relatively new cash crop, while cabbage and garlic are sometimes seen. No Ba Pai farmer is growing rice for subsistence consumption or sale. The hallmark of Bai Pai at harvest time is the presence of large threshing machines rented to harvest corn.

Ba Pai households are not involved in livestock in any way. It is common to seek alternative employment in the dry season, and Ba Pai households migrate as far as Bangkok for wages, which can reach 75 baht per day. Logging and the manufacture of furniture is also an important source of additional income. Curiously, logging is illegal; furniture manufacture is not.

Ba Pai farmers do have access to loans from the BAAC office down the highway, although land titles may be required by a local BAAC officer and many farmers in Ba Pai have at most land-use certificates.

Within the village of Ba Pai there is relatively little borrowing and lending in response to fluctuations. Two of the four of our interviewed households mention some borrowing. One of these is

from some kind of fund, but conversations in the village picked up no organization whatever. The second household mentions a short one-month loan from a friend. Farmers in the village claim that such lending was at 10 percent per month in response to crop shortfalls, when a farmer has an outstanding BAAC loan and cannot roll it over with the BAAC. Otherwise, three of the four Ba Pai respondents have fluctuations that are absorbed by the sale of gold, by use of cash, or by working harder in bad years (which in Ba Pai they are able to document).

Of particular interest, two of the four farmers had been adversely affected by illness in their households, with shortfalls in income. The headman confirmed that there are no health cards in this village, and that only the very poor have access to free medical services. Indeed, he noted two or three cases of elderly in the village being abandoned by relatives, something one might have thought unusual for Thai society (see Deaton and Paxson [1990]).

These observations are consistent with the hypothesis that Ba Pai is integrated into the cash economy without a backup internal insurance system. The insurance system is limited for incidence of illness.[12] Whether or not insurance is limited for income fluctuations depends on the uniformity of these fluctuations. If fluctuations are more uniform in Ba Pai than in the other villages of the survey, then accumulation and decumulation of assets may accomplish much of the requisite consumption smoothing. That is, there would be only a small welfare loss to absence of insurance against idiosyncratic income fluctuations. But if there is the usual nonuniformity, the welfare loss could be greater.

VII. Taking Mechanism Design, Information-Constrained Models to the Village Economies

We shall now ask whether some of the observations that are anomalous under full insurance, full information, and full commitment models can be explained with analogous private-information models.

To simplify, we focus on agricultural production alone and drop the possibility of lifestock and forestry activities. Further, we focus on labor and nonlabor inputs alone, dropping all capital goods. Finally, we preclude the possibility of market labor supply so

12. There is enough variation across villages that the weakness of insurance in Ba Pai might not be associated with its growth.

that households must work on their own plots and cannot hire labor.

A typical information structure of the principal-agent literature, e.g., Grossman and Hart [1983], Harris and Raviv [1979], Hart and Holmstrom [1985], Holmstrom [1982], Mirrlees [1975], Shavell [1979], and others is to suppose that the inputs of labor on the plots of each household are private. Outputs of the household's plots may be observed, but plots are subjected to idiosyncratic and aggregate shocks which make it impossible to infer labor inputs from outputs. The model can be made to accommodate inputs other than labor and can be made dynamic as in Phelan and Townsend [1991].

The hallmark of this kind of multi-agent, principal-agent model is that there will not be complete risk sharing. In particular, household consumption will not comove as much with aggregate consumption, and household income will influence household consumption. As an alternative to complete risk sharing, then, private-information models seem more consistent with the data. It should be noted, however, that information-constrained risk-sharing schedules do not necessarily make household consumption monotone with household output. A household's compensation depends positively on the inference that labor effort was high, and this inference depends on a likelihood ratio which may not be monotone with output. Indeed, with idiosyncratic and aggregate shocks, relative performance evaluation over households may make one household's consumption reward a function of the other household's output. Still, the data were not gathered in such a way as to allow more stringent tests of these types of private-information models.

