Solidarity Networks in Preindustrial Societies: Rational Peasants with a Moral Economy*

Marcel Fafchamps
Stanford University

I. Introduction

Mutual insurance networks in preindustrial societies have been an object of curiosity for many social scientists.[1] In his seminal book *The Moral Economy of Peasants,* James C. Scott showed how the solidarity mechanisms of southeast Asian peasants are reflected in their ethical values: the right to subsistence and the principle of reciprocity. He failed to explain, however, how mutual insurance can survive in spite of incentive problems. This led Samuel L. Popkin, in *The Rational Peasant,* to criticize Scott's view as implying that preindustrial communities, unspoiled by capitalism, are motivated by higher ethical values.[2] Popkin's contribution was to present numerous evidence of opportunistic behavior among precapitalist peasants.[3] His critique, however, failed to account for the well-documented existence of solidarity networks.

Richard A. Posner reconciles these two apparently diametrically opposed views, arguing that a mutual solidarity system can be sustained in the long run by the existence of a lasting relationship between its self-interested members.[4] Opportunistic behavior can be prevented as long as short-run benefits from deviation are smaller than long-run punishments. Posner's verbal argument is formalized in Miles S. Kimball and in Stephen Coate and Martin Ravaillon.[5] Elaborating on Posner's approach, Jean-Philippe Platteau presents an excellent discussion of Scott's and Popkin's views.[6] He also shows that mutual insurance can take a variety of forms—grain transfers, credit, access to land, labor assistance, etc.—and discusses in great detail the incentive problems associated with various types of solidarity mechanisms.

This article revisits many of the arguments presented by Posner, Platteau, and others in the light of recent developments in the theory of repeated games. Instead of analyzing particular institutions, this

0013-0079/93/4101-0006$01.00

article follows the tradition established by Posner: it concentrates on key features of solidarity systems and explains them in a consistent theoretical framework.

The key characteristics of solidarity systems are outlined in Section II. In Section III, I show that mutual insurance can be sustained as an equilibrium of a repeated game.[7] Incentive problems are addressed in Section IV and linked to the lack of privacy, the right to subsistence, ex ante solidarity, and networks. Private accumulation of wealth and other asymmetries between players are shown in Section V to lead to asymmetries in the insurance mechanism itself. Patron-client relationships are reviewed in that light.[8] Equilibrium refinements are reviewed in Section VI, and their applicability to mutual insurance contracts is discussed. Finally, policy implications concerning the prevention of destitution are presented in Section VII. In conclusion, Posner's view is reasserted: there is no contradiction between the fact that people in preindustrial societies pursue their long-term self-interest and the central idea of the moral economy of peasants, namely, that the ethical values of precapitalist societies emphasize solidarity as a moral obligation and subsistence as a right.

II. The Main Characteristics of Solidarity

In preindustrial societies, and much of the Third World today, solidarity bonds often tie members of a same family, kinship group, or village together. Those bonds manifest themselves in a wide variety of ways.[9] Labor invitations and other forms of manpower assistance are an opportunity for relatives and friends to help the sick and the old.[10] Cost-free land and livestock loans allow the redistribution of productive assets from those who cannot use them effectively to those who have unemployed labor resources.[11] Children that parents cannot support are taken care of, and sometimes adopted, by better off households. Gifts, food transfers, or credit without interest allow the less successful to close the food gap.[12] Finally, remittances from migrants increase during bad times.[13]

In rituals, solidarity is sometimes portrayed as an instantaneous exchange of gifts.[14] In practice, however, solidarity systems are usually organized around delayed reciprocity contingent upon need and affordability.[15] In other words, solidarity is a form of mutual insurance. The person receiving assistance is not expected to give back something equivalent to what is received. What is expected from the recipient is simply to help others in return. How much help must be provided is not entirely specified. It depends on the recipient's own circumstances at the time as well as on the situation of those calling for help.

Many authors have noted the strong relationship between the existence of solidarity mechanisms and the extreme precariousness of life in "primitive" and other preindustrial societies.[16] Even in developed

economies, the occurrence of war or natural calamities revives solidarity and mutual assistance. In the words of Evans-Pritchard, "It is scarcity not sufficiency that makes people generous."[17] This suggests that, whenever economic and social conditions are such that individual survival is extremely uncertain without some form of mutual insurance, informal solidarity mechanisms tend to emerge naturally.

The contingent nature of reciprocity is necessary for it to be an effective insurance mechanism against unforeseen events, but it generates serious incentive problems.[18] People may seek to hide, dissimulate, or misrepresent their situation of need or affordability. They also may be tempted to work less and rely on the mutual insurance system for their subsistence.[19] Preindustrial societies have devised ways of dealing with incentive issues. In fact, many features of solidarity systems can be interpreted as ways to minimize efficiency loss. The purpose of this article is to formalize the idea that solidarity springs from scarcity, without ignoring incentive problems.

III. Mutual Insurance as a Repeated Game

Solidarity mechanisms exist in many rural communities of the Third World. Yet, in most cases, there is no formal authority to enforce them. In the past, as Posner emphasized, "primitive" societies managed to sustain a significant degree of mutual insurance despite a weak central authority or no government at all.[20] Today, traditional local authorities, wherever they exist, have seen their power eroded by colonial governments and centralized postcolonial states. Moreover, modern courts are unable to enforce mutual insurance arrangements. Indeed, such arrangements are too informal in nature. Their terms remain incompletely specified, and the respect of contractual obligations is extremely difficult to verify for anyone who is not a party to the mutual insurance contract.

If the nonrespect of mutual insurance obligations cannot be penalized by an independent court or authority, how can risk pooling be sustained? Consider the following example. Say N people agree before the agricultural season that they will pool crop output. Each promises that, in case of high yields, he or she will transfer some of the output to others. In the absence of sanction for breech of promise, however, those who actually get high yields realize ex post that it is in their advantage not to share. Thus a one-shot insurance contract has no risk-pooling equilibrium. Its unique Nash equilibrium is autarky.[21]

This outcome is but another illustration of the prisoner's dilemma: all realize that they can benefit from cooperation, yet all find opportunistic behavior in their short-term interest. The theory of infinitely repeated games has shown, however, that cooperation can be supported if people are allowed to interact over a long period of time.[22] The reason is that cooperation can be rewarded and opportunistic be-

havior can be penalized in the future. People who breech their promise can be punished by being treated less well afterward. The mutual insurance agreement becomes self-enforcing: it is based on voluntary participation, not on coercion.

Again consider a situation in which people promise to pool crop output after harvest. Suppose further that they also specify that those who fail to respect the promises they made will be punished in subsequent years. In principle, since participation to the mutual insurance scheme is purely voluntary, people could withdraw to avoid the punishment. But as long as the utility from being punished is higher than from withdrawing, they voluntarily accept the punishment. Consequently, the maximal punishment someone would voluntarily incur must have an expected discounted payoff that is just above the autarky payoff.[23] Such punishment is self-enforcing and thus constitutes a credible threat.[24] A strategy profile can then be constructed specifying a cooperative path and minimax punishments for each participant.[25] Given these punishments, people find it in their long-run interest to remain on the cooperative path, that is, to give part of their crop output to others in order to avoid being punished.[26]

As Dilip Abreu has shown, more cooperation can be supported with harsher punishments. Thus, the more likely people are to starve if left to their own devices, the harsher the punishment is that can be imposed for breech of promise, and the more mutual insurance can be achieved. When people are poor and idiosyncratic risk is important, mutual insurance significantly reduces the chance of starvation and dramatically raises people's expected utility. Consequently, solidarity mechanisms should emerge quite naturally in societies that are vulnerable to starvation and in which idiosyncratic risk is large.[27] Economic prosperity, on the other hand, undermines solidarity to the extent that it reduces individual risk of starvation.[28] Simple observation indeed confirms that informal solidarity is much stronger among the poor of this world than among the rich.

At first glance, the large number of possible equilibria that repeated games can support seems a problem. However, when one considers the wide variety of solidarity institutions described in the anthropology literature the indeterminacy of the theory turns out to be an advantage.[29] Indeed, it is able to account for different solidarity systems arising from similar conditions. The process whereby a particular system is selected by a given society is path dependent. Since some form of negotiation is involved, the choice of solidarity arrangement is likely to be influenced by the political system of the society. Furthermore, symbolic representations and ethical values provide focal points —"fair" contracts—that guide the search for an equilibrium. The end result is somewhat arbitrary. This is reflected in practice by the fact that symbolic claims (e.g., magic powers, superior ethnicity,

caste, etc.) are often used to define social arrangements. Section IV*D* sheds some light on this issue, but elements of an answer as to how an equilibrium is chosen mostly lie in the political anthropology literature.[30]

At this juncture, one may wonder whether the use of the theory of infinitely repeated games is warranted when it is clear that participants to a mutual insurance agreement do not live forever.[31] Participants, however, do not know with certainty when the contract ends, that is, when they will die. As long as, at any point in time, there remains a positive probability of survival, the formal structure of the infinitely repeated game can be preserved.[32] Nevertheless, as players get old, their probability of survival decreases. This has several consequences.[33]

Theoretically, old people may reckon that they have little time left and decide to enjoy life while it lasts. However, it is extremely unlikely that this will induce old people to neglect their solidarity obligations. Indeed, as people age, they become increasingly dependent on others' help and goodwill. Furthermore, the stigma associated with antisocial behavior is likely to be transmitted to descendants. Since old people are usually taken care of by their descendants, passing onto them a poor solidarity record means endangering one's own welfare in old age.

