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Institutional Aspects of Credit Cooperatives

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If credit cooperatives are to be viable and help farmers, particularly small-scale farmers, they must pay more attention to the design of their operations — to the accountability of managers, to the structuring of incentives, and to the monitoring and enforcement of repayments.

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INSTITUTIONAL ANALYSIS OF CREDIT COOPERATIVES

by

Avishay Braverman and J. Luis Guasch

Perhaps the most common form of government intervention in the rural sector has been massive lending at subsidized interest rates. The standard justification has been that credit programs are easier to implement than other policies such as land reform or infrastructure development and are beneficial to agriculture. Without subsidized interest rates, adoption of technical innovation would be delayed and there would be underusage of costly inputs, like fertilizer, goes the reasoning. Both effects slow the growth of output and the development of the agricultural sector. It has also been argued that since rural credit markets are notoriously imperfect, access to credit is severely limited for farmers, particularly small farmers; without government intervention a high price of capital would prevail, further screening out the small farmers from the credit markets. Furthermore, because of distorted exchange rates, food price controls, imports of cheap food and inefficient markets, farmers receive low prices for their products, hampering their borrowing abilities.

Credit programs generally aim to reach small farmers. However, despite the remarkable expansion of credit throughout the rural areas of developing countries over the last three decades, few farmers in low income countries seem to have received or benefited from such credit. An estimated 5 percent of farms in Africa and about 15 percent in Asia and Latin America have had access to formal credit. Moreover, there seems to be a high correlation between credit recipients and size of land holdings, (see Lipton (1981) and Braverman and Guasch (1986)). The imposition of government interest rate restrictions (credit subsidies) has induced banks to ration credit in a manner that excludes the small farmers from formal credit markets. This is what Gonzalez-Vega (1977) has called "the iron law of interest rate restrictions". Rather than equalizing income inequality, low interest rate credit programs have increased it: on average 5 percent of borrowers have received 80 percent of the credit.

It has thus been common for farmers, particularly the small-scale ones, to resort to the formation of organized credit groups or cooperatives. Although those institutions have many advantages, they have been prone to encourage the wrong economic behavior. In terms of participation, productivity, volume of credit and repayment rates, failures have outnumbered successes. Given the level of resources involved and the significance of economic development in rural areas, a better understanding of these institutions is needed. What follows is a normative analysis of cooperatives viewed as institutions organized to improve the plight of small-scale farmers. This analysis is motivated by the theory of incentives in organizations. The purpose is to analyze which structures are most successful. Then a policy to promote credit cooperatives and help an optimal incentive design could be much more effective than the subsidized credit policies of the past. After a brief description of how credit tends to be allocated in rural markets, we proceed to analyze the issues of formation and design of credit groups, in both static and dynamic settings.

ANALYSIS OF RURAL CREDIT ALLOCATION

Consider an institution or financial intermediary which aims to allocate a given budget among a number of loan applications. For simplicity, assume that the demand for loans comes from two types of rural agents or farmers, small-scale and large-scale. The standard differences between the two types seem to be: a) the loan requested by the small agents is usually smaller than the one requested by the large ones; b) the collateral small agents can provide is smaller than that provided by the large ones; c) land holdings of small agents are smaller (if not absent) than those of large ones; d) information on past behavior is more extensive or less costly to collect on large agents than on small ones; and e) the output of the small agents is perceived to be subject to greater variation, reflecting perhaps the smaller and less diversified resource base of small farms.

Loan processing has strong positive scale economies. Estimates show that for small loans, processing costs can range from [illegible] rcent to 40 percent of the loan value (see Braverman and Guasch (1986)). These cost differentials, plus the typical lack of collateral and the higher perceived riskiness of the small agents, induces a bias against them in credit allocation. Interest ceilings and limited budgets further strengthen the bias. Interest restrictions stop financial institutions from charging higher interest rates and induce higher demand for credit from the large agents. Thus small agents face significant rationing or exclusion from credit. Their alternative is to use the informal credit market, which usually lends at much higher interest rates, and which also subjects the small agents to rationing. In addition, arbitrariness, patronage and corrupt practices, frequently undertaken by the financial intermediaries, further limit the access to credit of the small farmers (see e.g., Landman and Tinnermeir (1981), Robert (1979), and Adams and Vogel (1986)).

The conventional wisdom has been that providing subsidized credit would remove this bias and increase small farmers' share of institutional credit. Elsewhere (Braverman and Guasch (1987)) we have argued against that view and shown how subsidized credit will reduce small farmers' share, and likely increase the informal credit market interest rate. The natural conclusion is that subsidized credit should be abolished. 1/ That will ensure that small farmers' share of credit at the new higher formal market rate will be increased. In addition, the informal market rates they will face might decrease. 2/ Small farmers' will still face rationing since the arguments outlined above still apply albeit with somewhat less force (see Bell and Srinivasan (1985)). We should still expect to observe interest rate differentials according to loan size because of higher processing cost for smaller loans, and the higher risks in lending to small farmers.

