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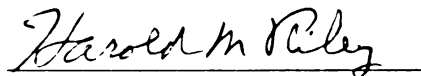
*A Theoretical Perspective on the
Behavior of Farmers' Cooperatives*

presented by

John Michael Staatz

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Major professor

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A THEORETICAL PERSPECTIVE ON THE BEHAVIOR
OF FARMERS' COOPERATIVES

By

John Michael Staatz

A DISSERTATION

Submitted to
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ABSTRACT

A THEORETICAL PERSPECTIVE ON THE BEHAVIOR OF FARMERS' COOPERATIVES

By

John Michael Staatz

Most formal models of the economic behavior of farmer cooperatives are extensions of the neoclassical theory of the firm under certainty. They investigate industrial-organization issues but do not address how the benefits and costs of collective action are distributed among the participants in farmer cooperatives, an issue that has become increasingly exigent as cooperatives have developed larger and more heterogeneous memberships.

This study develops a theoretical analysis, based on game theory and organization theory, of how the costs and benefits of cooperative activity are distributed among three classes of participants in farmer cooperatives (farmer-members, board members, and management) and of how that distribution affects the organizations' behavior. Initial chapters review previous models of decision making in farmer cooperatives, identify distinguishing structural characteristics of farmer cooperatives and some of their behavioral consequences, and develop a model of decision making within these organizations. The model assumes: (a) there are often net benefits to farmers in undertaking economic activities through cooperatives, (b) for those net benefits to be realized the payoffs to individual participants must be structured so

John Michael Staatz

as to induce their participation in the cooperative, and (c) information and other transaction costs play a crucial role in how individuals evaluate those payoffs. Subsequent chapters investigate the nature of the benefits farmers derive from founding or joining a farmer cooperative and analyze how many allocational issues in farmer cooperatives, such as the pricing of member services, can be addressed using the theory of cooperative games. Other issues, such as how to ensure member loyalty, are investigated using noncooperative games, including the prisoner's dilemma, the coordination problem, and the concept of supergames. The game-theoretic analysis is then modified to take account of transaction costs and the altering of members' preferences through the inculcation of cooperative ideology. A case study of the changing pooling practices of fruit and vegetable processing cooperatives illustrates many of the conceptual tools developed in the study. A final chapter discusses further ways of empirically applying this approach and some of its policy implications.

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Appropriately, this study of collective action represents a collective effort, and I want to thank all those who contributed to it.

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INTRODUCTION

This study grew out of a concern by officials of the Agricultural Cooperative Service (ACS) of USDA that existing economic theories of the behavior of farmer cooperatives did not adequately address many of the issues facing participants in farmer cooperatives, particularly participants in large, multiproduct cooperatives. As American agriculture and agribusiness have grown over the past thirty years and as farmers have become more diverse, farmer cooperatives have had to face a new set of challenges. Cooperative members and managers have increasingly questioned whether treating all members equally is either financially feasible or truly equitable, particularly when the costs of serving them differ. As farmer cooperatives have grown, some have found it increasingly difficult to induce members to contribute equity capital, and members of large, complex associations have often become concerned about their ability to monitor the actions of management and discipline it if necessary. Understanding these issues requires an understanding of internal decision making within the cooperative; however, most of the existing economic theory of farmer cooperatives, which is largely an extension of the neoclassical theory of the firm under certainty, pays little attention to the internal organization of the cooperative and therefore cannot adequately provide this understanding. In order to develop theoretical tools to address these issues, ACS funded research on cooperative theory at four land-grant universities: Missouri, Connecticut, V.P.I., and Michigan State. This dissertation is part of that larger joint research effort.

Over the past thirty years, economists and organization theorists, such as Simon, Williamson, and Cyert and March, have greatly broadened our understanding of decision processes within investor-owned firms.¹ In addition, techniques such as game theory have developed which address the issue of group choice in the presence of conflicting interests. One of the motivations for this study was the belief that theoretical concepts developed to examine decision making in investor-owned firms could be usefully extended to farmer cooperatives.

Although much of the work presented here represents an attempt to extend concepts from organization theory, game theory, and transaction-cost economics to farmer cooperatives, the research did not simply involve a priori theoretical reasoning. Open-ended interviews were conducted with over sixty cooperative managers, farmer-members, and board members; and numerous USDA, land-grant-university, and agribusiness personnel from throughout the United States who work closely with cooperatives were interviewed as well. These interviews helped to guide the development of the theory presented here and permitted preliminary testing of hypotheses, although not in a strict statistical sense. The sample was not random; it represented a broad spectrum of industry leaders chosen because they could offer particular insight into the issues being investigated. Many were interviewed at three major conferences: the annual meeting of the National Council of Farmer Cooperatives in 1982, a

¹In this study, the term "investor-owned firm" (IOF) is used to denote privately owned firms in which there is no legal limit on payments to equity capital and in which a stockholder's vote is weighted by the amount of stock (s)he owns. The term is used in preference to "private corporation" or "proprietary firm" because almost all large cooperatives are incorporated and owned directly or indirectly, by private individuals. The term IOF is also preferable to "noncooperative firm" because all multi-person organizations require cooperation.

milk-marketing seminar held at Michigan State University in 1982, and a conference on cooperative research (jointly sponsored by ACS, the Farm Foundation, and the University of Missouri), held in St. Louis in 1983. Others, both in the Midwest and the West Coast, were contacted individually and through the author's participation in extension workshops with Michigan cooperatives. Although participants from a broad range of cooperatives were interviewed, particular emphasis was given to participants in fruit and vegetable processing cooperatives. Many of the issues involving the distribution of costs and benefits of collective action, which is the central focus of this study, are starkly illustrated in the pooling and cost-allocation decisions of these cooperatives. Focusing on decision making within fruit and vegetable processing cooperatives therefore yielded insights into the broader issue of how farmer cooperatives allocate the costs and benefits of their actions among those who participate in the organizations.

The study is written in the institutionalist tradition. It recognizes that nonprice mechanisms, such as voting procedures in a cooperative, as well as prices are important allocators of resources in the economy and as such warrant investigation by economists. At its broadest level the study seeks to improve our understanding of what farmer cooperatives are, why they arise, why they adopt particular structures and practices, and what consequences their actions have for both participants and nonparticipants in the cooperatives.

A note about style: throughout the text masculine pronouns and possessives are used rather than the more accurate but cumbersome terms "he or she," "him or her," and "his or her." This is done simply to improve the flow of the text; in no way does the author mean to imply that

cooperative participants are only men, and he apologizes to those who may be offended by his choice of terms.

CHAPTER 1

PROBLEM STATEMENT AND REVIEW OF THE LITERATURE

"Taken by and large, cooperators are long on practice and short on theory." Nourse (1922), p. 161.

Problem Statement

Farmer cooperatives are a form of collective action in which individuals join together to accomplish things that would be more costly or impossible to accomplish individually. The benefit a person derives from a cooperative depends on the structure, rules, and practices of the organization, which define the person's relationship to the collectivity. This study examines how alternative structures, rules, and practices affect how the costs and benefits generated by farmer cooperatives are distributed among the participants in these organizations and the implications of these alternatives for the behavior of farmer cooperatives.

As long as all the members in a farmer cooperative want the cooperative to pursue similar goals and place similar demands on the organization, allocation of costs and benefits among the members may be relatively easy; equal sharing of the costs and benefits may pose few problems. Once the members begin to vary substantially in the goals they want the cooperative to pursue and the demands they place on the organization (which depend in part on the other market alternatives open to the different members) allocation of costs and benefits becomes more problematic. Equal treatment of all members may no longer be perceived by

everyone as equitable and may give certain members incentives to leave the organization, thereby threatening the ability of the cooperative to carry out the functions for which it was created.

As the membership of a cooperative becomes more heterogeneous, the individual's relationship to the collectivity becomes more complex. Growth of a cooperative often allows the organization to achieve goals that a smaller cooperative could not, but it also broadens the scope for implicit income transfers both among the members and between the members and the employees. As the cooperative provides services to an increasingly diverse membership, the sharing of costs and the pooling of revenues may become more contentious. In addition, an increasing number of nonmember participants (hired employees, input suppliers, and so forth) become involved with the organization, with each group seeking certain benefits from its association with the cooperative. The rules prescribing the cost-sharing and revenue-pooling procedures and the agreements specifying the relationships of nonmember participants to the organization determine the distribution of net benefits derived from the organization.