On the other hand, younger people as a group may realize that they would benefit if old people were to be dropped from the mutual insurance system.[34] Indeed, old people are likely to be net recipients of assistance. Since their probability of survival is small, their threat to retaliate if neglected by refusing help to young people does not have much bite. The danger of young people abandoning the old is thus far more serious than that of old people neglecting their solidarity obligations.[35]

This may explain why primitive and other preindustrial societies try to compensate by granting the old a lot of political and economic power. In sub-Saharan Africa, for instance, the clash between the old and the young has long been part of the sociopolitical landscape.[36] The economic power of the elders is largely based on their indirect control of their descendants' labor through direct authority over land and livestock. This explains in part why having many children is so important for most people. Old people without children are neglected unless they are able to find truly altruistic help.[37] These issues will be revisited in Sections VI and VII.

IV. Imperfect Monitoring

A. Observability of Income and Wealth

In a mutual insurance system, solidarity rights and obligations depend on realized income and wealth. These are only imperfectly observable.

Consequently, everyone has an incentive to underreport income and wealth in order either to be eligible for solidarity assistance or to be dispensed from supporting others. Obviously, if individual income and wealth are entirely unobservable, there is no way opportunistic misrepresentation can be prevented, and the mutual insurance system collapses. In small rural communities, however, commonly observed signals exist that are correlated with individual income and wealth. Can the solidarity system survive in those circumstances? As the theory of repeated games with imperfect monitoring has shown, the answer depends critically on how informative these signals are.[38]

Suppose that there are signals that are correlated with individual realization of income.[39] Some of them are associated with equal likelihood of either high or low income; they are not very informative. Others are associated with a high likelihood that income is high or low. Such signals can be used by the parties to the mutual insurance contract to verify each others' affordability and need. How signals are used depends on when information becomes available. If it is immediately available, it is possible to make mutual insurance transfers depend on commonly observed signals only. In that case, self-revelation of need and affordability is bypassed entirely and the danger of misrepresentation is avoided. Many manifestations of solidarity rely on such signals; for instance, transfers and gifts at funerals and weddings.[40] Of course, relying exclusively on signals can be very dangerous and costly in terms of efficiency; people may be requested to provide assistance when they actually cannot afford it, or may receive it in the absence of need.[41] Consequently, in many cases, solidarity transfers are at least partly determined by self-revelation.

In those circumstances, parties to the mutual insurance arrangement may have insufficient immediate information to judge the veracity of insurance claims. Additional information may become available over time, however. Truthfulness may thus be appreciated ex post. Information available after the fact can then be used to trigger harsh but delayed punishment. As was already argued, punishment cannot be so harsh that it induces people to leave the solidarity system. Consequently, if signals are not very informative or are delayed far in time, and if the maximum long-term penalty is low compared to short-term opportunistic gains, it will be impossible to prevent parties to the mutual insurance arrangement from misrepresenting their need and affordability. In that case, the mutual insurance system is hardly able to operate, and a self-enforcing agreement achieves very little efficiency.

In rural communities, sources of income and forms of wealth differ significantly in how observable they are. For instance, it is easy for an experienced farmer to guess crop yield by observing standing crops at harvest. But it is much harder to guess someone's income from migration or nonfarm activity. Livestock occupies a somewhat intermediate

position: it is observable when physically in the village, but mixing one's livestock with that of others or resorting to transhumance blur the picture to a great extent. Actually, the extreme secrecy surrounding grain storage, livestock, and other assets in rural areas of the Third World is a sign that people consciously try to decrease observability of their income and wealth.

Given that crop production is the most easily observable form of income, people have an incentive to shift away from crops and secure sources of income that are easy to dissimulate. In parts of rural Africa, it has been observed that young villagers in search of upward social mobility rarely invest their efforts in agriculture; instead, they migrate or go into trade and nonfarm activities.[42] The temptation to dissimulate income by moving away from agriculture can be very damaging for rural communities since it endangers food security. Therefore, it may be necessary to counteract it by limiting access to the village's solidarity network to those who farm and grow food crops. Those who do not grow food crops would be threatened with exclusion because they have signaled their intention to free-ride the system.

Consumption is a very powerful, yet delayed, signal of income and wealth. For instance, large consumption expenditures are an ex post confirmation of affordability, while the absence of such expenditures reveals need. As a result of the lack of privacy in preindustrial societies information about consumption is able to circulate widely in the community.[43] However, consumption is a manipulable signal, and thus the greedy may avoid consuming in an effort to misrepresent their wealth and thus minimize sharing with others. The scorn and moral sanction associated with greed in many preindustrial societies have led some observers to conclude that such societies are opposed to private accumulation of wealth.[44] In this article I suggest instead that the efficiency, and possibly the survival, of the mutual insurance system is seriously threatened when it is unable to rely on consumption as an ex post signal of need and affordability. The fact that greed is ridiculed and made morally reprehensible is proof of the weakness of the mutual insurance system. It has to rely on noneconomic incentives to try to limit opportunistic behavior. It is not so much private accumulation of wealth that preindustrial societies combat but the fact that some of its members may accumulate wealth while others are in need. In fact, preindustrial societies welcome wealth accumulation because it is an important source of insurance against collective risk. But wealth accumulation is encouraged to take place openly and to serve the common need for insurance. (More on this in the section on patron-client relationships.)

Finally, need can also be verified ex post if someone who has been refused assistance subsequently dies of starvation or illness. In his study of the Nuer, Evans-Pritchard mentions that if a member of

the community dies a sudden death in the presence of someone else, irrespective of that person's responsibility in the event, nonassistance is put on the same footing as murder.[45] Another way by which some societies ensure that a call for help is not taken lightly is to administer collective punishment when a sudden death occurs, irrespective of whether there was collective (or individual) contribution to that person's tragic end.

B. Observability of Effort

Imperfect monitoring of income and wealth is not the only incentive problem facing mutual insurance systems. Imperfect monitoring of effort may induce participants to shirk, that is, to work little and rely on the community for their subsistence. Since the more insurance is provided, the less incentive people have to work, there is a trade-off between efficiency in insurance and efficiency in labor effort. Incentive problems may thus limit the level of sustainable insurance. Possibly all that can be achieved is catastrophic insurance—in Scott's words, the right to subsistence.

As an example, consider a one period symmetric contract of full income pooling and, for simplicity, assume that it is fully enforceable and that income is observable. If effort is also observable, Pareto efficiency is achieved by requiring participants to provide the level of effort that corresponds to first best optimality.[46] Those who deviate are heavily penalized; punishments ensure that cheating is never in a participant's best interest. Since all parties are identical and are risk averse, equal distribution of income ensures the highest degree of social welfare.

If individual effort is not observable, however, moral hazard becomes a problem. Full income pooling remains Pareto efficient from an insurance point of view, but since the effort of each participant only has a marginal impact on his share of aggregate income, free riding becomes a best response. Consequently, efficiency in effort is not achieved and there is underapplication of effort. Formally, let the optimization problem of participant j be

$$\text{Max}_{l_j} EU_j\left(\sum_{i=1}^{N} y_i/N,\ 1 - l_j\right),$$

$$\text{subject to } y_i = f_i(l_i) \text{ for all } i = 1, \ldots, N,$$

where y_i stands for the income of household i, N is the total number of households, 1 is the total (normalized) time endowment, and l_i equals labor of participant i. Because of symmetry, the solution to the above also defines the Nash equilibrium contract. Dropping subscripts,

individual effort is implicitly given by

$$EU_y \frac{f'}{N} = EU_l. \tag{1}$$

The incentive effect of insurance on individual effort is identical to that obtained in models of sharecropping, income tax, or producers' cooperatives. Here, N represents the number of parties to the contract, but equation (1) would be formally identical if it represented the share of output that goes to a shareholder, the marginal rate of taxation on labor income, or the number of people in a cooperative.[47] In all models the effect is the same: because people do not capture the entire marginal product of their effort, they usually find it optimal to reduce their level of effort.[48] Consequently, aggregate output drops.