It is not our purpose here to dwell on the effectiveness of credit policies, but rather to elaborate on actions that small farmers can take to improve their access to credit and thus ultimately their welfare. In particular, we will focus on how credit groups can help.

COOPERATIVES AND CREDIT GROUPS

The three main obstacles to obtaining credit for the small-scale agents are: 1) much higher transaction costs per dollar lent for small loans; 2) the belief, real or perceived, that small agents are riskier to lend to than larger ones and 3) the patronage, corruption and arbitrary decisions of some lending agents reduce the share of credit funds to small agents. Small-scale agents might form cooperatives or credit groups to overcome these obstacles.

There are many types of credit groups ranging from purely nominal or umbrella organizations without much member interaction to those fully coordinated in all aspects of their operations including production decisions among members. Motivation behind their inception, organizational structure, incentive schemes, enforcement procedures, tradition and cultural legacy, technological structure and availability of information are important factors in determining their effectiveness.

The advantages of credit groups are multiple. They reduce the credit transaction costs of both lenders and borrowers, enabling the group to offer strong economic incentives to their members such as lower interest rates, price discount on inputs and relief from individual processing of loans. They might promote scale economies in technical assistance. They might help to circumvent the effects of risk, and also give leverage for dealing with the financial intermediaries. From the lenders' perspective, they may reduce the risk of loan default because of the common practice of joint liability among groups members.

That these advantages are clearly perceived is evident in the large number of cooperatives that have been established in the agricultural sector in practically all countries since their inception by F.W. Raiffeisen in Germany in 1847. However, results have been mixed, with failures outnumbering successes.

Why were there so many failures? Although largely an empirical question, to answer it properly one must first know what is the optimally designed credit group. We focus below on the characterization of such a benchmark organization, and on the role and design of incentives in credit groups.

THE INSTITUTIONAL DESIGN OF CREDIT GROUPS

Consider a collection of agents, each one involved in his own productive activity, say, agriculture, which is subject to uncertain factors and where the inputs needed are capital and his own effort. In a general formulation, we could think of those agents as facing two distinct types of risk. One, an individual or specific risk which is uncorrelated across agents and with the other type of risk. The second risk is common to all agents or perfectly correlated across agents. The most obvious example of the latter risk in agriculture is the variation in output or yield caused by weather's uncertainty, while those caused by incidence of pests and other diseases would be an example of the first type of risk. We could think then, of the random element z_i, affecting i's output, as composed of two terms, $z_i = (v, h_i)$ where v is a common (to all agents) uncertainty parameter, while the h_i's are independent idiosyncratic (specific to agent i) risks. Let Q_i (v, h_i, a_i, K_i) be the output for agent i, which is a function of the effort taken by the agent, a_i of the amount of capital utilized for production, K_i and of the two random factors v and h_i.

The agent's utility is a function of income and of the level of effort undertaken. Disposable income can be decomposed into two terms. One is that obtained from the sale of the output net of repayment of the loan. The other is given by the proportion of the loan the agent uses for consumption or other purposes, not directly linked with the productive activity under study. Let us denote that proportion by α. Also let Y be the income obtained from the sale of output net of repayment costs. Then, we can express the utility as $U(\alpha K, Y, a)$. Since the availability of those two incomes is not concurrent, they are treated differently in the agent's utility function. We assume preferences represented by a utility function separable in those variables, $U_1(\alpha K) + U_2(Y) - V(a)$, where U_1 and U_2 are concave functions, and V is convex. That reflects diminishing marginal utility of income and increasing marginal disutility of effort. Y can be written as $Y = pQ_i - (1+r_m)K_i$, where Q is output, p is its market price, and r_m is the interest rate. Let $\bar{K}$ be the credit limit the agents are subject to. Now we can state the optimization problem solved by the agent operating on his own as,

$$\text{(I)} \qquad \max_{a_i,\ \alpha_i,\ K_i} \quad U_1(\alpha_i K_i) + EU_2(Y) - V(a_i)$$

$$\text{s.t. } Y = pQ_i - (1+r_m)K_i$$

$$Q = Q(v,\ h_i,\ a_i,\ (1-\alpha_i)K_i)$$

$$0 \leq \alpha_i \leq 1$$

$$0 \leq K_i \leq \bar{K}.$$

The first order conditions of I, for an interior maximum, are,

$$\text{(IIa)} \qquad EU_2'[pQ_a'] - V_a = 0$$

$$\text{(IIb)} \qquad U_1'K + EU_2'\ [pQ_\alpha'(-K)] = 0$$

$$\text{(IIc)} \qquad U_1'\alpha + EU_2'[pQ_K'(1-\alpha) - (1+r_m)] = 0$$

Let the optimal actions taken by an agent not joining a credit group, the solutions to II, be denoted by K^m, α^m and a^m. Let the expected utility of that action be $\bar{U}^m$. The higher α^m is the higher the probability of insolvency. The choice of higher α by agents has been a common argument used to explain the failure of credit to achieve its goal.