The issue of the distribution of the benefits and costs within farmer cooperatives has become increasingly exigent as these organizations have developed larger and more diverse memberships and have relied increasingly on hired management to make both day-to-day and longer-term business decisions. In the 62 years since the passage of the Capper-Volstead Act, farmer-owned cooperatives have developed into major, at times dominant, forces in parts of the U.S. food system. Like investor-owned firms, cooperatives have become fewer, larger, broader in their range of activities, and more complex bureaucratically. Several farmer

cooperatives have sales in excess of \$1 billion annually and number among the Fortune 500 (Ingalsbe).

The environment in which agricultural cooperatives operate has also changed radically. Farmers are now a more diverse group, more highly specialized and closely integrated into national and international product and factor markets. The investor-owned firms with which cooperatives compete have become larger and more complex, and are often parts of conglomerates that pursue activities in many sectors of the economy.

The increasing size and complexity of farmer cooperatives raise important questions for farmer-members, boards of directors, cooperative managers, and society as a whole concerning the distribution of costs and benefits of cooperative activity. Individual farmer-members are concerned about ensuring that their interests will be served in an organization owned by an increasingly diverse membership and run on a day-to-day basis by a bureaucracy that may have goals for the cooperative different from those of the farmer-members. They are also concerned about maintaining the ability to monitor the organization's performance accurately and modify it if necessary. Management and the board of directors must address several questions, such as how to interpret the desires of a diverse membership and design policies and practices that are simultaneously consistent with these desires and with the competitive constraints faced by the cooperative, how to allocate decision-making authority between the board and management, and how to allocate costs and benefits intertemporally within the cooperative through decisions regarding the growth and financing of the organization.

Social concerns about the distribution of benefits and costs of cooperative activity have also increased as farmer cooperatives have

become larger and more diverse organizations. In the United States, a general belief that agricultural cooperatives serve the public interest is embodied in federal and state statutes that give cooperatives certain tax advantages relative to investor-owned firms, provide a limited antitrust exemption to marketing cooperatives, and establish specialized public agencies to assist cooperatives, such as the Agricultural Cooperative Service of USDA. Public support for farmer cooperatives seems to be predicated in part on the belief that a market system that includes cooperatives distributes the benefits and costs of economic activity more equitably than a system comprised solely of IOFs. This view has been increasingly challenged, as critics of large cooperatives have charged that these organizations differ very little from large IOFs. Large cooperatives, the critics allege, are controlled by management and a few large patrons, who capture most of the benefits of the cooperative's activities (Kravitz).

Most previous efforts to model the economic behavior of farmer cooperatives have concentrated on deriving "optimum" pricing and output rules for cooperatives and on analyzing the effects these rules have on the competitive structure of an industry. Although previous theorists have not entirely ignored the distribution of benefits and costs within farmer cooperatives, this has not been the main focus of their work. Previous models have generally paid little attention to the internal structure of cooperatives and to how co-ops' goals and practices arise, factors which are likely to be major determinants of cooperatives' behavior. The aim of this study is to develop a more detailed theoretical analysis of decision making within farmer cooperatives which is capable of shedding light on how costs and benefits are allocated within these

organizations and on the consequences of that allocation for the performance of farmer cooperatives. In particular, the study develops an approach that views farmer cooperatives as coalitions of individuals who undertake joint action to achieve certain goals. For that joint action to be successful its costs and benefits must be distributed in a way that aligns individual incentives with group goals, and the analysis focuses on the consequences for the cooperatives' behavior of allocating costs and benefits in alternative ways. In developing that theoretical analysis it is useful first to review in some detail previous efforts by economists to model the behavior of farmer cooperatives.

Review of the Literature

Sosnick (1960) argued that theoreticians have tended to view the farmer cooperative in three distinct ways: (1) as a form of vertical integration by otherwise independent firms, (2) as an independent business enterprise, which can be analyzed as a variant of the investor-owned firm, and (3) as a coalition of firms in which there is "a revocable substitution of collaboration for independent competition."

Each of the theoretical perspectives has its strengths and weaknesses, and some authors (for example, Kaarlehto, 1956) have combined more than one perspective in their analyses of farmer cooperatives. Viewing the cooperative as a form of vertical integration stresses the problems cooperative members face in trying to vertically coordinate and jointly optimize more than one level of production. Analysis carried out in this framework emphasizes that the optimum pattern of behavior of a cooperative should differ from that of an investor-owned firm because the optimization process in a cooperative takes place over a broader set of variables than in an IOF. (For a cooperative, decision variables include

both those at the farm level and those at the cooperative enterprise level.) Viewing the cooperative as a form of vertical integration also raises the issue of how an optimum pattern of behavior for the jointly-owned cooperative can be determined if the member-owners differ with respect to their preferences and resources. A major weakness of much of the literature on the cooperative as a form of vertical integration lies in its frequent assumption that the actions of a cooperative reflect purely the sum of the independent actions of its members--that there exists no separate locus of decision making within the cooperative itself. Furthermore, as argued in subsequent chapters, because a cooperative represents the attempt of many competing firms to integrate vertically through a joint plant, the scope for certain behavior on the part of the cooperative (for example, in setting the relative prices of its products) may be much more limited than that of a single firm that vertically integrates.

Viewing the cooperative as simply a firm that happens to be owned by its patrons focuses attention on the cooperative as a risk-bearing and decision-making entity separate from its member-owners. In so doing, this approach suggests that existing neoclassical and behavioral models of the investor-owned firm can be adapted to analyze cooperative decision making. Viewing the cooperative as a separate decision-making entity also raises the issue of the separation of ownership from control in these organizations. This approach tends to give relatively little attention, however, to the vertical coordination issues faced by cooperatives and to the consequences of having the stockholders consist of competing firms.

Analyzing the cooperative as a coalition focuses attention on the relationship of the individual member to the collectivity and on the income-distribution implications of the cooperative's practices regarding pooling, joint cost allocation, and financing. This approach also emphasizes the need to maintain adequate incentives to individual cooperative members to induce them to remain within the coalition--cooperative managers cannot focus simply on increasing the aggregate income of the organization; they must also be vitally concerned with its distribution. The coalitional approach, while it emphasizes the problems of collective action by a heterogeneous group of participants, sometimes underestimates the scope for autonomous decision making by the cooperative as a business entity separate from its member firms. (This is in part due to the failure of some of these models to deal adequately with information and other transaction costs.) The approach sometimes also fails to give adequate attention to vertical coordination issues.

Most of the remainder of this chapter is devoted to a review of previous theoretical studies of farmer cooperatives as forms of vertical integration, as separate types of independent business entities, and as coalitions of previously competing firms or individuals. The review does not cover all aspects of cooperative behavior; it emphasizes those aspects of cooperative theory dealing with the distribution of the benefits and costs of cooperative activity.¹ The review is further limited in that it deals primarily with the literature on agricultural marketing and supply cooperatives. Theoretical analyses of consumer cooperatives,

¹For general reviews of the theory of farmer cooperation see Vitaliano (1977), Helmberger, Campbell and Dobson (pp. 556-62), and LeVay.

producer cooperatives, and the labor-managed firm (e.g., Ward, Domar, Vanek), which in many ways parallel analyses of marketing and supply cooperatives, are discussed only tangentially.

The Cooperative as a Form of Vertical Integration

Basic Models

Although discussion of farmer cooperatives as a form of vertical integration goes back at least as far as Nourse (1922), formal modeling of agricultural cooperatives as a form of vertical integration did not begin until the 1940s with the work of Emelianoff.¹ From the 1940s through the early 1960s much of the debate in cooperative theory focused on whether cooperatives represented purely a form of vertical integration by farmers, that is, simply an extension of the member firms, or whether cooperatives could legitimately be analyzed as organizations having scope for decision-making independent of their member firms. This debate was often phrased in terms of whether cooperatives were really "firms."