As it stands, the dynamic principal-agent model is not consistent with some of the anomalies. One would not expect households to be bearing year-to-year fluctuations on their own with virtually no year-to-year insurance or credit from the rest of the community. As in Atkeson and Lucas [1992], Phelan and Townsend [1991], and Thomas and Worall [1990], neither the rich nor the poor should stand disconnected from year-to-year credit markets and community institutions.[13] Related, the community funds in the villages (the central planner in the models) should retain full control over each household's asset and storage decisions. This is also not

13. More detailed transaction data like that available from ICRISAT would allow one to test for this stand-alone hypothesis and hence reject the private information model.

consistent with how relatively rich households describe their behavior.

Consider, however, an alternative private-information model. Suppose that households are allowed to store on their own and can engage in unobserved asset transactions. This can undercut otherwise beneficial, intertemporal tie-ins. Indeed, this may reduce the information-constrained contract to that implemented as if in a series of static, year-by-year arrangements. Indeed, in the model of Allen [1985], Fudenberg, Holmstrom, and Milgrom [1990], and Green and Oh [1991], consumption smoothing is limited to that associated with the pure borrowing-lending solution. (Rogerson [1985] and Townsend [1982] also discuss the need to control consumption in the information-constrained contract.) More generally, households stand on their own in year-to-year asset transactions.

Still, they may not be on their own in production within the year. Labor and other inputs will be induced or assigned to cope with incentive problems while providing as much within-period insurance as possible. Transfers, the difference between consumption and output, are the cause of incentive problems, and on average transfers to a household should depend on a household's weight in the programming problem. Thus, if households do not receive the same weight in the programming problem, then households with identical plots should not be farming the same way. Production decisions no longer separate from household consumption and leisure allocations. This may help explain some of the diversity in the village production data.[14]

Related also, private-information models have the capability of explaining plot fragmentation and other attempts at diversification. The more a household does in ex ante plot, crop, and seed diversification, the less pressure there is for transfers to smooth income fluctuations. Still, the extent of fragmentation and the diversification depends on costs and inferences of labor effort given public information (see the examples in Townsend [1993a]). Predictions of this sort cannot be tested with the data gathered here, but they may be testable given more standard survey data with landholding, production, consumption, income, and transactions modules.

Static principal-agent prototypes predict insurance over pub-

14. Roughly speaking, one would need data on average levels of consumption and leisure in order to estimate diverse Pareto weights and the implication that this is the cause of diversity in production.

licly observed shocks. If household shocks such as illness are observed, then these should be insured. If such shocks are not observed, then there may be a role for insurance via communication. Reported shocks may influence incentive schedules, and incentive schedules are designed to get households to report honestly (see Melumad and Reichelstein [1986] and Prescott [1994]). Thus, one would expect to see risk contingencies and "flexible" arrangements, either in private credit markets or in quasi-formal village institutions.

More generally, multi-agent principal-agent models, such as Myerson [1979] or Townsend [1988] predict a great deal of within-period insurance. This may take the form of either gifts and transfers or of credit arrangements with risk contingencies. The extent depends on the correlation of underlying shocks as well as on incentive problems. If insurance is possible, then these same models predict that much information will end up in the hands of the central planner (principal or lenders or village committee), either because information is known ex ante, because it is found out at a cost as in Townsend [1979], because it is communicated under the terms of the agreement as above, or because it is inferred ex post under the terms of the agreement.

The results of the survey, though mixed, do seem to pick up a rough correlation between shared information, on the one hand, and the existence of informal markets or quasi-formal institutions, on the other. One extreme data point is generated by Ba Pai. Five out of seven farmers on the plot questionnaire claim not to know inputs, crop operations, and outputs of farmers with nearby plots. Six out of seven claim not to know about relatives, and six out of seven not to know about friends. When pressed, all try to answer questions about a relative or friend, all with a nearby plot, and are able to name quantities or crop plot conditions 45 percent of the time (on average over households). This "information score" refers to the number of questions answered relative to the total number asked. On the household questionnaire, two out of four claim to talk to someone, but those talking know relatively little.