Consider now the possibility of agents joining or forming a credit group. The key characteristic of the arrangement is that the group assumes liability for any loans made to any of its members or that it serves as the recipient of all credit, which is then distributed among the members. The security for credit repayment is usually provided by the joint liability of group members, diffusing the risk bias argument held against small agents. Credit to the whole group is stopped until the default is corrected. This provides diversification of risk and induces strong peer pressure for the proper use of credit and its repayment.

The direct benefits to agents in joining a credit group are lower interest rates and presumably higher credit lines. They are a consequence of two essential features of credit groups, joint liability and a centralized or block request of credit by the group as opposed to a number of individual applications, thereby reducing transaction costs.

Aside from the lower costs of inputs, another benefit the agents can derive from joining a credit group is risk-pooling. The argument is straightforward particularly when there is no moral hazard problem. Each agent's income is a random variable y_i, with a given distribution, induced by v and h_i. For any realization of v, the distribution of income of each agent is independent and identically distributed across agents, with variance var(y). Suppose the structure of the group is such that the agents' income is pooled together, and that the aggregate proceeds are divided equally among the identical agents. If there are n of them the variance of the aggregate income is, $\text{var}\,(y_1 + y_2 + \ldots + y_n) = n\,\text{var}\,(y)$. Each agent receives $(1/n)(y_1 + y_2 + \ldots + y_n)$ but the variance of that income is, $n\,\text{var}(y/n) = \text{var}(y)/n$. Thus the expected income has not changed but its variance has been greatly reduced. With risk averse agents, their expected utility is now higher.

The argument is not so simple when the agent can take unobservable actions affecting the distribution of his contributed income (output), since then expected income from productive activities in the group regime will in general be different. The tradeoff is lower expected income but also lower variance. Of course, the nonproductive income might be larger. Let α, a and K be the agent's optimal choices in the credit group regime. The solution concept we use to determine those values is the Nash equilibrium. An equilibrium allocation under a credit group regime can be thought of as a Nash equilibrium of the game where each agent computes his optimal borrowing, consumption and production plan, given the actions of the others agents and knowing what the resulting expected distribution of income would be. That allocation has the property than no one can do better by deviating in his choice of actions given what the others are doing. Then the resulting aggregate income is $y_1 + y_2 + \ldots + y_n - (1+r)nK$, with of course they y's and K's being different than the ...ces made under an individualistic regime of production, since there, agents were not acting strategically with respect to each other, and of course there were not moral hazard problems. Here again the agent's variance of income is reduced to var $(y - (1+r)K)/n$. Of course the y_i's are a function of α, a, K and r. The chosen values of y will depend on the institutional organization of the group, particularly the incentive structure implemented by the group.

Assuming equal and exhaustive distribution of the proceeds by the group, the problem solved by agent i, under the credit group regime, that gives rise to the y's is,

$$\text{(III)}\quad \max_{a_i,\ \alpha_i,\ K_i} U_1(\alpha_i K_i) + EU_2(Y) - V(a_i)$$

s.t.

$$Y = [\Sigma_{i=1\ldots n}\{pQ_i - (1+r_c)K_i\}]/n$$

$$Q_i = Q_i(v,\ h_i.\ a_i,\ (1-\alpha_i)K_i)$$

$$0 \leq \alpha_i \leq 1.$$

Note that this formulation captures the joint liability characteristic of the arrangement. All the proceeds are pooled by the group and all loans are paid out prior to any distribution of income to the members. Then, because of symmetry, all of them receive the same share, independent of their own realization of output Q_i. This formulation is not equivalent to the one (also capturing joint liability) where each agent is allocated his net income less a share of the debt from bankrupt members (when applicable). The latter formulation induces lower expected utility, because of a higher variance on the realized income. The dominance of the former formulation reflects the benefits of risk-pooling.

The first order conditions for a maximum of problem III are,

$$\text{(IVa)} \qquad EU_2' \, [(pQ'_{i_{a_i}})]/n - V_a' = 0$$

$$\text{(IVb)} \qquad U_1'K + EU_2' \, [pQ'_{i_{\alpha_i}} \, (-K_i)]/n = 0$$

$$\text{(IVc)} \qquad U_1'\alpha_i + EU'_2 \, [pQ'_{i_{K_i}} \, (1-\alpha_i) - (1 + r_c)]/n = 0$$

Every agent solves a similar problem. The Nash equilibrium allocation is the simultaneous solution to the set of n first order conditions, one for each agent.