Emelianoff, Phillips, Robotka, and Roy were major proponents of the view that cooperatives served merely as coordinators of joint action by their otherwise independent member firms. These authors argued that because a cooperative operated at cost, it did not incur profits or losses itself; only its member firms incurred profits or losses. Therefore, the cooperative was not an acquisitive unit and was no more an

¹Nourse argued that farmers should use cooperatives to integrate vertically into marketing, processing, and supply activities in order to give farmers a standard against which to judge the performance of the IOFs serving them and to force these firms to behave more competitively. This view of the role of cooperatives became known as "the competitive yardstick school of cooperative thought" (Cotterill, 1983a; Vitaliano, 1980).

independent firm than, for example, the shipping department of a vertically integrated investor-owned firm. In Phillips's words (pp. 74-76):

When a group of individual firms form a cooperative association, they agree mutually to set up a plant and operate it jointly as an integral part of each of their individual firms (or households in the case of a consumer cooperative). The cooperative has no more economic life or purpose apart from that of the participating economic units than one of the individual plants of a large multi-plant firm. Instead the participating firms agree to function coordinately with respect to their joint activityit is technically correct to speak of the cooperative plant and of cooperating firms, but not of the cooperative firm.

Robotka (1957) argued that the cooperative represented a federation of sovereign firms, not an independent firm itself.¹ The participating firms operated a joint economic plant, not a new firm, and although they submitted certain questions to joint decision making, they did "not surrender their individual prerogatives as they relate to the jointly conducted activity. Each still functions as a sovereign unit in deciding whether or not to participate in the jointly conducted activity " (pp. 131-32). Robotka's emphasis on the cooperative as a form of voluntary collaboration and as a nexus of contractual relationships among its member firms presaged later theoretical work on the cooperative as a coalition.

Roy agreed with Emelianoff, Phillips, and Robotka that the cooperative did not constitute an independent firm, which he defined as an organization that "seeks and acquires entrepreneurial profit on its own

¹ Robotka's view of cooperatives changed over time. In his earlier work (1947) he held that members delegated responsibilities to the cooperative, and hence the cooperative became a new decision-making and risk-bearing body whose decisions changed the nature of the risks faced by the member firms. Therefore, cooperatives could not be analyzed entirely in terms of their member firms; they had to be examined as organizations and decision-making units in and of themselves. By 1957, however, Robotka's view of cooperatives had become similar to that of Phillips.

account" (p. 269). This explained, Roy stated, the limited dividends paid on member equity in cooperatives. "In a cooperative, the capital subscribed is neither entrepreneurial nor acquisitive" (p. 11); it is a loan, at a specified rate of interest, from the member to the association. The entrepreneurial risks are borne by the co-op members when they patronize the cooperative; hence, returns to those risks are distributed according to patronage rather than according to capital contribution.¹

Kaarlehto (1955, 1956) argued that cooperatives had to be viewed primarily as a form of economic integration because "the cooperative strives to perform the business activities, selling or buying, of its member firms in the way which is most profitable for them...as compared with the purpose of an enterprise or private profit firm [which is] quite independently striving for profit maximization" (1955, p. 85). He stressed: (1) that it would not always be in the interest of the members to optimize the performance of the cooperative as a single entity (for example, to minimize average cost in a purchasing cooperative); rather, the goal should be to optimize the combined farm-cooperative operation; and (2) that vertical integration via a cooperative is more complex than other forms of integration because of the large number of independent economic units involved. Whereas vertical integration by an

¹This view of the cooperative as a form of vertical integration seems to underlie much of U.S. public policy towards farmer cooperatives. For example, federal income tax law exempts cooperatives from paying tax on that part of their surplus (qualified patronage refunds) that they distribute back to the membership. The tax liability accrues to the member firms. For an economic justification of such tax treatment, based on the view of the cooperative as a form of vertical integration, see R. Taylor. For details on the U.S. tax treatment of cooperative earnings see appendix A.

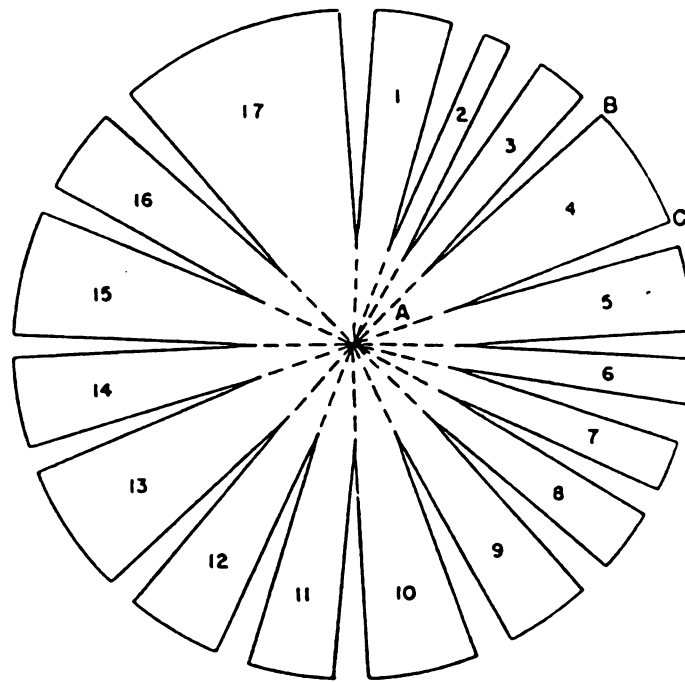
IOF may simply involve coordinating production in two separate plants, integration via a cooperative involves coordinating the actions of the jointly owned plant with those of many heterogeneous firms.

Kaarlehto went on to analyze how members with different cost functions would participate to varying degrees in the cooperative's activities and how the presence of a cooperative would affect the price and output levels in various market configurations. Kaarlehto's graphical analysis of both these issues presaged the work of Helmberger and Hoos, described below. (For a concise summary of Kaarlehto's work, see Vitaliano (1977), pp. 27-28.) Like Emelianoff, Phillips, and Roy, Kaarlehto's formal model of cooperatives made no mention of an independent role for management in cooperative decision making.

Distribution of Costs and Benefits

The view of the cooperative as purely a means of vertical integration by otherwise independent firms is summarized in Figure 1.1, taken from Phillips (p. 76). Each triangular numbered section represents a member firm, and the small uninscribed circle at A represents the joint plant. Each member firm is conceived as including part of the joint plant and that "joint plant is indistinct except as part of each of the member firms" (p. 76).

Consistent with the view that the cooperative simply constituted the sum of all the member firms' proportionate shares of an off-farm plant, Phillips believed that in order to achieve a static optimum, each member firm would have to share the benefits and costs of the joint plant in direct proportion to the member firm's share of the total business conducted through the cooperative. Similarly, the benefits and costs of individual departments within the cooperative should be allocated among



**Figure 1.1 Phillips's Conception of
the Cooperative Structure**

the members in direct proportion to their use of those departments, and the benefits and costs of using the cooperative should be distributed intertemporally in proportion to use. In the absence of perfect knowledge about the future use of the cooperative, costs and benefits should be allocated on the basis of anticipated rather than actual proportionality (pp. 76-78).

Based on the assumption of proportionality and the view of the cooperative as purely a form of vertical integration by member firms, Phillips derived the conditions for determining the equilibrium output of the cooperative and of each member firm. (Throughout this analysis Phillips assumed that member firms dealt exclusively with the cooperative; he thus abstracted from the process by which a member firm determined its degree of participation in the cooperative). A vertically integrated member firm determined its optimal level of output by equating the sum of the marginal costs in all plants (farm and co-op) with the marginal revenue in the final plant from which the product was marketed. Phillips argued that in evaluating the marginal cost of operating the jointly owned plant, each member of the cooperative took the equilibrium outputs of all the other member firms as given (pp. 79-80).¹

Phillips's view that a member should share the benefits and costs of a cooperative's activities in direct proportion to use seems reasonable at first glance but implicitly assumes that:

¹This implies that the precise equilibrium point for an individual firm can only be determined if the equilibrium level of output of all other firms is given--a major weakness for a model that predicts a unique equilibrium (Vitaliano, 1977, p. 25). Aresvik later pointed out that because of pooling, member firms may actually make decisions on the basis of the co-op's average costs and average revenues, not its marginal costs and marginal revenues.