Recall that Ba Pai is the most fragmented village of the survey in terms of credit and insurance. The absence in Ba Pai of year-to-year credit transactions or gifts, as in kinship networks, might be explained by unobserved asset transactions and the consequent impossibility of beneficial intertemporal tie-ins. The relative lack of information about plots of friends and relatives would suggest that not much information is shared a priori (at low

cost) and that households are not involved in within-year credit and insurance arrangements that would allow more information to be acquired or inferred ex post. This could be explained if shocks across households and plots were not idiosyncratic; that is, had a large aggregate component. Relatively little insurance would be possible a priori (this would also explain the relative absence of year-to-year credit or insurance within the village). Finally, there remains the possibility that the information flows are badly measured, that there exists a central planner or group of lenders who would show up sharing information more than the sampled households do.

Still, the relative absence of insurance for incidents of serious illness remains a puzzle. As noted, many models would predict (partial) insurance over such events. Overall, the weight of the evidence is that Ba Pai is more fragmented in information and insurance than its environment would seem to dictate.

Yang Pieng provides another extreme data point with an information structure consistent with its organizations and credit markets (see Table VI). On the plot questionnaire, eleven out of sixteen claim to know about farmers with nearby plots, eleven know about a relative, eight know about friends, and two know about people they lend to. All but two answer questions about someone with a nearby plot, and the knowledge score is 59 percent on average. On the household questionnaires, three of the four smaller, interactive households are talking to others. Two of these say they know something about the person they borrow from or lend to. All persons who are talking to someone are able to provide example information of the other person's assets, rice storage, and credit transactions. In contrast, however, two of the three relatively wealthy, isolated households of Yang Pieng are not talking and know little about others.

With the exception of those relatively rich isolated households, then, the insurance and information flows in Yang Pieng qualitatively resemble those predicted by mechanism-design models. Households know a great deal about one another's plot operations and also about one another's assets and storage transactions. This knowledge would allow or be consistent with the degree of insurance we seem to see in the data. There remains, of course, an obvious issue: is this information obtained a priori at low cost, or is it more endogenous, moving with other aspects of mechanism design? Why would a priori information structures vary across villages?

TABLE VI
COMMUNICATIONS AND KNOWLEDGE OF PLOT OPERATIONS AND INPUTS: YANG PIENG

Household code	Know about within sight plots—identity	Know about relatives—identity	Know about friends—number	Know about persons—borrow from	Know about BAAC partner	Know about person lend to	Person named for quizz—within sight?	Information score
P-35	Yes/internal	Yes	Yes	No	No	Yes	Relative/yes	0.72
P-36	Yes	No	—	—	—	No	Neighbor/no	0.97
P-37	Yes	Yes	Yes	No	No	No	Relative/yes	0.62
P-38	No	No	No	No	No	No	Neighbor/yes	0.23
P-39	—	—	—	—	—	—	Neighbor/yes	0.32
P-40	No/other relatives	Yes/father, mother	Yes, 2	No	No	Yes	Relative/yes	0.56
P-41	Yes/friend	No	No	No	No	No	Neighbor/yes	0.40
P-42	Yes/relatives	Yes/son, daughter	No	No	No	No	Mother/yes	0.71
P-43	Yes/internal	Yes/brother	Yes, 2–3	No	No	No	Uncle/yes	0.78
P-44	Yes/internal	Yes/2 brothers, 1 sister	Yes, 2–3	No	No	No	Friend/yes	0.97
P-45	No/son and employees	Yes/sisters-in-law	No	No	No	No	Friend/yes	0.35
P-46	No	Yes/daughter	No	—	—	—	Neighbor/yes	0.33
P-47	Yes/other relatives	Yes/father, mother, cousin	Yes, 3	No	No	No	Relative/yes	0.66
P-48	No	No	No	No	No	No	Friend/yes	0.72
P-49	Yes/not much	Yes/father	Yes, many	No	No	No	Neighbor/no	0.26
P-50	Yes	Yes—son, daughter	Yes, 2	No	No	No	Relative/yes	0.79