There is now a moral hazard problem, since α_i and a_i are not observable by the group, and thus cannot be contracted for. The group only observes K_i, and aggregate output. As of now we assume that the Q_i's are not observable by the group. Later we will relax this assumption.

To make the claim that a credit group regime dominates individualistic production from the agent's standpoint, we have to compare the expected utility levels under both regimes, namely the solutions to problems I and III. The tradeoffs are clear. Under regime I, the agent acts unilaterally, keeping all the proceeds induced by his actions, but has to incur higher input costs, and a higher variance of income, <u>ceteris paribus</u> and perhaps credit ceilings. While under regime III, he benefits from lower costs, lower variance but receives only one n-th of his contribution. His strategic behavior behavior vis-a-vis the other agents

(Nash non-cooperative) will tend to induce a lower contribution towards the general pool. If we evaluate the first order conditions IV at the optimal values given by the solution to II, we obtain that: i) the sign of IVa is negative, implying a lower effort contribution; ii) the sign of IVb is positive, implying that a higher proportion of credit will be allocated to nonproductive activities; and iii) the sign of IVc is positive, meaning that a larger amount of credit will be requested.

The allocation induced by III, is clearly suboptimal even relative to the second best or constrained efficient one. The credit group regime problem shares many features with the standard common ownership and team production problems. As with those, the equilibrium allocation is not Pareto optimal. Non-cooperative behavior there usually yields an inefficient outcome if joint output or liability is fully shared among the agents. Everyone's welfare can be improved by exercising restraint in present consumption, and by increasing the productive activities. The source of the inefficiency is that each agent imposes a negative externality on the others by the diversion of credit and actions from the productive activity. That behavior is nevertheless optimal for the agent, given the allocation rule of problem III, since while he incurs the full cost of the actions taken in the productive activity he receives only one-nth of the output; a similar argument applies for his use of credit on productive and nonproductive activities. That arrangement fosters moral hazard and free rider problems, since agents cannot be induced to supply proper amounts of productive inputs when their actions cannot be observed and contracted for directly. Moreover, a severe problem that can appear is that the agents might increase their credit demands and the proportion of credit for other nonproductive purposes (like current consumption), and decrease their effort contribution, reducing the expected production levels so much that credit group will be unable to repay the loans. Bankruptcy and failure of the credit group as a viable institution would be the end results. Therefore it should be clear that the internal dynamics of the set of actions taken by the members cannot be ignored, and a system of incentives based on the acquired information ought to be implemented to induce the desired or optimal actions. The critical elements in the design of incentive schemes are the nature of the information available, the nature of the uncertainty affecting the agents' output, and the structure of production.

The important question then is whether there are alternative institutional arrangements and incentive mechanisms that can elicit an efficient or at least a better allocation than the one described above for a credit group regime. Presumably the larger the difference between the allocation induced by I and the one induced by the credit group regime, the more attractive and stable the group will be. To resolve the question, we turn to the theory of incentives under imperfect information and moral hazard. We know that in these situations the assignment of an individual or entity to serve the role of a principal can reduce problems significantly, since implementing other allocation rules can induce more efficient outcomes (see Alchian and Dempsetz (1972), Mirrlees (1976), and Holmstrom (1982)). We can assign that role to the credit group. The group is empowered to monitor, allocate and implement incentive schemes. Given transaction costs and risk factors, delegating the monitoring to one or all members will enhance total output relative to what could be achieved on an individual basis. Thus, even though production will take place on an individual basis, the group aspect of the arrangement will require setting-up incentive schemes and sharing rules that are usually associated with teams and structures under observability and moral hazard problems.

Moreover, in its role as principal, the group can account for any surplus or deficit incurred. This is essential since it is often the case that "optimal" incentive schemes do not balance the budget. Without that capacity, those schemes might not be implementable.

Under certainty, and where only in aggregate is the outcome observable, one can construct a set of sharing (the output-income) rules, $s_i(y) \geq 0$, $i = 1, \ldots, n$, inducing a Nash equilibrium in actions, which satisfies the conditions for Pareto optimality. Generally, they take the following form: $s_i(y) = c_i$ if $y \geq y(a^*, \alpha^*, K^*)$, and $s_i(y) = 0$ otherwise, where the arguments of y are the Nash equilibrium and Pareto optimal actions. If all the agents are identical ex-ante, the sharing rules will also be identical for all agents. The optimal sharing rules are, in general, discontinuous in income, and need not be budget-balancing. This latter feature is essential to solve the free rider problem, and to neutralize externalities. It reflects the ability to sufficiently penalize deviations from the optimum. The enforcement problem is then overcome by bringing in a principal, in our case the credit group, which will assume the residual of the nonbudget-balancing sharing rules (when applicable).