- (1) all costs of cooperative activity should be borne by co-op members because they accrue all the benefits of that activity;
- (2) all the benefits from one department within a cooperative accrue solely to the direct users of that department;
- (3) all activities of the cooperative in one time period generate benefits only in that time period; and
- (4) there are no overhead costs, or if there are overhead costs, they can be allocated among departments in a nonarbitrary manner.

In keeping with his "theory of proportions," Phillips advocated that voting power in cooperatives be proportional to patronage. He argued that since costs and benefits in a cooperative are ideally distributed proportionately, the rule of one-person, one vote, in cooperatives had no "scientific basis" (pp. 86-87). This conclusion was one of several attacked by Phillips's critics, particularly those who tended to view the cooperative as a separate business firm.

The Cooperative as a Firm

Critiques of the "Cooperative as Vertical Integration" Approach

Critiques of Emelianoff's and Phillips's work focused on three major issues: the narrow definition of the firm used by Emelianoff and Phillips, the locus of decision making within the cooperative, and Phillips's conclusions regarding how cooperatives should be structured internally.

Savage, one of the earliest critics of Phillips's work, argued that Phillips's conclusion that cooperatives had no economic existence independent of the actions of their member firms was based on too narrow a definition of the firm. Common observation, Savage argued, demonstrated that a cooperative was a "going concern," an entity to which members

delegated entrepreneurial functions in order to gain the advantages of joint action. The members, rather than exercising entrepreneurial control over the cooperative on a daily basis, reasserted this control only in dire situations--for example, when they believed that co-op management had exceeded its delegated authority. Savage also attacked Phillips's model for ignoring the role of strategic considerations (for example, the quest for market power) in co-op decision making.

Both Savage and Aresvik took issue with Phillips's conclusion that the one-person, one-vote rule of most cooperatives was inconsistent with the theory of proportionality and hence should be abandoned in favor of voting based on patronage. Aresvik argued that Phillips was implying that one could infer optimal institutional rules for the internal organization of cooperatives from the formal analysis of conditions necessary for an equilibrium output. Aresvik pointed out that several institutional structures could be consistent with an equilibrium and that selection of institutional structures such as voting rules required "value judgments" (normative knowledge) about the organization's goals.

Formal Models of the Cooperative as a Firm

In 1945 Enke examined the consumer cooperative as a separate type of business firm and analyzed graphically how the manager's choice of maximand could affect overall economic efficiency. Enke argued that the appropriate goal for the cooperative, from both the members' and society's point of view, was the maximization of net consumer surplus.

A slightly different idea was put forth by Helmberger and Hoos (1962), who produced the first formal model of the farmer cooperative as a separate business firm. Because the Helmberger-Hoos model dominated

discussions of cooperative theory during the 1960s and 1970s, the following paragraphs examine that model in some detail.

Helmberger and Hoos

Like Savage, Helmberger and Hoos argued that Emelianoff and Phillips had adopted a view of the firm that was too restrictive in analyzing whether cooperatives were business entities separate from their member firms. Helmberger and Hoos argued that organization theory, as developed by Simon, Barnard, and Papandreou, provided a broader interpretation of the firm that was useful in guiding empirical research on cooperative decision making. Particularly important was organization-theory's replacement of omniscient "economic man" with "administrative man," who had to contend with limited information and computational ability. Helmberger and Hoos discussed in general how organization theory might be used to explore the relationships between the internal organization of cooperatives and their performance in such areas as technical efficiency, the level of returns to members, selling costs, growth, and progressiveness.

The first part of Helmberger and Hoos's paper, which discussed an organization-theoretic approach to analyzing cooperatives, suggested that decision making in cooperatives was much more complex than implied by Emelianoff and Phillips. Helmberger and Hoos failed to develop a detailed model of internal decision making within the cooperative, however, in part because they accepted Papandreou's (1952) concept of a "peak coordinator" within the firm. Papandreou viewed the "peak coordinator" as an individual (not necessarily the firm's owner) who determined the firm's goals ("values") and transmitted them to other members of the organization. While positive information ("facts") about operating and

environmental conditions was presumed to flow in both directions through the firm's hierarchy, there was only a one-way flow of information about the firm's goals--from the peak coordinator to other members of the organization. This approach assumed away any conflict within the cooperative over the choice of appropriate organizational goals, although conflict could still remain over how best to reach those goals.

Using the concept of the peak coordinator, the second (and most widely-cited) part of the paper went on to adapt the neoclassical theory of the firm to farmer cooperatives. Helmberger and Hoos presented three models of a single-product processing cooperative's output and pricing decisions: (1) a short-run model, in which the cooperative had a fixed plant and agreed to market whatever its membership produced; (2) a long-run model, in which the cooperative could vary its plant size and had a closed membership; and (3) a long-run model, in which the cooperative had an open membership. All three models assumed that co-op members marketed their output exclusively through the cooperative and that the cooperative purchased all of its inputs (with the exception of the raw product produced by its members) and sold all of its output in perfectly competitive markets. Hence, input prices (with the exception of the raw product price) and the output price were regarded as parameters.

Helmberger and Hoos derived their model of the behavior of farmer cooperatives by modifying the neoclassical model of the firm, which assumes that under conditions of certainty, an IOF strives to maximize profits,

$$(1.1) \quad \pi = P_y Y - \underbrace{P_m M}_{\text{input cost}} - \sum_{i=1}^{\ell} P_i X_i - F,$$

where:

- π = profits;
- P_y = price of the processed final product;
- Y = output of the processed final product;
- P_m = price of the raw product purchased from farmers;
- M = quantity of raw product purchased from farmers;
- P_i = price of the i th variable input (excluding the raw product) used in processing;
- X_i = quantity of the i th variable input (excluding the raw product) used in processing; and
- F = fixed costs of the firm.

A cooperative, in contrast to an IOF, is constrained to operate at zero profit, returning any net surplus to the members. If $\pi = 0$, equation (1.1) implies that

$$(1.2) \quad S = P_m M = P_y Y - \sum_{i=1}^L P_i X_i - F$$

Helmberger and Hoos defined the quantity $S = P_m M$ as the "cooperative surplus," the total amount of money available to distribute to the members once the cooperative's variable and fixed costs were deducted from gross receipts. Helmberger and Hoos assumed that the cooperative manager, the presumed "peak coordinator" of the cooperative, strove to maximize P_m , the average per-unit cooperative surplus. In two of the three models presented in their paper (the short-run model and the long-run open-membership model) the cooperative took the quantity of raw product produced, M , as given. In these models maximization of P_m implied maximization of S .

In all three models, members received "uniform treatment," which the authors took to be consistent with paying each member the same raw-product

price. Helmberger and Hoos further assumed that no single member was large enough to influence the price the cooperative paid for raw product; hence, members behaved as price takers. All members accepted the manager's objective function as appropriate.

Helmberger and Hoos presented their work as only the first step in building a more complete theory of farmer cooperation, noting that in their models "problems of intra-organizational conflicts which arise in the case of various types of pooling, multiple product operations, and multiplant cooperatives have been abstracted away" (p. 290). Nonetheless, as outlined below, their models did highlight potential conflicts between co-op members and nonmembers over the issue of open versus closed membership.

In all three of Helmberger and Hoos's models the general approach to determining the raw product price, P_m , paid by the cooperative was the same. The authors showed that there existed a functional relationship between the maximum price the cooperative could pay for the raw product while still covering its costs and the total amount of raw product processed by the cooperative. The shape of this "net return" (NR) function varied depending on whether the model was short-run, in which the cooperative plant was fixed, or long-run, in which the cooperative plant could vary.