Is it possible to find another contract that does better than full income pooling? An alternative is suggested by Scott, who insists that solidarity among peasants is characterized by guaranteed subsistence, not full income pooling. A contract aimed at guaranteeing subsistence can be constructed as follows. Set a minimum survival income. Because utility drops dramatically below survival income, the largest welfare gains from insurance are achieved from the reduction in the risk of starvation.[49] Finance the minimum survival income insurance by lump-sum "fees" levied on all players with an income realization above the survival threshold. Intuitively, such a contract improves efficiency by making participants partially residual claimants of the fruits of their efforts. If the chance of falling below the starvation income level is relatively small, financing the scheme by lump-sum fees insures that more efficiency in effort is achieved.[50] On the other hand, if the chance of falling below starvation income is high, individuals may prefer to shirk and reduce their labor effort.[51]

Formally, let $\tilde{c}$ be the fee that is charged to each member of the insurance pool. It covers the subsistence requirements of pool participants and therefore depends on realized aggregate income and its distribution. Let c stand for the expected value of the fee.[52] Participants are guaranteed a minimum income level y_f.[53] The optimization problem facing each member of the insurance pool is to choose a level of effort that maximizes expected utility:

$$\operatorname*{Max}_l \int_{\underline{y}}^{y_f} U(y_f - c, 1 - l)h(y)\,dy + \int_{y_f}^{\bar{y}} U[y(l) - c, 1 - l]h(y)\,dy,$$

where y stands for income, l for effort, $h(y)$ is the probability density function of y, and $(\underline{y}, \bar{y})$ is the support of y. As before, the utility function $U(\cdot)$ is defined over income and leisure. Assume that income risk is multiplicative: $y = f(l)s$, where s is a random shock. Let $g(s)$

be the probability density function of s. The first order condition for an interior optimum is

$$-\underline{U}_l \text{ Prob}\left[s \leq \frac{y_f}{f(l)}\right] + \int_{y_f/f(l)}^{\bar{y}/f(l)} (U_y f' - U_l) g(s)\, ds - \overline{U}\frac{\bar{y}f'}{f(l)^2} g\left(\frac{\bar{y}}{f(l)}\right) = 0,$$

where $\underline{U}_l$ stands for $U_l(y_f - c, 1 - l)$, and $\overline{U}$ stands for $U(\bar{y} - c, 1 - l)$.

Totally differentiating the above with respect to l and y_f shows how, other things being equal, effort changes with the level of minimum guaranteed income. The resulting expression can be written as

$$\frac{dl}{dy_f} = \frac{-1}{\text{SOC}}\left\{-\underline{U}_{ly} \text{ Prob}\left[s \leq \frac{y_f}{f(l)}\right] - \underline{U}_y \frac{f'}{f} g\left[\frac{y_f}{f(l)}\right]\right\},$$

where SOC stands for the second order condition of the optimization problem. The second order condition is negative at an interior optimum. Assume that the marginal utility of leisure increases with income. Then the expression in brackets is negative. Thus, for any expected insurance fee c, effort is a decreasing function of the level of minimum insured income, bringing to light the trade-off between insurance and efficiency.

More complex, nonlinear contracts may be able to achieve a better balance between efficiency and insurance, but the theory of mechanism design suggests that such contracts are sensitive to slight changes in model parameters and are easily manipulated by participants if observability is not perfect.[54] In other words, delicate optimal contracts are not robust. Consequently, attempting to identify an optimal short-term risk-pooling contract is likely to lead to counterfactual results. A more promising line of enquiry is to investigate whether repeated contracts may reduce moral hazard.

As Drew Fudenberg, D. Levine, and E. Maskin and Abreu, D. Pearce, and E. Stacchetti have shown, moral hazard could in principle be minimized, say, by the use of trigger punishment strategies.[55] Realized output can be used as a signal for effort. Underapplication of effort is more likely when individual output is low relative to output of others. Consequently, low output could trigger harsh punishment. The problem is that (1) the purpose of the mutual insurance contract is to shelter people against low output and (2) risk pooling can shelter people only against idiosyncratic risk. Letting low individual output relative to the output of others trigger punishments contradicts the very purpose of the contract itself.

Thus other signals have to be found. Restricted privacy ensures a permanent check on people's actual work performance. Consumption of leisure and leisure-related commodities (beer, gambling, etc.) can be used as a monitoring device. In land surplus areas of the Third World, planted acreage can also serve as a signal, an indicator of work effort. Unfortunately, this signal is manipulable as it is possible for people to inflate planted acreage yet fail to perform other agricultural operations in an efficient and timely fashion. Signal manipulation and moral hazard issues thus also help explain why labor inputs per hectare are so low in African agriculture.[56]

C. Ex ante Solidarity

Another way to reduce incentive problems in ex post mutual insurance is for group solidarity to operate ex ante. While ex post solidarity compensates someone for a shortfall in income, ex ante solidarity attempts to prevent the occurrence of a shortfall. By granting access to key factors of production—land, labor, and capital—ex ante solidarity minimizes costs in two ways: it reduces moral hazard, and it avoids the waste of community resources.[57] The rationale and foundation for ex ante solidarity thus must be sought in the existence of ex post solidarity; without a right to subsistence, ex ante solidarity would not exist.

There are numerous manifestations of ex ante solidarity. Labor assistance during the cropping season, for example, is used to help the sick or the old complete farm operations on time.[58] Indeed, it is more cost effective for the community to salvage crops via immediate labor assistance rather than waiting for crops to fail and provide ex post insurance. By giving this assistance, the land and labor resources already invested in crop production are not wasted, and the cost to the group is reduced.

Another example of ex ante solidarity is land borrowing, free of charge, as practiced in the West African semiarid tropics.[59] There, marginal returns to land are low (low rainfall, low soil fertility, simple technology, slow natural fertility restoration), and yields depend primarily on labor, directly via careful cultivation, and indirectly via labor investment in land fertility and water retention (manuring, ridging).[60] In those circumstances, it is more attractive for farmers to acquire other people's goodwill by lending out excess land, instead of cultivating it with hired manpower. Actually, attempts at direct cultivation by land rich households face social resistance in the form of labor shirking because they violate the principles of solidarity.[61] Here again the rationale is that someone short of land will also be short of food at the end of the season. Thus, a land loan is a way to prevent the need for food assistance, while making full and efficient use of the labor resources and reducing moral hazard.

Temporary transfers of land are not the only way by which food

shortages of land-poor households can be prevented. Sharecropping, or providing employment to landless and land-poor households, may prove a better alternative, depending on the circumstances.[62] In the absence of increasing returns to scale in agriculture, however, and provided that landlords do not have a preferred or exclusive access to key factors of production, land transfers present advantages.[63] Indeed, they minimize moral hazard and the need for labor supervision by making tillers residual claimants of the fruits of their efforts.

Even consumption loans and food transfers can be viewed partly as manifestations of ex ante solidarity. Short-term consumption loans are very common in rural areas of the Third World.[64] Very often, they are used to buy food so that people may continue working until the end of the agricultural season.[65] Such loans are sometimes made without interest, and their repayment varies with the situation of both lender and borrower.[66] Similarly, food assistance is a measure that can prevent incapacitation due to malnutrition, as it enables recipients to continue working. Again, the rationale is that it is cheaper for the system to transfer food now in order to reduce demands for assistance later.

D. Networks

In practice, solidarity does not really operate as a group insurance. Rather, as Lynn Ellsworth has shown, it operates as a network in which individuals are connected to a small number of other people, who, in turn, are connected to other people.[67] The end result is a net or mesh of interpersonal relationships in which individuals are connected to each other either directly or indirectly. Lineage, kinship, neighborhood, or consanguinity often are major axes of solidarity networks, but friendship and patron-client relationships also matter.[68] Although customs and traditions influence the structure and operation of the solidarity network, in practice, mutual obligations between each participant are personalized and based on trust.

At some level of abstraction, solidarity networks can be treated as equilibrium paths of a large repeated noncooperative game of mutual insurance. The fact that mutual insurance systems operate as networks, however, can again be interpreted as a result of incentive problems. Make the following two assumptions: monitoring is costly, and the cost of monitoring falls over time between any pair of individuals who actively practice solidarity. The idea behind these assumptions is that, as two individuals assist and monitor each other, over time they acquire relation-specific information that allows them to monitor each other more effectively; they know each other's situation better, they have learned to read each other's facial expressions, etc. Call the result of this process of learning-by-doing "trust."