Group incentives can also work quite well under uncertainty, particularly if the agents are risk-neutral. Mirrlees (1974), and Holmstrom (1982) have shown that a first best solution can be approximated arbitrarily closely by using group penalties. In that situation, the sharing rules, in general, take the following form: $s_i(y) = s_i y$ if $y \geq \bar{y}$ and $s_i y - k_i$ otherwise, where $\Sigma s_i = 1$, and $k_i > 0$. The term k_i describes the penalty to agent i if a critical output $\bar{y}$ is not reached. The effectiveness of these rules, however, is greatly reduced if there are many agents and if they are risk averse. Of course, the group has the option to subdivide itself into several cells to keep the size reduced when desirable. Under risk aversion and uncertainty in production, the first best is usually not attainable. Then monitoring becomes quite important since it can help improve welfare and achieve an allocation that approximates the first best, (see Holmstrom (1982) for a general statement of the problem). In our formulation, monitoring should be a viable and quite natural option, since observations by the group of each agent's output can be obtained, generically at fairly low cost. [3/]

Let us consider now those situations where the information system is so rich or monitoring so easy that total output can be itemized according to the contribution of each agent; this is the case when the Q_i's are separately observed; then,

$$Q(\S,z) = \Sigma_i Q_i(\S_i, z_i),$$

where $z = (z_1,\ldots,z_n)$, $\S = (\S_1,\ldots, \S_n)$ and $\S_i = (a_i, \alpha_i, K_i)$. If the z'_is are not random or observable by everybody, then efficiency can be achieved by holding each agent responsible for his own output. However, the most frequent case is where the z'_is are random and not observable. Then the sharing rules are functions of the output and should describe the proportion of insolvent loan claims to be assessed against agent i. In general, the optimal sharing rule of agent i will depend on something else than i's output. It will only depend on i's output alone if the outputs of all agents are independent.

Generally, the optimal set of sharing rules $\{s_i(y)\ i=1 \text{ to } n\}$ will have s_i depend on some relative or average measure like $\bar{y}$ and y_i alone where $\bar{y}$ is a weighted average of the agents' outcomes. The only assumptions needed to generate these results are that v, $h_1,\ldots,h_n$ are independent and normally distributed. The intuition is that the aggregate measure of peer performance $\bar{y}$ captures all the relevant information about the common uncertainty. In other words, the aggregate measure, $\bar{y}$, is then a sufficient statistic. Clearly, this rationalizes the common practice of comparing performance against peer aggregates, and basing compensations (pecuniary or non-pecuniary) on that differential.

In those contexts, incentive schemes based on relative output performance, or rank-order tournaments can do quite well as has been shown in Nalebuff and Stiglitz (1982) and Bhattacharya and Guasch (1988). 4/ They can be utilized, not only to elicit the desired actions, but also to allocate among the members the excess balance of the credit group, induced by interest rate differentials or nonbudget-balancing rules. A rank-order tournament awards agents merely on their performance rank, not on the value of the output itself; thus it is based on ordinality as opposed to cardinality. An advantage of this compensation scheme compared to others based on cardinality is that it requires less information since only the ranking of the agents needs to be determined. In particular, when all agents' output (the monitored variable) is subject to a common (correlated) risk or random variable, these reward (or penalty) schemes automatically neutralize that risk or adjust for its effects.

A rank order tournament generally consist of a set of n prizes $q_1 \geq q_2 \geq \ldots \geq \ldots q_n$, one for each agent, and an observable variable(s) upon which the ranking of the agents is established. If that variable is, say, the output, then the agent with the highest output receives q_1, and so on. Of course, some of the prizes can be penalties.

If the agents are risk neutral, a properly designed contest can elicit the efficient allocation, (see Lazear and Rosen (1981), and Bhattacharya and Guasch (1987) with either homogenous or heterogeneous agents. Moreover, under risk aversion, such contests may be preferred to individualistic reward schemes, particularly when the risk associated with the common environmental variable, v, is large. Again, the role of a principal is essential for the implementation of these schemes. Among the various forms a contest can take, that with a penalty to the lowest ranked individual will be superior to one with a prize to the highest ranked individual (see Nalebuff and Stiglitz (1982) for an analysis of relative effectiveness of different types of tournaments). [5/]

DYNAMIC CONSIDERATIONS

The analysis developed above has been largely static. It begs the question of why agents do not 'take the money and run', and limits enforcement considerably. In a static framework, threats to agents for departing from the expected or established course of action are not credible, since they cannot be implemented. By the time inferences or observations can be made about deviant agents, the game is over, so retaliation cannot take place. It is only in a dynamic (infinite or uncertain horizon) framework that stated punishments can be carried out. Future periods provide the place for disciplining agents who deviated and the agents can take into account the future consequences of any deviations.