Because cooperative members acted as price takers, they had well-defined individual supply curves that could be summed horizontally into an aggregate supply curve for the raw product.¹ The intersection of the net revenue function and the supply function determined total output handled by the cooperative and the price paid to members for their raw product (see Figure 1.2 for the short-run case). In the long run, the equilibrium output and price depended on whether the cooperative followed an open- or closed-membership policy (see Figure 1.3). A closed-membership cooperative would restrict membership so that the aggregate supply curve S_r , would intersect the long-run net revenue (LRNR) curve at its maximum, yielding a raw product price to members of P_{mr} . If the cooperative followed an open-membership policy, members would enter as long as they found it profitable to do so, shifting the aggregate supply curve

¹There is controversy among cooperative theorists over whether a supply function for members of a marketing cooperative (or, equivalently, a demand function for members of a supply cooperative) can be unambiguously defined. The problem is that if the initial price paid by the cooperative results in a net margin for the organization and if the margin is rebated to the members in proportion to their patronage, the members will probably interpret the rebate as part of the payment for their product. They will therefore have an incentive to expand their production further in cob-web fashion. (As discussed in the next section, Kaarlehto raised this problem as a possible source of conflict among members of the cooperative.) Only if the cooperative sets its prices for the raw product in a way that results in a net margin exactly equal to zero is the problem eliminated. Helmlinger and Hoos assumed that the co-op manager know the firm's net revenue function, which specified the price the cooperative should pay for any given quantity of raw product in order to set the co-op's net margin equal to zero and thus overcome the indeterminacy problem. Pricing in this manner does not maximize member welfare in the Enke sense, but it does avoid the indeterminacy of the supply (demand) curve inherent in Enke's approach. It is highly questionable, however, whether co-op managers really know in advance their firms' net revenue functions. For more details on this issue see Cotterill (1983b); Bateman, Edwards, and LeVay (1979a); and Lee.

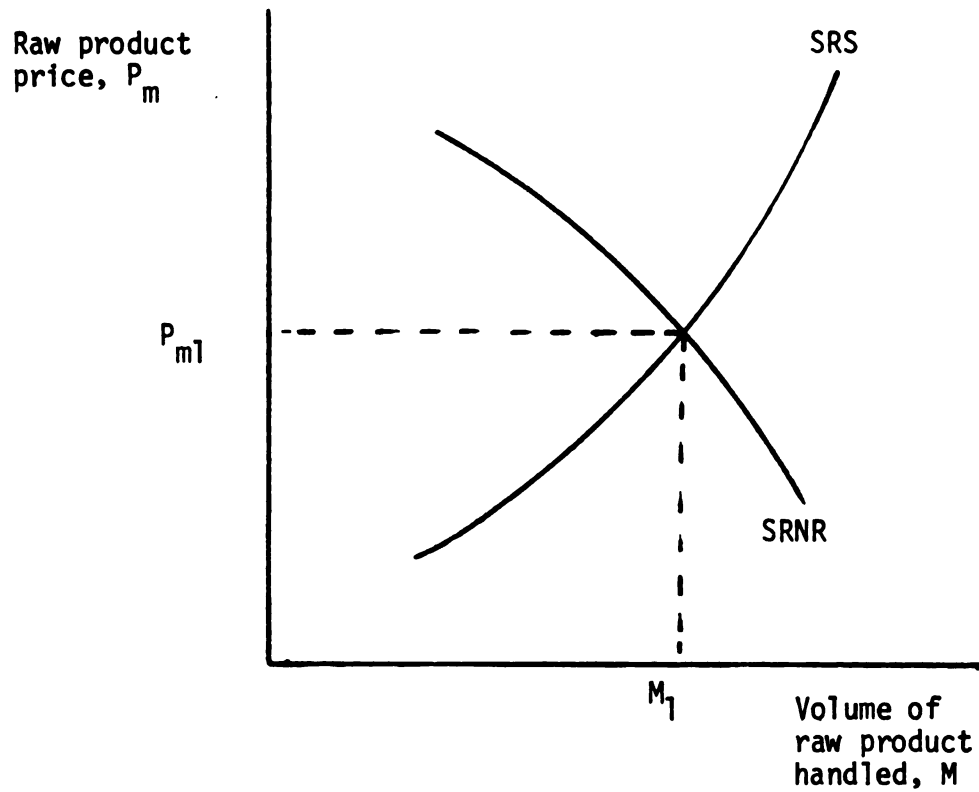


Figure 1.2 Cooperative Price and Output Determination in the Short Run

SOURCE: Helmberger and Hoos (1962), p. 285.

NOTES: SRS = Short-run aggregate supply curve.

SRNR = Short-run net return function.

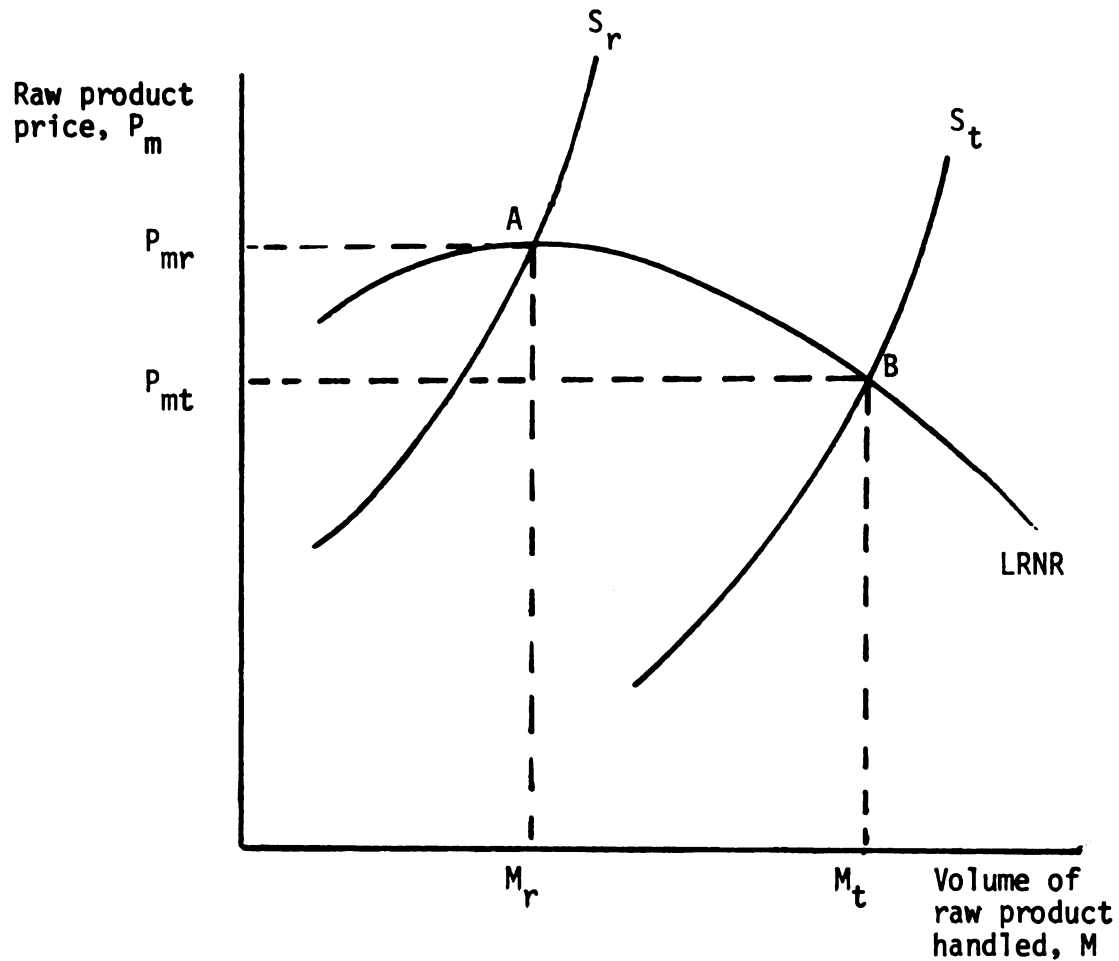


Figure 1.3 Cooperative Price and Output Determination in the Long Run--Open and Closed Membership

SOURCE: Helmerger and Hoos (1962), p. 289.

NOTES: S_r = Aggregate supply curve for closed-membership cooperative.

S_t = Aggregate supply curve for open-membership cooperative.

LRNR = Long run net returns function.

outward from S_r to, for example, S_t in Figure 1.3. This would result in a larger output being marketed through the cooperative and a lower raw-product price to members than would obtain in a closed-membership cooperative.

The open- and closed-membership models each implicitly assumed a different locus of decision making within the cooperative. In the open-membership model, decision making was decentralized--members were free to join and expand their production as long as it was privately profitable. In the closed membership model, a collective decision had been taken to limit membership and production, and members had vested management with the authority to impose production quotas. Nothing in the Helmberger-Hoos framework suggests which alternative cooperatives would be likely to adopt; understanding this requires an analysis of the cooperative's internal decision-making rules, which Helmberger and Hoos did not discuss in their formal model.