Now start from a situation in which mutual insurance ties do not exist. If people recognize that cooperation is Pareto improving, they will want to enter into informal mutual insurance arrangements. Since

they have limited resources to cover monitoring costs, they will concentrate on a limited number of informal arrangements that, over time, develop into personalized and privileged relationships based on mutual trust. This means that the process whereby the mutual insurance system is formed crystalizes it into a mesh of interpersonal relations.[69] The process of crystallization, like many processes with dynamic increasing returns, is likely to generate multiple equilibria, path dependence, and lock-in.[70] Efficient outcomes are not guaranteed. Hence customs, traditions, and ethics provide the focal points that guide the process and increase the chance that it generates an efficient and fair outcome.

At its inception, the process of network crystallization is likely to take advantage of special relationships preexisting between society members: filiation, kinship, neighborhood, and consanguinity. Indeed, these relationships give a joint monitoring advantage to pairs of people. For instance, because of the lack of privacy in preindustrial societies, it is hard to hide something from your neighbor or brother-in-law, and vice versa. By reducing monitoring costs, such relationships allow solidarity links to develop faster and stronger. Altruistic feelings between people can also serve as initial catalyst, thus the role of filiation and friendship. Consequently, solidarity networks largely reproduce the structure of lineage, vicinity, kinship, and consanguinity.

Networks present other informational advantages. They save on information flows and allow the day-to-day operation of the mutual insurance system to be decentralized. Without a network, tracking the cooperative equilibria of the repeated game would actually require that large amounts of information be shared by all the members of the mutual insurance contract. Given the cost and complexity of such information flows, cooperative equilibria would probably not materialize. With networks, even the decision to punish can be decentralized; punishment by the best-informed people can be used as a signal that other villagers should punish as well. Unfaithful wives and ungrateful sons, for example, can be collectively fustigated this way.

Finally, by their decentralized nature, networks are more resilient and flexible than a global insurance pool. Births, deaths, weddings, and migrations are easily accommodated without having to renegotiate and reconsider the insurance arrangements of the entire community. Adjustments are made in a decentralized fashion, saving on renegotiation costs. Decentralization may also allow solidarity rights and obligations to remain incompletely specified without imposing an extremely complex accounting system on the members of the insurance pool.

V. Wealth and Patronage

A. Individual Wealth Accumulation

Individual wealth accumulation is very common in rural areas of the Third World. It takes various forms—for example, livestock, jewelry,

land, bullocks, equipment, and durable consumption goods—and is more prevalent in high risk areas like the semiarid tropics.[71] From a theoretical point of view, wealth accumulation introduces a nonstationary element in the situation and destroys its repeated game nature. Though strictly speaking the theory of repeated games is no longer applicable, the intuition one gains from it remains a valuable source of inspiration. Self-enforcement remains the central question: Is it possible to reconcile individual wealth with the self-enforcing character of solidarity? In what follows I will suggest elements of an answer.

Accumulated wealth constitutes both a curse and a blessing for the mutual insurance system. First of all, it provides protection against many sources of risk, including collective risks like drought, war, and locusts; mutual insurance protects only against idiosyncratic risk. Accumulated wealth thus offers a form of protection that mutual insurance cannot substitute for. People with accumulated wealth are the only ones who can provide that kind of insurance. Their participation in the mutual insurance system enables it to operate also as a mechanism of intertemporal consumption smoothing. Consequently, it is in the interest of the solidarity group to allow—and possibly encourage—wealth accumulation. This does not mean, however, that wealth accumulation may be encouraged in all circumstances. In particular, allowing people to accumulate wealth while others starve violates the fundamental objective of the solidarity system, which is to minimize the risk of starvation. Limits or conditions to individual wealth accumulation may thus be imposed to ensure, according to Scott, the "right to subsistence."

There is another, more fundamental, difficulty, however—the necessity to preserve the self-enforcing character of the solidarity arrangement. People with a high realized income may be tempted to evade their solidarity obligations and instead accumulate their surplus income as individual protection against starvation.[72] Those with sufficient accumulated wealth may even defect entirely from the mutual insurance system, taking away with them what amounts to the intertemporal insurance fund of the solidarity group. One possible way to prevent defection in the presence of individual wealth accumulation is to base solidarity contributions on wealth instead of current income. Addressing solidarity claims to wealthy people would "cream off" the top wealth and, it is hoped, prevent people from accumulating enough to escape the system. Unfortunately, creaming off top wealth has serious disincentive effects on effort. Many societies seem to have found a solution to this problem, namely, granting preferential treatment to wealthy individuals. This is discussed below.

B. Patron-Client Relationship

Patron-client relationships are a formal way of organizing the compensation of wealthy individuals for their continued participation in the

solidarity system. In practice, such relationships take a variety of forms, but they can schematically be described as follows.[73] Say there are two groups of people, the rich, and the poor. The rich promise to help the poor in times of hardship and, in particular, to insure the poor against starvation. Since the rich have little to gain from a risk-pooling arrangement with the poor, the poor have to reciprocate in some other ways. Repeated small gifts are thus made: religious contributions, gifts to the chief, payment for methaphysical services, etc. Since the rich often need additional manpower, the poor can also provide labor, sometimes as a form of labor insurance whereby the client is at his patron's beck and call. Finally, because of the patron's ability to take advantage of economic opportunities, useful information is chaneled to him. Arbitraging possibilities and other good bargains are reported by the client—whatever reinforces his patron's economic, political, and social standing.

The protection against starvation guaranteed by the patron's wealth significantly improves the expected utility of his client(s). Yet over time, transfers of labor help the rich get richer and may lead to the concentration of wealth in his hands. For instance, household surveys in sub-Saharan Africa often show that livestock, an essential store of wealth, is distributed very unevenly across rural households.[74] The ability of wealthier individuals to turn the mutual insurance system into an instrument of exploitation—that is, of extraction of surplus—is the compensation they receive for continued participation in that system. Even though the poor may find that patrons are exploiting them, they value security enough to accept it. Indeed, without clientelism, either solidarity would collapse altogether or it could survive only by banning wealth accumulation and, therefore, offering no protection against collective risk.[75]

Clientelism can easily be accommodated within the solidarity network. Wealthy people, because they are a source of insurance against collective risk, are very desirable to befriend. Consequently, patrons are likely to be better "connected" and to sit at the top of a pyramid of interpersonal relationships.[76] In those circumstances, it is possible for the mutual insurance network to simplify into a single star-shaped arrangement, whereby all members of the network are connected only to the patron, and all insurance transfers are coordinated by him. When that happens, the position of the patron is obviously reinforced; not only is he the only source of insurance against collective risk, he is also the only source of mutual insurance. Under what conditions centralized network patterns are likely to emerge will be the object of future research.

To summarize, patron-client relationships provide an incentive for wealth accumulation while preserving insurance against starvation in a self-enforcing manner. In these circumstances, the ability to help others in need becomes a source of prestige and power. Social mobility

takes the form of competition for clients. Lavish expenditures, public display of wealth, and prodigal assistance to the poor may simply be temporary instruments to wrest clients away from their current patron.[77] Finally, given the close ties between insurance and wealth, patrons' wealth in a sense is held for the benefit of their clients. It is not really theirs to dispense at will, and attempts to do so are likely to be met with disapproval or even revolt.[78]

C. Social Differentiation

The existence of asymmetries in wealth and the ensuing emergence of clientelism polarizes the solidarity network. The outcome is the emergence of a center (or centers) and a periphery.[79] People found at the periphery are of various types. Old people without descendants and widows without children often survive with great difficulty at the margin of the solidarity system. Recent settlers belonging to different ethnic groups are treated as "outsiders."[80] Merchants and civil servants also remain at the edge of the village solidarity network, prefering to rely on their own extra-village networks.[81]

The center is usually occupied by traditional authorities—village chief, marabout, religious leader, traditional healer—as well as by more recent contenders—cadre, head of the cooperative, storekeeper, miller, teacher.[82] Centers are responsible for representing their community to the rest of the world. In case of a drought, for instance, it is the center's duty to call the attention of the regional authorities and to attract as much food aid as possible. In other words, the center is relied upon to insert himself into a regional or national solidarity network.

Since the center is so important for the solidarity system as a whole, efforts to remove it based on the perception that it is feudal and exploitative are bound to fail. Though the current center may be physically eliminated, the solidarity system will by its own internal logic strive to replace it.[83] The new center may take another form—religious leader instead of traditional chief, cadre instead of landlord—but it will reappear as long as the real reasons for its emergence—that is, the need for insurance based on accumulated wealth—still exist.

VI. Equilibrium Refinements

In the recent literature on repeated games, several refinements have been proposed to the concept of subgame perfection. Two of them in particular provide additional insight on the workings of solidarity networks. They are briefly discussed in this section.