A dynamic analysis increases the viability of credit groups. Given the moral hazard and team problems, the success of the credit group in supporting a cooperative scheme that is superior to an individualistic one lies in its ability to punish any defector from the scheme. In this section, we extend the previous analysis to an environment where each agent, within a credit group regime, repeatedly sets his choice variables. The group responds to such choices. This becomes a repeated game and since we are considering an infinite number of repetitions, it is a supergame. The environment does not change and decisions can be made contingent on past outcomes of the game.

In our structure, the credit group cannot perfectly observe or infer the actions a_i and α_i taken by the agents. Then the natural strategies for the credit group to consider are trigger output or review. Mentioned by Stigler (1964), their general formulation has been developed by Green and Porter (1984) in repeated collusive market games and by Radner (1985) in repeated games with imperfect monitoring and moral hazard, and are most appropriate in formulations with informational imperfections. Our formulation is a hybrid of those two types of problems. While each agent prob. m is more like a repeated moral hazard problem, the fact that it has consequences for group welfare (the expected utility of a member of the group depends positively on the size of the group) brings in the market element.

Under trigger output strategies, each agent selects his level, agreed by the group, of unobservable actions, until his output (if observable by the group) or the aggregate output falls below a certain specified trigger output Q^*, during some period. Then, in the former case, that or those agents whose output falls below that selected trigger benchmark is or are forced out of the credit group for T-1 periods. After T periods, the agent(s) is/(are) allowed to return to the credit group, to resume cooperation and so on. If aggregate output is the only observable variable, when output falls below its trigger value the credit group is dismantled for the T-1 periods. After T periods, the credit group resumes operations. The analysis below deals with this latter case, but it also fits the former when the expected utility for any agent in the group does not depend on the number of members. This would be the case if the group is quite large. Then, at the margin or inframargin the variation is negligible since all the scale effects are exhausted at a relatively smaller size. Otherwise, we need to keep account of the size of the group and corresponding probabilities. Our choice is based on ease of exposition.

A trigger output scheme is characterized by four parameters, assuming identical agents, a^*, α^*, Q^*, and T. Note that the capital or loan principal K, need not be part of it since it is observable, and can be forced to the agent at the onset of each period. The problem for the credit group is, then, to select values of those parameters in order to induce the highest possible expected utility for each agent. Deviations from agreed actions are undesirable to the group because they might lead to insolvency of the agent. Then because of the joint liability, the group has to cover the losses.

Let $\bar{U}^c$ be the agent's expected payoff per period under cooperative behavior in the credit group regime. Let $\bar{U}^m$ be the expected payoff per period when operating on his own. Let σ be the discount rate and β the induced probability of having a realization of output below the trigger level. The distribution of that probability depends on a, α, K, the trigger output Q^*, and the random variables v and h.

The overall expected utility $\bar{U}$ to each agent is given implicitly by:

$$\bar{U} = \bar{U}^c + (1 - \beta)\, \sigma\bar{U} + \beta\, (\bar{U}^m\, (\sigma + \ldots + \sigma^{T-1}) + \bar{\sigma}^T U).$$

It contains three elements: (1) the current expected payoff from agreed or cooperative behavior; (2) the expected utility starting next period when the credit group is still operating, discounted by the probability of that event, namely that the output is above the specified level and (3) the expected utility upon the credit group being dissolved for T-1 periods, and resuming operations thereafter affected by the probability of that event. Solving for $\bar{U}$, we obtain:

$$\bar{U} = [(1/(1-\sigma))\ (\bar{U}^c\ (1-\sigma) + \bar{U}^m\beta(\sigma-\sigma^T)/((1-\sigma) + \beta(\sigma-\sigma^T))]$$

further manipulations yield:

$$\bar{U} = [(\bar{U}^m/(1-\sigma)) + (\bar{U}^c - \bar{U}^m)/((1-\sigma) + \beta(\sigma-\sigma^T))],$$

with the two terms being, first the expected utility from the individualistic regime from now on, and second, the single period gains accruing each period from now on from the cooperative behavior, properly discounted.

Then the credit group problem is:

$$\max \bar{U} = \max\ [(\bar{U}^m/(1-\sigma)) + (\bar{U}^c - \bar{U}^m)/((1-\sigma) + \beta(\sigma-\sigma^T))],$$

$$\text{s.t., } (\partial U_i/\partial \alpha_i)|\alpha^* \leq \sigma(\partial\beta/\partial\alpha_i)((\bar{U}^c - \bar{U}^m)/(1-\sigma+\beta\sigma)),$$

and,

$$(\partial \bar{U}_i/\partial a_i)|_{a^*} \leq \sigma(\partial\beta/\partial a_i)((\bar{U}^c - \bar{U}^m)/(1-\sigma+\beta\sigma)),$$

where the first constraint guarantees that it will not be possible to increase the agent's expected utility by increasing the share of capital for nonproductive purposes beyond α^*. The second constraint states that the agent cannot increase his expected utility by decreasing his effort below a*. The solution of this problem will determine a*, α^*, Q*, and T* which provides for the maximum expected utility and makes the credit group sustainable.