The Helmberger-Hoos model, by assuming that all members exclusively patronized the cooperative and produced identical output under the same cost conditions, abstracted from the possibility of disputes among the current members regarding goals for the organization. The analysis of open- versus closed-membership, however, drew attention to a possible conflict between current members, who would favor expanding membership only to the point where the aggregate supply curve intersected the LRNR curve at its apogee (point A in Figure 1.3) and potential members, who would favor expanding membership as long as the long-run net returns exceeded the potential members' long-run cost of production (for example, expanding to point B in Figure 1.3).

Disputes over open- versus closed-membership could also be manifested in conflicts between the current members and either a management interested primarily in growth of the cooperative or the public at large, interested in expanding output as long as the marginal social benefit of that output exceeded its marginal social cost.

Under certain circumstances then, an open-membership type cooperative will in fact pursue a policy which is inimical to the interests of existing members but beneficial to potential members. Whether a cooperative enterprise pursues a policy of open or restricted membership might depend on the effectiveness of existing members in electing a board of directors who will insist on one cooperative policy or the other. If a cooperative is management controlled, however, cooperative growth as measured by the amount of raw material handled, the number of members, or gross sales might well be one of the effective goals (p. 289).

The election process mentioned by Helmberger and Hoos and the possibility of the cooperative having more than one "effective goal" suggest a process of preference articulation within the cooperative more complex than simply relying on a "peak coordinator" to set organizational goals. As detailed below, theorists in the 1970s and 1980s began to address the issues of preference articulation in the cooperative firm.

Industrial Organization Analyses

Several theorists used the Helmberger-Hoos model and other models of the cooperative as a firm to analyze how the presence of cooperatives would affect market outcomes in different market structures. Although these analyses usually did not examine the internal distribution of costs and benefits within the cooperative, by examining how cooperatives affected resource allocation, they highlighted how the costs and benefits of cooperative activity might be distributed among major groups in society, such as consumers, farmers, and other private entrepreneurs.

The first to examine the industrial-organization effects of farmer cooperatives was Nicholls, who in 1941 discussed the impact of dairy cooperatives on farm milk prices. Nicholls's graphical analysis pre-saged that of Helmberger and Hoos by over 20 years. Kaarlehto (1955) also analyzed graphically how cooperatives could affect the competitive balance in different market structures.

Helmberger (1964) used the models developed in the 1962 Helmberger and Hoos article to contrast the decisions made by a cooperative following the Helmberger-Hoos maximization rule to those of a profit-maximizing IOF. The essential difference between the two types of firms was that the IOF's demand function for the raw product M corresponded to a portion of the value of the marginal product (VMP) function for M, while the co-op's demand function for M corresponded to a portion of the net average revenue product (NARP) function for M, as defined as:

$$\text{NARP} = \frac{P_y Y - \sum_{i=1}^L P_i X_i - F}{M}$$

where the variables are as defined above. NARP, therefore, represented the per unit cooperative surplus--i.e., average revenue minus average costs (excluding the cost of the raw product).

Helmberger concluded that as a result of its decision rule an open-membership cooperative generally would process a greater volume of raw product and pay farmers a higher price for that product than would an IOF (see Figure 1.4).

Helmberger assumed that the raw product was sold by a perfectly competitive farming industry to the processing industry. His conclusions regarding the effects of cooperatives in different marketing structures were the following:

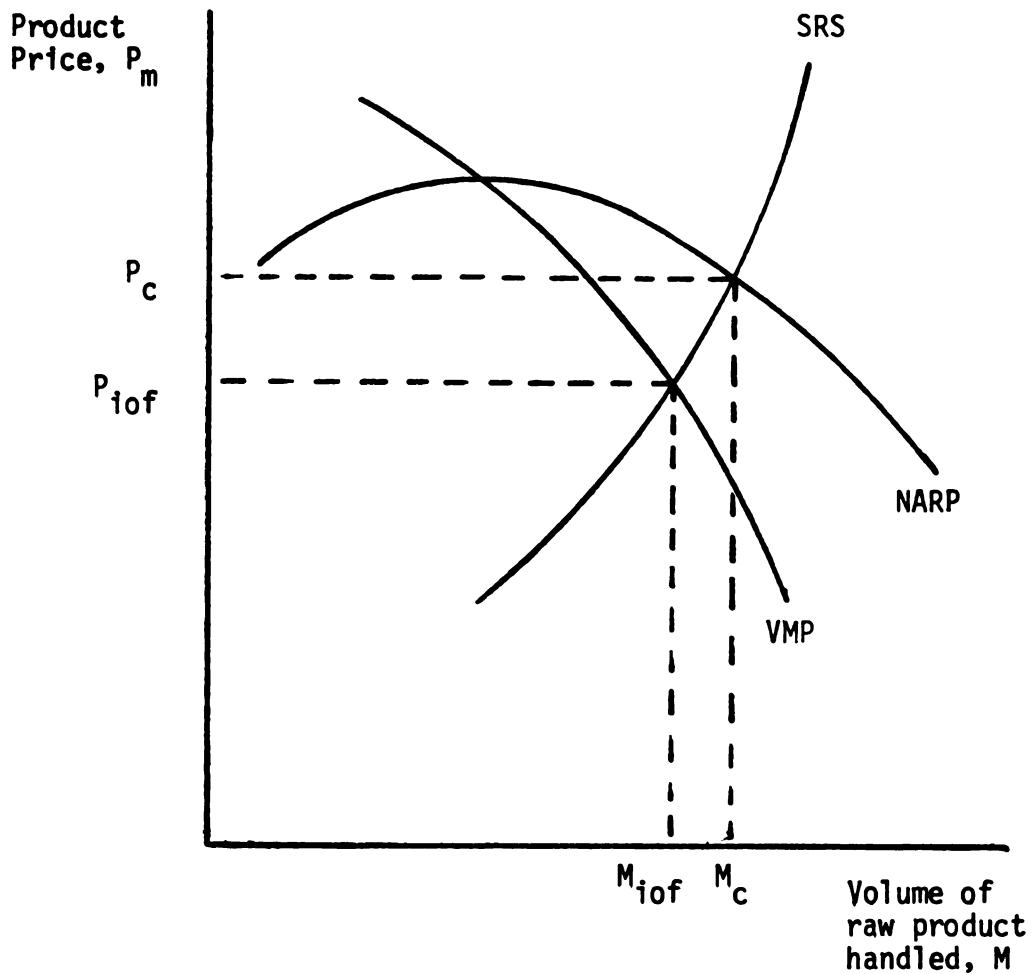


Figure 1.4 Price and Output of an Open-Membership Cooperative and of an IOF in the Short Run^a

SOURCE: Adapted from Helmberger (1964).

NOTES: SRS = short-run supply curve.

P_c = raw-product price paid to producers by a cooperative.

P_{iof} = raw-product price paid to producers by an IOF.

M_c = volume of raw product processed by a cooperative.

M_{iof} = volume of raw product processed by an IOF.

^aThis figure assumes that the cooperative and the IOF have the same costs and gross revenues and face the same short-run supply curve.

- (a) If the processing industry was atomistic and exhibited no barriers to entry, the presence of cooperative processors could lead to departures from the perfect-competition equilibrium in the short-run, but not in the long-run.
- (b) In most circumstances, a monopsonistic cooperative operating in a market to which entry was blockaded would generate outputs and price levels closer to those that would prevail under perfect competition than would an IOF operating under the same conditions. A major exception was the closed-membership cooperative, which in this market structure could lead to a smaller equilibrium output and a higher raw-product price than would obtain under a monopsonistic IOF.
- (c) If the finished product was sold in perfectly competitive markets and there existed no economies of scale in processing, cooperative marketing would tend to lead to a competitive equilibrium regardless of other structural elements that would support monopsony.

Other industrial-organization analysts (for example, Rhodes, 1983) came to roughly similar conclusions. Knutson, however, questioned whether the conditions theoretically necessary for cooperatives to improve market performance were actually met in practice. In particular, he contended that in cooperatives that had long revolving periods for their members' equities, farmers had difficulty perceiving the true average net return function, and hence could not operate as Helmberger and Hoos had hypothesized.