A. Renegotiation-Proofness

In Section III, it was suggested that the maximum punishment that can be imposed on individuals who deviate from the cooperative path

yields the expected autarky payoff. Indeed, any lower punishment payoff could be evaded by leaving the solidarity group. Does it mean that participants to the mutual insurance contract can be credibly threatened with a punishment that gives them a payoff as low as their autarky payoff? Suppose some deviate from the cooperative path—that is, do not comply with insurance obligations. This triggers a punishment strategy from the subgame perfect strategy profile whereby the deviants gets their autarky payoff. Now suppose that the deviants refuse to go along with the punishment and threaten the group with withdrawal. If the solidarity pool is small, losing one of its members means that the pool is less able to spread risk. Consequently, it is willing to renegotiate the mutual insurance contract and forgive the deviants for their defection. Of course, if participants anticipate that punishments will never be enforced, cooperation itself is not self-enforcing and risk sharing will not be attained. This is, in short, the argument made by J. Farrell and Maskin.[84]

It is possible, however, to find punishment paths that are renegotiation-proof. But because they are less harsh, the amount of cooperation that they can support is reduced. The idea is to build punishment paths that do not penalize nondeviant participants, that is, to create punishments that they wish to enforce.[85] In that case, deviants will not be able to renegotiate themselves out of their own punishment. In terms of mutual insurance contracts, it means that exclusion from the solidarity pool, even temporarily, is not a renegotiation-proof punishment path. On the other hand, fines are a form of punishment that is (weakly) renegotiation-proof. Indeed, suppose that the payment of fines is made contingent upon income: high income for the punished participant results in large fines; but low income still triggers assistance from the solidarity pool. Obviously, nondeviants benefit from the fines while continuing to share risk with the punished participant. Consequently they cannot be swayed away from the punishment path. From the point of view of the punished person, the payment of fines may still be preferable to withdrawal because protection against starvation is still provided.

Anthropological accounts suggest that complete exclusion from the village community is rare and is considered quite extreme, but there is little direct evidence on this issue.[86] Posner's review of tort law among primitive societies, however, provides convincing indirect evidence.[87] In particular, Posner emphasizes that compensation (i.e., fines) are the preferred remedy for wrongdoing. Moreover, liability is strict in the sense that it punishes "the mere act of injuring or killing another regardless of the state of mind of the injurer or the care he took to try to avoid the injury."[88] In other words, compensation is due irrespective of intent. If the worst possible transgression to the duties of mutual assistance—murder—is punished by the transfer of a few

cows to the lineage of the deceased, then surely minor deviations from mutual insurance obligations can be similarly dealt with. Reliance on various signals to trigger solidarity claims can also be viewed as an indirect way of punishing deviations. For instance, ostentatious consumption will immediately attract neighbors and friends who invite themselves to the table and present incessant requests for "loans." Failure to comply is met with anger and resentment. Such forced transfers can be viewed as fines that sanction an attempt to circumvent mutual insurance obligations.

B. Coalition-Proofness

So far, equilibrium paths have been required to be individually rational: that is, any single participant must find it in his or her long-term individual interest to meet his or her obligations to others. Among such equilibrium paths, however, there are situations in which a subgroup (or coalition) of participants could improve its collective welfare by withdrawing and creating its own mutual insurance arrangement. For instance, suppose that a member of the solidarity pool gets handicapped by age, disease, or accident. It is of course not in his or her interest to defect; but the rest of the pool members would probably be better off without that member.

The emergence of a mutual insurance arrangement supposes that individuals recognize that efficiency gains can be made from cooperation and that they can negotiate a social contract in order to achieve such gains. If a large group of people is assumed able to define a social contract, then a fortiori one would express smaller groups of individuals to recognize the gains they can jointly make by defecting. Consequently, equilibria in which subgroups can improve their situation by jointly defecting and recreating smaller risk-sharing arrangements should be eliminated. I call the remaining equilibria coalition-proof.[89]

Requiring that equilibria be coalition-proof seriously reduces efficiency. Consider again the above example. Ex ante, all members of the solidarity pool have some probability of becoming handicapped. Thus, all prefer a social contract that provides insurance against such risk. Yet if coalitions form freely and costlessly, they also know that if anyone becomes handicapped, others will renegotiate a solidarity agreement exclusively among themselves. Therefore, protection will not be provided against disability, old age, and other permanent reductions of anyone's usefulness to the risk pool.[90] Whether, in practice, such coalitions can be prevented remains an open question. Obviously, the political and legal system will to a great extent impede or favor the formation of particular coalitions, and not all coalitions are equally likely to emerge.[91] The possibility that coalitions be formed raises, however, important issues and may help explain some of the features

of societies in which solidarity plays an essential role. In particular, gerontocratic power structures may reflect old people's intrinsic fear of being deserted. As is argued in the next section, the behavior of solidarity networks during famines may also be understood as a coalition of the poor against the poorest.

VII. The Breakdown of the Solidarity System

The existence of solidarity networks has numerous policy implications: it affects rural welfare, as well as peasant behavior, with respect to food aid, prices, risk, technology, and new institutions. In this article the attention is concentrated on the prevention of destitution. When poor rural communities are hit by a major shock, say, a flood, drought, or famine, the solidarity system often seems to break down.[92] It may happen that after the shock the entire wealth of the community is no longer sufficient to ensure everybody's survival. In that case, some people may actually starve because there simply are not enough resources to support everybody. Although it is likely that those who have barely enough to sustain themselves will refuse to help others, reallocating existing resources would not reduce the number of casualties. In other words, starvation is not due to the failure of the mutual insurance system.

Evidence on the incidence of famines, however, suggests that some segments of the population may suffer from severe deprivation while others do more than survive, and even prosper. The entitlement literature emphasizes this dimension and argues that famines are often due not to the unavailability of food per se but to the inability of some members of the community to lay claim to that food.[93] The entitlement literature also implicitly recognizes that the solidarity network is unable to redistribute claims on food. The theory of repeated games sheds some light on the perplexing possibility that, despite the existence of a mutual insurance system, the solidarity system fails to redistribute income and food when they are most needed.

Consider a rural community in which some people are better off than others. As repeated droughts and other calamities strike, people progressively liquidate their productive assets: land (if land sales are legally permitted), livestock, grain stocks, bullocks, and farm equipment.[94] Poor people run out of alienable assets faster than rich people do. They are left with unalienable assets such as their own labor force, experience, and skills. Depending on the circumstances, the expected discounted future value of these assets may be very low—think of herders without livestock or farmers without land. Besides, it is likely that malnutrition and disease have diminished the ability of individuals to work and households to function. In these circumstances, the expected future contribution of poor people to the mutual insurance system is very low. They are no longer attractive partners, and nobody

wishes to attract their goodwill by supporting them. Better-off members of the solidarity network then find it in their collective best interest to shut off poorer people temporarily from the mutual insurance arrangement. This is more likely to happen when times are difficult for everyone, when the global resources of the solidarity network are seriously reduced and the maintenance and rehabilitation of the poverty stricken is particularly onerous.

Knowing that they may be denied assistance when they most need it, poor people probably do not have the option to refuse to participate in the solidarity system. Since they need the mutual assistance system just to get through normal years, they do not have the luxury to refuse a contract that shuts them off in bad years. All they can do is gamble their way out of poverty and destitution and hope that "nature" allows them to accumulate enough so that they may be perceived as somebody worth preserving in the system.

When the mutual insurance operates as a network, coalitions need a coordinating mechanism by which they can jointly exclude poor members. Again, various types of signals can be used to this end. In practice, poor people are likely to have a small number of asymmetric ties with participants in the insurance pool. Being dropped by one influential member of the network is a signal to others that leads them to discontinue their interpersonal relations as well. This singularly reinforces the power that patrons exercise on their poorer clients; writing them off may be a death warrant.

The ideas suggested here are consistent with some of the empirical evidence about famines. For instance, they explain how destitution can exist in societies with strong solidarity ties and why indigents often leave their village and come to the cities. More empirical research is needed to verify this, but the view of solidarity systems presented here also casts serious doubts regarding their ability to deal effectively with the old, the sick, and the disabled (particularly those without relatives) and with poor segments of the population in cases of recurrent drought.

VIII. Conclusion

In this article, I have used the concepts developed by the theory of repeated games to better understand the functions of the solidarity network—an essential feature in the Third World. I have shown how the insurance rationale is the major reason for the existence of such a system; how imperfect observability limits its efficiency and generates incentive problems; how the need for intertemporal insurance favors the emergence of centers or patrons able to concentrate resources and information; and finally, how large external shocks may lead to the rejection of poorer people from the system. The existence of solidarity networks influences how changes in economic environment affect be-

havior and welfare. Exploring those interactions should be the object of future research.

To conclude, there is no contradiction between the formalization of peasant behavior presented here and the central idea of the moral economy of peasants—that is, that ethical values of precapitalist societies emphasize solidarity as a moral obligation and subsistence as a right. Ethics can be viewed as performing two functions: first, reducing moral hazard by attaching a moral penalty to unobservable infringments of solidarity rules, and second, mediating conflictual relationships between asymmetric players and providing guidance on what behavior is fair and acceptable.[95] Studying mutual reinforcement between the right to subsistence as a moral obligation and mutual insurance as a social institution is a promising topic for future research.