It could well be that the optimal solution is to set T equal to infinity. Then if the output level falls below a certain specified trigger level Q*, the credit group is dissolved forever. However, that policy might not always be optimal, since it might induce agents to make excessive efforts, when on average they all can be made better off by selecting a finite T. It depends on the discount rate and the difference betweeen $\bar{U}^m$ and $\bar{U}^c$. The characteristics of the solution to problem V, are as follows. For risk averse agents, the resulting allocation generates higher levels of utility than those induced in the static framework. In equilibrium, agents do not deviate from agreed actions, but excluding agents or dissolving the group takes place every now and then, during periods cf 'bad' realizations of the random variable affecting production. It is optimal for agents to supply less effort or less expected output than the levels they would choose if operating alone but under the same terms (interest rate) of the credit group. Agents go through alternative phases of being in the credit group and operating outside the group. While the latter phase is deterministic, lasting T-1 periods, the former phase has random length. The optimal length of exclusion or dissolution might be infinite. 6/ Another advantage of the dynamic formulation of the problem is that to implement the allocation stated above, the credit group need not have as large a degree of control as it is required to implement the sharing rules or contest induced allocations in the static formulation.

EMPIRICAL EVIDENCE

The empirical evidence on credit cooperatives is quite extensive and rather a mixed bag. Examples of successful cooperatives and credit groups abound, particularly in East Asia. A large number of credit programs in that region have achieved most of their objectives, particularly in reaching a large number of small agents, having high repayment rates and increasing output in a cost-effective manner. Besides early land reform, the success of rural credit programs in Korea, Taiwan and Japan have been frequently attributed to strong village cooperative systems which have provided significant incentives to participate and comply, as well as credible enforcement procedures. Peer esteem and social norms served the role of an effective incentive scheme. Other successful examples are scattered throughout different countries, like Kenya, Malawi, Nicaragua, etc. The success there can be attributed to a much better incentive, control and monitoring systems (see von Pischke, Adams and Donalds (1983).

Unfortunately, however, the empirical evidence also indicates that the number of failed cooperatives is extraordinarily large. Thailand is a typical example. Despite the extensive cooperative network in Thailand and the government's significant involvement in their development, the success rate has ranged from mediocre to poor. The reasons are the following: first, a lack of sense of belonging and joint responsibility by most members. Cooperatives are perceived as merely nominal organizations. Second, cooperatives lack efficient administration and are short on incentive schemes. Dishonesty is quite common amongst officials. Third, there is not much coordination with the financial intermediary. Fourth, there does not seem to be much coordination between the credit, marketing and production activities within the cooperative. Last, their large size and lack of proper monitoring activities coupled with the perception by members that credit funds are more like grants or aid given by the state induces detachment, high delinquency rates and the improper use of funds. Poor performance such as Thailand exhibits--even relative to individual farmers--is quite disturbing, since we tend to think of cooperatives as an effective tool for rural development and for improving the plight of small farmers. Delinquency rates through the last decade have ranged from 35 percent for individual farmers to 60 percent for farmers' cooperatives and associations on average.

The viability of any credit organization is strongly linked to its success in recovering loans. Strong punitive measures and a proper set of incentives ought to be implemented to induce high repayment rates; those elements seem to be lacking in most credit cooperatives, thus the high failure rates. Most empirical studies of credit group programs in rural areas in developing countries report low recovery rates. Defining default or non-performing loans as those loans that are still on the books, but are past due by 90 days or more, are non-accruing, or have been renegotiated, those studies have indicated default rates ranging from 20 percent to 95 percent for credit programs in Africa, the Middle East, and Latin America. Similar results have been reported in South and Southeast Asia, (see Braverman and Guasch, 1986). To some extent, the reasons for those high levels of default can be attributed to a lack of properly designed incentive schemes, lack of enforcement procedures and quite often to a self-serving confusion on the farmer's part regarding the nature of credit. It is not unusual for them to perceive the loans as grants or welfare. In fact, in some South Asian languages the word used for loans from government institutions (tagai, taccari) means "assistance, grant". Thus the reluctance to repay those loans should not be surprising.