Recently, some authors (for example, Bateman, Edwards, and LeVay, 1979a; LeVay; Cotterill, 1983b) have examined not only how the

cooperative's choice of maximand affects the market outcome in different situations but also which groups in the cooperative would likely favor the choice of which maximand. For example, LeVay (pp. 12-13) suggested that active members of a co-op would often favor maximization of raw-product price because this would maximize their current cash flow, whereas management and the board might favor maximization of net margins because this would allow the cooperative to grow more rapidly. These authors' work suggests that in order to carry out accurate analyses of the industrial-organization effects of farmer cooperatives it is first necessary to understand how the participants in these organizations determine the cooperatives' objectives.

Extensions of the Helmberger-Hoos Approach

A distinguishing characteristic of the Helmberger-Hoos approach was the reliance on a "peak coordinator" to set a single objective for the cooperative. Most cooperative theorists of the 1960s and early 1970s continued to base their models on this sort of centralized goal setting, although not all agreed with Helmberger and Hoos that cooperatives sought to maximize raw-product price or cooperative surplus.

The basic Helmberger-Hoos model was extended to analyze supply cooperatives (Youde, 1966, 1968), consumer cooperatives (Mather), and to a limited extent, multiproduct processing cooperatives (see Helmberger, Campbell, and Dobson, pp. 558-59).

The most extensive effort to look at multiproduct cooperatives within the Helmberger-Hoos framework was the work of Hardie, who attempted to derive an optimum raw-product pricing rule for a multicommodity processing cooperative by viewing the maximization of cooperative surplus

as a linear programming problem. The resulting shadow prices for the raw-product inputs were the optimal raw-product prices to pay the members in the sense that these prices: "(1) maximize the total cooperative surplus... (2) return all of the cooperative surplus to the members ... (3) allocate the same return to every unit of a homogeneous member product...[and] (4) pay each product what it contributes to the cooperative surplus" (p. 832). To reach this conclusion, however, Hardie had to assume fixed supplies of several member inputs and a prior allocation of overhead costs among member products.

By assuming that overhead costs could be unambiguously allocated among the various products handled by the cooperative Hardie sidestepped one of the most contentious problems in determining equitable member returns. Furthermore, Hardie's recommendation to pay the shadow price to all units of a raw-product would result in assigning the same value to both marginal and intramarginal units of that input. "Total returns to an input thus computed could be extremely low, even though the 'contribution' of that input to cooperative surplus is very large" (Helmberger, Campbell, and Dobson, p. 539).

Despite these and other limitations of Hardie's approach discussed in chapter 5, his basic concept of paying each product its "contribution" to cooperative surplus has remained a goal towards which cooperative theorists and practitioners have striven.¹ As discussed in chapter 7, a simplified version of Hardie's approach, aimed at paying each raw-product its average contribution to cooperative surplus, was recently

¹The problem is that in the presence of joint costs and commingling of products, the contribution of each raw-product to cooperative surplus cannot be unambiguously defined.

adopted by the three major California fruit and vegetable processing cooperatives.

Bar used the decomposition principle of linear programming to model decision making at two levels in Israeli village cooperatives, the level of the individual member firm and the level of the cooperative manager. Bar's model pictured the individual members as attempting to maximize their profits given a set of resources and prices charged by the cooperative, while the cooperative manager attempted to allocate common resources and set the co-op's prices in a way that would maximize the sum of all member profits, subject to the constraint of guaranteeing each member a certain minimum income (in order to prevent his defection from the cooperative). Separate linear subprograms were developed for each member and these subprograms were combined into a master program for the manager. The models generate shadow prices that can be interpreted as the "optimal" (in terms of joint-profit maximization) allocation of the cooperative's overhead costs among the members.

Although Bar's work represents an interesting attempt to model a degree of decentralization into cooperative decision making, it suffers from some of the same drawbacks as Hardie's work: it requires a prior specification of certain costs (variable costs, as opposed to overhead costs in Hardie's model) and it values intramarginal units of output at their marginal return. In addition, although maximization of joint member profits (subject to a certain minimum return to each member) is a possible managerial goal, it may not be the most likely one; political pressures within the cooperative may lead management to pursue a certain distribution of member profits, or management may have scope to pursue its own goals, such as cooperative growth.

Ladd attempted to generalize the Helmberger-Hoos model to a multi-service cooperative, which provided its members with bargaining services, a production input, and some other unspecified service. Ladd developed a five-equation model aimed at determining the price the cooperative should charge for the productive input it sold to both members and non-members and the level of bargaining services the cooperative should provide in order to maximize the members' raw-product price. Unfortunately, in order to keep the model tractable mathematically, Ladd had to make certain assumptions (such as fixing the total supply of the raw-product and stipulating that the difference between member and nonmember prices was determined exogenously) that greatly limit the insights the model offers into cooperative behavior.

Theorists in cooperative finance (for example, Royer, 1982a; Van Sickle) have built models that assume that cooperatives attempt to maximize a single objective, although not always the Helmberger-Hoos objective of per-unit cooperative surplus. Royer's model, for example, assumes that cooperative management attempts to maximize the sum of all member-patron's profits. The analysis in these models, like that in the Helmberger-Hoos model and most other single-objective models, involves tracing the consequences of the cooperative's constrained maximization of its objective, usually through determining the first-order conditions. Most of these models assume a homogeneous membership and therefore do not highlight intracooperative conflicts over either the organization's choice of goals or the allocation of costs and benefits in achieving those goals. Royer's work on equity redemption (1982b, 1983), however, can be used to draw inferences about how conflicts might arise between

different members (for example, old and young members) over the appropriate equity redemption policies for the cooperative.

Carson

Carson's model of "a generalized welfare-maximizing firm" (or "G-firm") represents the most ambitious attempt to build a general model of the cooperative as a firm that maximizes a single objective. Carson portrayed the G-firm as attempting to maximize a generalized welfare function

$$W = W(U_1, U_2, \dots, U_n), \frac{\partial W}{\partial U_i} > 0 \quad \forall i$$

where U_i is the utility function of the i th stockholder of the firm.

Stockholders were free to buy goods and services from the firm or from other firms and the G-firm could purchase inputs from and sell outputs to both stockholders and nonstockholders. Farmer cooperatives, consumer cooperatives, the investor-owned firm, and the worker-managed firm each represented a special case of the G-firm.¹

Carson initially assumed that each co-op member was free to adjust his purchases from and his sales to the co-op and to outside firms as long as these were consistent with his budget constraint, which was determined in part by the cooperative's (or the members' collective) decision regarding the prices he would be charged and the share of the

¹ Carson drew almost all of his illustrations from the literature on the worker-managed firm; indeed, he cited none of the theoretical literature on farmer cooperatives. Carson's model is general enough, however, that by simply substituting the words "raw agricultural product" for "labor input" in his illustrations, most of his findings are directly transferable to agricultural processing cooperatives. (As discussed in chapter 2, many of the problems highlighted in the literature on the labor-managed firm have their direct analogues in farmer cooperatives.)

firm's profits he would receive. (Thus the model permitted price and profit discrimination among members.) Deriving the first-order conditions for welfare maximization under these assumptions (and assuming a fixed membership), Carson showed that a welfare-maximizing co-op would not price discriminate among current members (although it would price discriminate between members and nonmembers); furthermore, if the co-op weighted each member's welfare equally and assumed a uniform marginal utility of money, it would distribute profit shares equally. In general, the cooperative would maximize welfare by maximizing the sum of its total profits plus the members' consumer and factor surpluses (rent) derived from the cooperative.¹ Only if there was perfect competition in all markets (in which case, consumer and factor surpluses would be zero) would the co-op seek to maximize profits.

Otherwise, for given costs a consumer co-operative [farm supply cooperative] would charge lower prices of its members--or sell them higher-quality products at the same prices--than would an owner-controlled firm selling to the same individuals. For given values of marginal products the producer co-operative [farm marketing cooperative] would pay higher wages [higher raw-product prices] or provide better working conditions [improved marketing services] (p. 572).

Carson went on to show that if three conditions were met a welfare-maximizing cooperative of this kind would expand its membership indefinitely, limited only by the size of the market; this outcome Carson called "the full welfare-maximizing solution." The three conditions included:

¹This was simply a generalization of Enke's optimal pricing and output rule for consumer cooperatives. It is important to remember that in Carson's model, the welfare that is being maximized is the welfare of current members of the cooperative. Only in the "full welfare-maximizing solution" described below, in which all members of society are members of the cooperative, does the maximization of the cooperative's welfare necessarily correspond to the maximization of social welfare.