Notes

* I would like to thank Partha Dasgupta, Julie Anderson, Pan Yotopoulos, Dilip Abreu, Paul Milgrom, Bernard Salanié, Jean-Philippe Platteau, Alain de Janvry, the participants of two seminars at Stanford, and two anonymous referees for comments and suggestions.

1. In the works of anthropologists, e.g., E. E. Evans-Pritchard, *The Nuer* (Oxford: Clarendon, 1940); Elizabeth Colson, *The Plateau Tonga of Northern Rhodesia (Zambia)* (Manchester: Manchester University Press, 1962); political economists, e.g., Michael Watts, *Silent Violence* (Berkeley and Los Angeles: University of California Press, 1983); Robert H. Bates, *Essays on the Political Economy of Rural Africa* (Berkeley and Los Angeles: University of California Press, 1983); political scientists, e.g., James C. Scott, *The Moral Economy of the Peasant: Rebellion and Subsistence in South-East Asia* (New Haven, Conn.: Yale University Press, 1976); Samuel L. Popkin, *The Rational Peasant: The Political Economy of Rural Society in Vietnam* (Berkeley and Los Angeles: University of California Press, 1979); historians, e.g., Thrainn Eggertsson, *Economic Behavior and Institutions* (Cambridge: Cambridge University Press, 1990); economists, e.g., Lynn Ellsworth, "Mutual Insurance and Non-Market Transactions among Farmers in Burkina Faso" (Ph.D. diss., University of Wisconsin, 1989); Hans Binswanger and John McIntire, "Behavioral and Material Determinants of Production Relations in Land-Abundant Tropical Agriculture," *Economic Development and Cultural Change* 36, no. 1 (October 1987): 73–99; Hans P. Binswanger and Mark R. Rosenzweig, "Behavioral and Material Determinants of Production Relations in Agriculture," *Journal of Development Studies* 22, no. 3 (April 1986): 503–39. See also Richard A. Posner, "A Theory of Primitive Society, with Special Reference to Law," *Journal of Law and Economics* 23 (April 1980): 1–53; and Jean-Philippe Platteau, "Traditional Systems of Social Security and Hunger Insurance: Past Achievements and Modern Challenges," in *Social Security in Developing Countries,* ed. E. Ahmad, J. Dreze, J. Hills, and A. Sen (Oxford: Clarendon, 1991) for excellent reviews of the literature. For quantitative information about gifts and transfers, see, e.g., Ellsworth; Lynn Ellsworth and Kenneth Shapiro, "Seasonality in Burkina Faso Grain Marketing: Farmer Strategies and Government Policy," in *Seasonal Variability in Third World Agriculture,* ed. David E. Sahn (Baltimore: John Hopkins University Press for International Food

Policy Research Institute [IFPRI], 1989); Martin Ravallion and Lorraine Dearden, "Social Security in a 'Moral Economy': An Empirical Analysis for Java," *Review of Economics and Statistics* 70 (1988): 36–44; Christopher Udry, "Rural Credit in Northern Nigeria: Testing the Role of Credit as Insurance" (Yale University, Department of Economics, September 1989, mimeographed).

2. This criticism applies better to dogmatic substantivists than to Scott himself, who rightly acknowledged incentive problems. Max Gluckman's comment on the estranged family, in *Custom and Conflict in Africa* (Oxford: Basil Blackwell, 1955), pp. 54–76, also cast doubts on altruism as a major motivation for mutual assistance.

3. Here, opportunism is defined as by Oliver E. Williamson in *The Economic Institutions of Capitalism* (New York: Free Press, 1985), p. 47. For recent evidence on opportunistic behavior among rural communities in Africa, see, e.g., Karla Poewe, *Religion, Kinship, and Economy in Luapula, Zambia* (Lewiston, N.Y.: Edwin Mellen, 1989).

4. For less convincing attempts at a reconciliation, see the symposium on "Peasant Strategies in Asian Societies: Moral and Rational Economic Approaches," ed. Charles F. Keyes, *Journal of Asian Studies,* vol. 42, no. 4 (August 1983). For instance, Charles F. Keyes, "Peasant Strategies in Asian Societies: Moral and Rational Economic Approaches—a Symposium: Introduction," *Journal of Asian Studies* 42, no. 4 (August 1983): 753–68, still calls upon the Weberian idea of "affectional impulse" to explain mutual insurance.

5. Miles S. Kimball, "Farmers' Cooperatives as Behavior toward Risk," *American Economic Review* 78, no. 1 (May 1988): 224–32; Stephen Coate and Martin Ravallion, "Reciprocity without Commitment: Characterization and Performance of Informal Risk-sharing Arrangements," Discussion Paper 96 (presented at the Warwick Economics Summer Research Workshop, August 1989). See also Daniel W. Bromley and Jean-Paul Chavas, "On Risk, Transactions, and Economic Development in the Semiarid Tropics," *Economic Development and Cultural Change* 37, no. 4 (July 1989): 719–36. For an early attempt at applying game theory to primitive societies, see, e.g., Bates, chap. 1.

6. Platteau, "Traditional Systems of Social Security and Hunger Insurance." See also Watts, p. 107.

7. For an excellent review of the theory of repeated games, see David M. Kreps, *A Course in Microeconomic Theory* (Princeton, N.J.: Princeton University Press, 1990), chap. 14.

8. See also Watts, p. 127; Scott; Kaushik Basu, "One Kind of Power," *Oxford Economic Papers* 38 (1986): 259–82; Jean-Philippe Platteau, "A Two-Season Model of Hunger Insurance through Patronage: The Case of the Jajmani System of South India," Cahiers de la Faculté des Sciences Economiques et Sociales de Namur (Facultés Universitaires Notre-Dame de la Paix, Namur, December 1988); Lucy Mair, *Primitive Government* (Bloomington: Indiana University Press, 1962), p. 60.

9. See Scott; Posner; and Platteau, "Traditional Systems of Social Security and Hunger Insurance," for examples and references.

10. Watts, p. 127; David Feeny, "The Moral or the Rational Peasant? Competing Hypotheses of Collective Action," *Journal of Asian Studies* 42, no. 4 (August 1983): 769–89; D. Moerman, *Agricultural Change and Peasant Choice in a Thai Village* (Berkeley: University of California Press, 1968); John Cleave, *African Farmers: Labor Use in the Development of Smallholder Agriculture* (New York: Praeger, 1974).

11. On cost-free land, see R. Norhona, "A Review of the Literature on Land Tenure Systems in Sub-Saharan Africa," World Bank Report ARU 43

(Research Unit of the Agriculture and Rural Development Department, Washington, D.C., 1985); Peter Matlon, "Patterns of Land Use, Indigenous Land Tenure Systems, and Investments in Soil Fertility: Results from Three Agroclimatic Zones in Burkina Faso" (International Crops Research Institute for the Semi-Arid Tropics [ICRISAT], Patancheru, August 1988, mimeograph). On livestock, see Evans-Pritchard (n. 1 above); Colson (n. 1 above), p. 170; Casper Odegi-Awuondo, *Life in the Balance: Ecological Sociology of Turkana Nomads* (Nairobi: ACTS Press, 1990), chap. 6.

12. Regarding food transfers, see Watts (n. 1 above), p. 124; Ellsworth (n. 1 above); Ellsworth and Shapiro (n. 1 above); Evans-Pritchard, p. 84; Thomas Reardon and Peter Matlon, "Seasonal Food Insecurity and Vulnerability in Drought Affected Regions of Burkina Faso," in Sahn, ed. (n. 1 above). And on credit without interest, see Posner (n. 1 above); Feeny; Scott (n. 1 above); Mair, p. 60; Jean-Philippe Platteau and Anita Abraham, "An Inquiry into Quasi-Credit Contracts: The Role of Reciprocal Credit and Interlinked Deals in Small-Scale Fishing Communities," *Journal of Development Studies* 23, no. 4 (July 1987): 461–90; B. Samson, *The Economics of Insurgency in the Mekong Delta of Vietnam* (Cambridge, Mass.: MIT Press, 1970).

13. Ellsworth and Shapiro.

14. In anthropology, the substantivist school has given a lot of attention to solidarity rituals and reciprocal gifts (see Karl Polanyi, *The Great Transformation* [New York: Holt, Rinehart, & Winston, 1944]; the references cited in Posner; and Platteau, "Traditional Systems of Social Security and Hunger Insurance" [n. 1 above]). Those rituals "stage" reciprocity and reassert the bonds that link the villagers and/or the lineage together. They are a way symbolically to "live" solidarity as an everyday reality. At the same time, however, those rituals often portray village solidarity the way villagers would like it to operate but not necessarily the way it actually works. Granting too much attention to those rituals and their underlying egalitarian ideology may have led some anthropologists to overestimate the efficiency and redistributive performance of actual solidarity mechanisms. See Popkin (n. 1 above); and Watts for a similar criticism.