CONCLUSIONS

We have presented an analysis of the motivation, formation and design of credit cooperatives. We have shown that they can provide significant advantages to their members, insofar as their intrinsic informational and moral hazard problems are properly accounted for. Particular care to the design of incentive mechanisms is warranted if credit cooperatives are to prove successful. The incentive schemes, degree of control, enforcement and information gathering by the credit cooperatives are most important to predict the likelihood of success. Long-term arrangements, rather than one-shot liaisons can provide higher benefits to the members and financial viability to the organization.

We have also mentioned the empirical relevance of those forms of organizations, describing some of both successful and unsuccessful ventures. By and large, the elements that we have been able to identify as present in the successful incentive schemes, control of resources, quality monitoring and enforcement of punishing rules. We believe that a policy of providing assistance to existing and potential credit groups on how to set incentives, implement monitoring schemes and develop centralized control of resources, is most desirable and should receive highest priority. Moreover, it is better and much more cost effective than the old fashioned and largely regressive subsidized credit policies. It is just as important to address the political rigidities that so often hamper genuine cooperative promotion.

FOOTNOTES

1/ The arguments are as follows. The lower the r is, the larger the demands from both types of agents for institutional funds. As stated above, on purely efficiency grounds, if there is need for rationing, the small agents will be the affected ones. Moreover, the larger the difference between r and the "free" market, the more attractive the subsidized loans (the larger the income transfer) are and the stronger the pressures put upon the lending institution by the larger agents. As a result, the share of the institutional funds going to small agents will decrease as the rate r decreases and in consequence, the demand for credit by the small agents in the informal market will increase.

2/ If indeed reaching a large number of small agents is one of the main objectives of credit policies, another option is to intervene directly in the credit market by setting targets or quotas in the composition of the institution's loan portfolio. Then a proportion of the funds allocated to the institution is earmarked for the small agents. A more detailed intervention might entail a description of the number of agents to be reached as well as the size of the individual's loan to be allocated. Incentives to induce compliance will need to be developed. They can take the form of tying future availability of public funds to the institution's portfolio composition and performance. Another option would be to offer interest rate rebates on loans granted to the targeted groups of agents up to a certain proportion or volume of funds; this is equivalent to subsidizing targeted loans ex-post to neutralize the higher transaction cost and risk arguments.

3/ Alternative budget-balancing sharing rules that might prove effective if the agents are sufficiently risk averse are those where all the agents but one (randomly chosen) are penalized, a massacre contract, or those where one agent (randomly chosen) is severely penalized, a scapegoat contract, whenever the output falls below the desired level. Their effectiveness has been shown by Rasmussen (1987) in the absence of production uncertainties. A problem with those rules is that they might require the agents to have significant wealth endowments.

4/ Following upon the early work of Lazear and Rosen (1981), and Bhattacharya (1982), the optimality of tournament contracts in that context has been shown for heterogeneous agents by Bhattacharya and Guasch (1988) and for a restricted scenario in which marginal productivity of effort is not affected by common shocks, in Green and Stokey (1983), whereas Lazear and Rosen (1981) and Nalebuff and Stiglitz (1983) have compared tournaments with linear piece-rates contracts.

5/ For a game-theoretic analysis of individual incentives to form cooperatives, see Sexton (1986), and Staatz 1983). These studies depart from the traditional organization-oriented approach to cooperative analysis and emphasize the core of the game as the viable solution or allocation. The idea is that since there are gains to be realized by forming a cooperative, relative to each one acting independently, one has to consider how the gains ought to be allocated among the members, particularly when they are not identical. In addition, for a view of the traditional analysis of cooperatives and of its motivations see, e.g., Helmberger and Hoos (1962), and Vitaliano (1983).

6/ A generalization of the trigger-price strategies models has been developed by Abreu, Pearce and Stacchetti (1986), where they characterize the optimal strategies. They take a fairly simple form. The punishment phase last only one period and carries a more severe punishment than unilateral production. Its usefulness in our framework is questionable since punishments more severe than exclusion from the group might not be implementable. A policy to force the defector(s) to work as bonded labor for a period might not be sustainable.

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To overcome these obstacles, small-scale farmers have formed organized credit groups and cooperatives. But such endeavors have frequently failed.

This paper takes new developments in the theory of incentives and organizations and applies them to the institutional design of credit cooperatives.

Because the proper design of these organizations considerably increases their likelihood of success, policies to promote appropriate designs could be much more effective than mere subsidies, the predominant policy instrument so far.

More specifically, the focus of such policies should be on the optimal nature and scope of joint-liability arrangements, on the gathering and use of information in setting incentives, and on the rigidity of enforcement rules.

This paper is a product of the Agricultural Policies Division, Agriculture and Rural Development Department. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Cecily Spooner, room J2-084, extension 37570. The paper will also appear in Pranab Bardhan (ed.), *Economic Theory for Agrarian Institutions*, Oxford University Press (forthcoming).

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