Between these two extremes lie other villages. Maanajohn, with its informal credit market, produces eight out of twelve households on the plot questionnaire who know about farmers with nearby plots, and nine out of twelve who know something about relatives. Curiously, only two know about friends, suggesting perhaps some kind of network. The knowledge score is a surprisingly high 83 percent on average. On the household questionnaire, six out of seven farmers who are active in credit markets are talking to someone, more often than not with someone they borrow from or lend to. Two larger isolated farmers do not talk to their relatives or neighbors about inputs, outputs, or crop operations.

On the other hand, three of the four smaller, isolated farmers are also talking. Some small farmers who are talking claim to know little. But several seem reasonably well informed of livestock, rice storage, and borrowing-lending transactions of others.

One comes away with the impression that there may be more communication about plot operations than is necessary to support the existing informal credit market of Maanajohn. Put another way, information may not be the only constraint on some credit market transactions within this village. It should be noted in this regard that much can be learned by comparing what a pair of individuals know about one another and whether they are linked in a credit-insurance relationship. In private-information models these are jointly determined. In principle, private-information models can be rejected with sufficient data.

VIII. Conclusion

One is reminded in this contrast across villages of the work of Wade [1988] on 31 villages in southern India and also of Hirsch [1990] in a detailed study of two villages in western Thailand. Both find more variation in organization and structure across villages than would be suggested by the literature. Specifically, Scott [1976] suggests that most villages are collective entities, while Popkin [1979] suggests that most villages are individualistic and inefficient. Here, in contrast, one finds apparent heterogeneity across villages. This heterogeneity raises some key, unanswered questions that must be addressed in future efforts.

First, despite appearances, do well-functioning village organizations really have a positive net impact on welfare, an impact that is measurable? Surely, organization per se is not the desideratum. As suggested in the text, consumption, production, and labor

supply outcomes are more evident variables to use to judge success. Related, if there is an impact, what is the distribution of benefits and costs in the village population? Are there groups that are excluded, or that bear these costs and benefits in an asymmetric way? Finally, the paper appears to suggest that the deviations from the predictions of theory may have large welfare losses, but more measurement and numerical calculations are necessary before one draws this conclusion. One needs sufficient data to estimate parameters of technology and preferences.

A second related question: are there elements missing from the theory, and from measurement in the preliminary survey, that might explain the variation over villages? The theoretical work of Hart and Moore [1988], Besley and Coate [1991], Coate and Ravallion [1991], and Diamond and Dybvig [1983] suggests that limited legal systems, lack of perfectly costless enforcement of contracts, and variations in expectations can explain variations in observed arrangements. The field research and three-village comparison in Section V also suggest that these variables are related to variations in structure and organization across villages, but more work needs to be done in an extended survey in quantifying these variables and measuring them systematically. An intriguing start in this direction is the work of Wenner [1989], who shows that variations in organizational form among borrowing groups in Costa Rica, and the human capital of group leaders, seem to explain variations in internal and external defaults. A final related question is can variations in village organization and outcomes be explained in the end by variations in village environments or not? That is, do two villages that look alike in terms of the environment have dissimilar organizations and outcomes? The field research and three-village comparison of Section V suggest an affirmative answer to this question, but the number of villages in the sample is far from adequate to address the question econometrically. Of course, an affirmative answer would have enormous implications for policy, for it would suggest strongly that welfare-improving interventions are possible. For example, improved legal systems, allowing more complete contracts within and across villages, might lead to ready improvements. Even a negative answer to the policy question might provide guidance for intervention. For example, small and relatively inexpensive changes in the environment, e.g., education of the headman in accounting, might be shown to lead to ready improvements.

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