15. There are exceptions to systems being organized around delayed reciprocity, as, e.g., when hunters share a good kill, and fishermen the day's catch. See, e.g., studies of South Indian fishermen by Platteau and Abraham; and Jean-Philippe Platteau and Jean-Pierre Baland, "Income-sharing through Work-spreading Arrangements: An Economic Analysis with Special Reference to Small-Scale Fishing," *Cahiers de la Faculté des Sciences Economiques et Sociales de Namur,* Facultés Universitaires Notre-Dame de la Paix, Namur, June 1989; and of the Dakar fishermen by F. Sow, "L'économie du poisson sur la petite côte (Senegal): Le rôle des femmes" (The fish economy on the little coast [Senegal]: the role of women), Etudes Scientifiques (Université de Dakar, March 1986). For an illustration of the principle of reciprocity being contingent on need in the case of credit transactions, see Udry (n. 1 above); and Platteau and Abraham.

16. For example, Scott; Posner; Kimball (n. 5 above); Coate and Ravallion (n. 5 above); Platteau, "Traditional Systems of Social Security and Hunger Insurance."

17. Evans-Pritchard, p. 84.

18. Scott, p. 5.

19. This concern is at the center of Poewe's work (n. 3 above). See also Popkin; Platteau, "Traditional Systems of Social Security and Hunger Insurance"; and Melville J. Herskovits, *Economic Anthropology* (New York: Knopf, 1952), p. 121, as cited in Posner, p. 14. Moral hazard has been studied

in a wide variety of economic situations, e.g., sharecropping, income taxation, managers' motivation, etc. See, e.g., Joseph E. Stiglitz, "Incentives and Risk Sharing in Sharecropping," *Review of Economic Studies* 41, no. 2 (1974): 219–55; O. Hart and B. Holmstrom, "The Theory of Contracts," in *Advances in Economic Theory,* ed. Truman F. Bewley (Cambridge: Cambridge University Press, 1987); Pranab Bardhan, *The Economic Theory of Agrarian Institutions* (New York: Oxford University Press, 1989); and the references cited in Kreps (n. 7 above), chap. 16.

20. See also Evans-Pritchard (n. 1 above); Colson (n. 1 above); and Gluckman (n. 2 above).

21. Unique, i.e., except for noncredible promises.

22. Ariel Rubinstein, "Equilibrium in Supergames with the Overtaking Criterion," *Journal of Economic Theory* 21 (1979): 1–9; Robert J. Aumann, "Repeated Games," in *Issues in Contemporary Microeconomics and Welfare,* ed. George Fiewel (New York: Macmillan, 1985); Drew Fudenberg and E. Maskin, "The Folk Theorem in Repeated Games with Discounting or with Incomplete Information," *Econometrica* 54 (1986): 533–54. See also Kreps, chap. 14, and the references cited therein.

23. This does not mean that someone can never be brought temporarily below the autarky payoff. Indeed, as Dilip Abreu, D. Pearce, and E. Stacchetti, "Optimal Cartel Equilibria with Imperfect Monitoring," *Journal of Economic Theory* 39 (1986): 251–69, have shown, front-loading punishments is often optimal in games with discounting, because it allows harsher punishments. Optimal punishment paths involve pushing the deviant player below the one-shot minimax payoff for a while before reverting to a long-term cooperative equilibrium. See also Dilip Abreu, Paul Milgrom, and D. Pearce, "Information and Timing in Repeated Partnerships," *Econometrica* 59, no. 6 (November 1991): 1713–33.

24. That is, it is subgame perfect.

25. By the optimal penal code argument. See Dilip Abreu, "On the Theory of Infinitely Repeated Games with Discounting," *Econometrica* 56 (1988): 383–96.

26. The above argument can be made mathematically rigorous. See Kimball (n. 5 above); Coate and Ravallion (n. 5 above).

27. Assuming that society members are able to coordinate their actions to achieve an efficient mutual insurance agreement. Obviously some level of social stability is required for coordination to emerge. Political or social unrest, or the rapid structural transformation of society, may hinder individual efforts toward coordination.

28. Using a simple model of mutual insurance, Coate and Ravallion (p. 19) show, however, that the result can be reversed when the third derivative of the utility function, with respect to income, is negative.

29. On the range of solidarity institutions, see, e.g., Posner (n. 1 above); Platteau, "Traditional Systems of Social Security and Hunger Insurance" (n. 1 above); and the references cited therein.

30. For example, Bates (n. 1 above); Colson (n. 1 above); and Gluckman (n. 2 above).

31. As is well known, when the stage game has a single Nash equilibrium, as here, the theory of finitely repeated games predicts that no cooperation can be achieved (see J.-P. Benoit and V. Krishna, "Finitely Repeated Games," *Econometrica* 53, no. 4 [1985]: 905–22).

32. This is achieved by combining the probability that the game will continue with the players' discount factor (see Kreps [n. 7 above], pp. 505–6).

33. Donald Cox, "Motives for Private Income Transfers," *Journal of Political Economy* 95, no. 3 (June 1987): 508–43, models transfers between generations based on altruism and exchange neither using the theory of repeated games nor recognizing the incentive problems associated with such transfers.

34. This is not a figure of speech. In some hunter-gatherer tribes, old people who can no longer walk are simply left behind to die.

35. In fact, in at least one primitive society it is reported that the young are reluctant to share their food with the old because it is unlikely that the old will reciprocate in the future (see Allan C. Holmberg, *Nomads of the Long Bow* [n.p.: Natural History Press, 1969], pp. 151–53).

36. See, e.g., Sankara's attempts to shake the power of elders in rural Burkina Faso.

37. Regarding neglect of the elderly, see, e.g., the Burkinabe movie *Yaaba* (1989) by film maker Idrissa Ouedraogo.

38. See, e.g., Drew Fudenberg, D. Levine, and E. Maskin, "The Folk Theorem with Unobserved Action," Working Paper (University of California, Berkeley, Department of Economics, 1988); and Abreu, Milgrom, and Pearce (n. 23 above).

39. The same argument works for wealth.

40. Ellsworth (n. 1 above), pp. 287, 293, 295.

41. A perfect illustration of this danger is given by the Senegalese movie *Mandabi* (The money-order) directed in 1968 by Ousmane Sembene and produced by Domireve, Dakar, and CFFP, Paris.

42. See, e.g., Poewe (n. 3 above), p. 99.

43. For evidence of lack of privacy in preindustrial societies, see Posner (n. 1 above), pp. 6–7.

44. The survival of greed in the popular mythology of industrialized societies is obviously a heritage from a time when solidarity and sharing were much more common. Poewe is one observer concluding that preindustrial societies oppose private wealth (pp. 91–124).

45. Evans-Pritchard (n. 1 above), pp. 152–64. See also Posner, pp. 42–52, and the references cited therein.

46. For an application of the same principle to sharecropping, see, e.g., Steven N. S. Cheung, *The Theory of Share Tenancy* (Chicago: University of Chicago Press, 1969).

47. B. Holmstrom, "Moral Hazard in Teams," *Bell Journal of Economics* 13 (1982): 324–40.

48. It is difficult if not impossible to prove that an increase in N decreases effort in all possible cases. The reason is that, depending on the parameters of the model, decreasing effort at some levels of N might increase the chance of low levels of income sufficiently to outweigh the disutility of effort (see, e.g., N. Singh, "Theories of Sharecropping," in *The Economic Theory of Agrarian Institutions,* ed. Pranab Bardhan [Oxford: Oxford University Press, 1989], for a discussion in the sharecropping case).

49. Starvation cannot be entirely prevented, however, as long as there remains the possibility that the average income of the entire group falls below the survival threshold.

50. Note that the first best level of effort with the solidarity scheme need not be the same as the individually optimal level of effort without it. Indeed the income and risk reduction effects of the scheme may reduce the supply of labor.

51. Remember that symmetry is assumed here. In an asymmetric situa-

tion, poor households would have a much greater chance than rich households of finding it in their interest to rely exclusively on welfare. As with all insurance models, asymmetries raise the possibility of adverse selection.

52. The insurance pool is assumed large enough that the covariance between $\tilde{c}$ and individual income can be ignored.

53. Again for simplicity, the distribution of aggregate income is assumed such that the minimum income level is attainable in all circumstances.

54. See Hart and Holstrom (n. 19 above), pp. 91–97.

55. Dilip Abreu, D. Pearce, and E. Stacchetti, "Toward a Theory of Discounted Repeated Games with Imperfect Monitoring," *Econometrica* 58, no. 5 (1989): 1041–63.

56. See, e.g., Cleave (n. 10 above); Cark Eicher and D. Baker, "Research on Agricultural Development in Sub-Saharan Africa: A Critical Survey," Michigan State University International Development Paper no. 1 (Michigan State University, East Lansing, 1982); Marcel Fafchamps, *Labor Use and Productivity and Technological Change in African Smallholder Agriculture: Synthesis Report* (Addis Ababa: International Labour Organisation, 1986).

57. On capital, see Platteau, "Traditional Systems of Social Security and Hunger Insurance" (n. 1 above), pp. 121–29, and the references cited therein. Providing jobs to relatives and friends can be viewed in the same light.

58. Indirect evidence of labor assistance can be found in Cleave, pp. 169, 173–74; Joachim von Braun and Patrick J. R. Webb, "The Impact of New Crop Technology on the Agricultural Division of Labor in a West African Setting," *Economic Development and Cultural Change* 37, no. 3 (April 1989): 522–29; S. Y. Atsu, "Ashanti Farm-Level Studies" Interim Report no. 1 (Institute of Statistical, Social and Economic Research, University of Ghana, Accra, 1981), p. 11; République du Mali, *Programme de Recherche Socio-Economique Appliquée dans la Zone de Production Cotonnière—Region Sikasso* (Program of applied socioeconomic research in the Cotton production zone—Sikasso Region) (Bamako: Comité National de la Recherche Agronomique, April 1979), p. 1; Peter J. Matlon and Helga Vierich, *Annual Report of ICRISAT/Upper Volta Economics Program* (Ouagadougou: ICRISAT, 1982), p. G73.

59. Matlon. Land borrowing is free except, possibly, for a nominal fee.

60. Yves Coffi Prudencio, "A Village Study of Soil Fertility Management and Food Crop Production in Upper Volta—Technical and Economic Analysis" (Ph.D. diss., University of Arizona, 1983), and *Soil and Crop Management in Selected Farming Systems of Burkina Faso* (Ouagadougou: OAU/STRC/SAFGRAD, March 1987).

61. Philip Woodhouse and Ibrahima Ndiaye, e.g., examine labor shirking in "Structural Adjustment and Irrigated Food Farming in Africa: The 'Disengagement' of the State in the Senegal River Valley," DPP Working Paper no. 20 (Open University, Milton Keynes, June 1990).

62. See, e.g., Platteau, "Traditional Systems of Social Security and Hunger Insurance," pp. 129–35, and the references cited therein.

63. Among those key factors of production: capital, in G. Feder, "The Relation between Farm Size and Farm Productivity," *Journal of Development Economics* 18, nos. 2/3 (August 1985): 297–314; or management, in Mukesh Eswaran and Ashok Kotwal, "A Theory of Contractual Structure in Agriculture," *American Economic Review* 75, no. 3 (June 1985): 352–67.

64. See, e.g., Platteau and Abraham (n. 12 above).

65. For example, Garry Christensen, "The Influence of Agro-Climatic Conditions on Rural Credit: Evidence from Burkina Faso" (University of Wisconsin—Madison, May 1987, mimeographed).

66. For example, Udry (n. 1 above).

67. Ellsworth (n. 1 above); Bromley and Chavas (n. 5 above), pp. 730–32. See also Williamson (n. 3 above), p. 46.

68. On consanguinity, see, e.g., Mark R. Rosenzweig, "Risk, Implicit Contracts and the Family in Rural Areas of Low-Income Countries," *Economic Journal* 98 (December 1988): 1148–70.

69. Modeling the process rigorously is the object of future research.

70. W. Brian Arthur, "Self-reinforcing Mechanisms in Economics," in *The Economy as an Evolving Complex System,* SFI Studies in the Sciences of Complexity, ed. P. W. Anderson, K. J. Arrow, and D. Pines (Redwood City, Calif.: Addison-Wesley, 1988), "Urban Systems and Historical Path Dependence," in *Cities and Their Vital Systems,* ed. Jesse H. Ausubel and Robert Herman (Washington, D.C.: National Academy Press, 1988), "Competing Technologies, Increasing Returns, and Lock-In by Historical Events," *Economic Journal* 99 (March 1989): 116–31, and " 'Silicon Valley' Locational Clusters: When Do Increasing Returns Imply Monopoly?" *Mathematical Social Sciences* 19 (1990): 235–51.

71. Binswanger and McIntire (n. 1 above).

72. The temptation is stronger if wealth generates income, i.e., if it is not simply hoarded as jewelry or food stocks.

73. Patron-client relations are described in Scott (n. 1 above); and in Ellsworth (n. 1 above). See Platteau, "A Two-Season Model of Hunger Insurance through Patronage" (n. 8 above), for an effort toward the modelization of such relationships. See also Watts (n. 1 above), p. 127; Basu (n. 8 above); Mair (n. 8 above), p. 60.

74. Gini coefficient for livestock ownership is usually greater than 0.5 (see Fafchamps [n. 56 above], p. 18).

75. Wealth accumulation might be banned, e.g., by organizing the wasteful elimination of grain surplus in ceremonies and beer festivals.

76. See Ellsworth for evidence that wealthier people have denser networks as evidenced by reciprocal gift relationships.

77. See also Posner (n. 1 above), pp. 14–15.

78. Scott's account indeed suggests that peasant revolts in southeast Asia occurred when landlords relocated themselves in the cities and invested in nonrural activities.

79. See Popkin (n. 1 above), p. 26, about "insiders" and "outsiders."

80. In West Africa, Fulani herders and Mossi settlers are examples of ethnic groups that manage to live at the periphery of rural solidarity networks.

81. Hausa merchants, e.g., often reside in villages outside of their ethnic boundaries. Solidarity between them and the villagers is minimal. See, e.g., E. Eddy, "Labor and Land Use on Mixed Farms in the Pastoral Zone of Niger," *Livestock Production and Marketing in the Entente States of West Africa,* Monograph no. 3 (Ann Arbor: University of Michigan, 1979).

82. The borders of what is traditional and what is not are blurred. For instance, the current penetration of islam in parts of sub-Saharan Africa creates new centers of power that may have a "traditional" look to the uninformed eye.

83. See Pranab Bardhan, *Land, Labor and Rural Poverty* (New York: Columbia University Press, 1984), pp. 176–77, for an expression of the same principle.

84. J. Farrell and E. Maskin, "Renegotiation in Repeated Games," *Games and Economic Behavior* 1, no. 4 (December 1989): 327–60. See also Dilip Abreu and D. Pearce, "A Perspective on Renegotiation in Repeated Games," Working Paper (Harvard University, Department of Economics, 1989).

85. Note that it is the concept of "weakly renegotiation-proofness" as defined by Farrell and Maskin that is used here.

86. The informed reader will have noticed one of the ironies of attempting to apply repeated game theory to real-life situations. In equilibrium, the threat of credible punishment is sufficient to prevent deviation. Consequently, punishments should never be observed. In the presence of imperfect monitoring, events may trigger punishment paths even though nobody deviated from the cooperative path. This may allow punishments to be observed, but they will remain rare occurrences.

87. Posner (n. 1 above), pp. 45–51. See also Evans-Pritchard (n. 1 above), pp. 152–64.

88. Posner, p. 48.

89. B. Douglas Bernheim, Bezalel Peleg, and Michael D. Whinston, "Coalition-Proof Nash Equilibria. I. Concepts," *Journal of Economic Theory* 42 (1987): 1–12; B. Douglas Bernheim and Bezalel Peleg, "Coalition-Proof Nash Equilibria. II. Applications," *Journal of Economic Theory* 42 (1987): 13–29. Showing formally that coalition-proof equilibria exist requires an extension of Herbert E. Scarf's proof of the existence of a core in cooperative games and is left for future research ("The Core of an n-Person Game," *Econometrica* 35 [1967]: 50–69).

90. Formally, this does not require outright exclusion. Such people can be kept in the system, but the insurance benefits they can lay claim to are essentially reduced to nothing.

91. For instance, see Watts (n. 1 above) for an in-depth study of the interaction between the polity, informal solidarity, and hunger in northern Nigeria.

92. See, e.g., Amartya Sen, *Poverty and Famines* (Oxford: Clarendon, 1981).

93. See, e.g., ibid.; Jean Dreze and Amartya Sen, *Hunger and Public Action* (Oxford: Clarendon, 1989).

94. See, e.g., Mark R. Rosenzweig and Kenneth I. Wolpin, "Credit Market Constraints, Consumption Smoothing and the Accumulation of Durable Production Assets in Low-Income Countries: Investments in Bullocks in India" (University of Minnesota, October 1989, mimeographed).

95. That is, in the parlance of repeated games, provide a focal point.