- (1) the marginal cost to the cooperative of providing member goods and services had to be a nondecreasing function of output;
- (2) new members could be restricted from sharing in the net profits of the firm; and
- (3) the cooperative had to be prohibited from practicing price or wage discrimination between members and nonmembers.

If any one of these conditions were violated (which Carson considered likely), current members would have an incentive at some stage to restrict membership in order to capture whatever monopoly rents the organization generated. "As a general rule, therefore, the G-firm will operate...between the profit maximizing and full welfare-maximizing rates of output and input use" (p. 576). Such firms could have an incentive to shift an increasing volume of their business to nonmembers, thereby gradually losing their cooperative character.¹

Carson then compared his welfare-maximizing cooperative with the standard wage-maximizing model of the labor-manager firm (e.g., Domar), which is exactly analogous to the Helmberger-Hoos raw-product-price-maximizing model of an agricultural processing cooperative. Carson argued that only in rare circumstances would the G-firm behave as a wage (raw-product-price) maximizer; more frequently, current members would have an incentive to restrict membership and hire (buy from) nonmembers or establish wage (price) discrimination between senior and more junior members. Carson's model thus raised the possibility of conflicts not only between members and nonmembers but also among members with different levels of seniority.

¹See chapter 2.

Carson also discussed the relative efficiency of cooperative and investor-owned firms, an issue generally ignored by cooperative theorists. He stressed that his earlier conclusion that a cooperative would produce at least as much as an investor-owned firm depended on the assumption that the cooperative was at least as efficient as the IOF. Carson questioned this assumption, outlining possible cost advantages and disadvantages of cooperatives. Among the possible advantages he included less worker (customer) alienation, swifter and surer implementation of decisions (since decisions in co-ops tend to be reached by consensus), and co-ops' ability to internalize (capture) certain externalities. Disadvantages included higher decision-making costs because of the direct involvement of more people who usually represented a broad range of interests; and the tying of ownership with participation (patronage), which limits role specialization and entrepreneurship in the cooperative. Because members of the cooperative are simultaneously customers and stockholders of the organization, the stockholding function cannot, as in an IOF, be concentrated among persons who are either more risk-preferring than the customers or who have the ability to reduce their risks by diversifying their portfolios.¹ Therefore, Carson believed, cooperatives tended to be more risk-averse than their IOF counterparts. Furthermore, because hired managers in cooperatives cannot in general become members of the organization and because cooperative stock does not appreciate, it is impossible for the board to reward managerial entrepreneurship through stock options. Indeed, because the benefits of a cooperative may accrue to the membership in forms (such as consumer surplus) that are

¹See the discussion of agency theory in chapter 2.

difficult to measure, establishing criteria by which to judge managerial performance is more difficult in a cooperative than in an IOF. This, Carson believed, reduced the ability of a cooperative's board of directors to ensure that the manager worked in the best interests of the owners.

Carson's generalized model provides a broad framework in which to analyze cooperatives, but he stressed that understanding how particular co-ops behave (whether they are more efficient than IOFs and so on) required a more detailed understanding of their internal decision-making processes. "Unfortunately," he concluded, "there is no rigorous theory ...to guide us here" (p. 583).

The Cooperative as a Coalition

The early models of the farmer cooperative as a form of vertical integration (for example, Emelianoff, Phillips) portrayed a very diffuse decision-making process within the organization. The cooperative as such made no decisions; only the individual member-firms made decisions. In contrast, most models of the 1960s and early 1970s that viewed the farmer cooperative as a type of firm saw decision making in the cooperative as being completely centralized in a "peak coordinator," presumably the manager. Both types of models generally assumed a homogeneous membership and thus abstracted from intraorganizational goal conflicts. By doing so these models could show that the maximizing activities of the individual farmer-members (in the "cooperative as vertical integration" models) or of the co-op manager (in the "cooperative as firm" models) led to a unique, stable cooperative equilibrium.

As early as the 1950s, however, several authors pointed out that heterogeneity of the membership, differences of opinion between the

membership and the management over the appropriate goals for the organization, information costs, and the nature of the collective action itself could each prevent such an equilibrium; the cooperative's behavior in these situations would result from a bargaining process that reflected the relative power of the different participants in the organization. Analyzing this bargaining process required a model of cooperative decision making that moved away from the highly centralized process pictured in the "cooperative as firm" models but at the same time recognized that the decisions of a cooperative reflect more than simply the sum of the independent actions of its member firms.

The research reviewed in this section has attempted to provide such a model by viewing the cooperative as a coalition of participants, whose interests are neither perfectly congruent nor diametrically opposed. Many of the models reviewed in this section can also be considered extensions to farmer cooperatives of behavioral and administrative models of the investor-owned firm.

Early Critiques of the Concept of a Unique Cooperative Equilibrium

Since at least the 1920s some observers have viewed farmer cooperatives as coalitions of previously independent and often competing firms. Early cooperative organizers, notably Aaron Sapiro, saw cooperatives as a means by which farmers could form cartels to exert market power (Cotterill, 1983a). After the decline of the Sapiro movement cooperative organizers stressed the role of the cooperative as a coalition through which farmers could gain economies of size and improved vertical coordination without giving up their role as independent farm operators. Although these alternative views of the role of the cooperative each implied a different distribution of benefits and costs among farmers (for

example, the likelihood of free riders was much higher in the Sapiro approach), each also raised important questions about how cooperatives would decide on the distribution of benefits among participating members and how an organization comprised of competing firms would establish its goals. Given the sometimes competing interests of the members, it seemed unlikely that a cooperative would singlemindedly pursue a sole objective.

In theoretical debates about the behavior of farmer cooperatives, Ohm, Kaarlehto (1956), and Trifon (1961, n.d.) were among the first to stress that the behavior of cooperatives is more likely to reflect a bargaining process among the participants than the optimization of a single objective. Ohm, for example, argued that although management might try to run a cooperative in a manner that would maximize member profits (Phillips's hypothesized cooperative objective), information costs and the nature of the collective enterprise itself would prevent management from reaching this goal. Members of a farmer cooperative, Ohm believed, were unlikely to be well-informed about the cost function of the cooperative's plant and thus unable to follow Phillips's optimization rule, which required farmers to compare their individual marginal costs and returns with those of the jointly owned plant. Moreover, even if an individual member was aware of the co-op's costs, in most instances he would not have an incentive to restrict his output so that the members could jointly maximize their profits; because of the differences in scale between the farm's and the cooperative's operations, he would have an incentive to "chisel" on any output-restricting agreements.¹

¹This point was also made by several authors whose work is discussed below.

Kaarlehto (1956) stressed the nature of the collective action itself as a barrier to the achievement of a unique cooperative equilibrium. Kaarlehto's arguments can be illustrated using Figure 1.5, which shows a supply cooperative's short-run average and marginal cost and return functions. If the cooperative took as its objective operation at minimum average cost, it would attempt to produce quantity OR and charge its members price OQ . This, however, would lead to a per-unit surplus of QM , which, if rebated to the members on the basis of patronage, would lead to an effective member price of OM , which in turn would lead members to increase their purchases to OT . At this level of output, however, the cooperative would incur a short-run per-unit loss of SV . Thus, although it might be in the collective interest to operate at minimum average cost, the incentives facing individual members prevented the cooperative from doing so.¹ Other authors (Eschenburg, Lopez and Spreen) have made essentially the same argument, although their definitions of the economic optimum for the cooperative differed from that of Kaarlehto. Lopez and Spreen describe the situation as a prisoner's dilemma, in which the pursuit of individual benefits leaves the group as a whole worse off.²

Kaarlehto was also among the first cooperative theorists to discuss possible conflicts among members arising from cross-subsidies (in the contexts of financing the organization and of operating multicommodity cooperatives) and conflicts between the members and management. (He assumed that management was interested primarily in growth of the

¹See footnote 1, p. 24. Kaarlehto also argued that in some circumstances it would not be in the collective interest to operate a supply cooperative at minimum average cost.

²The prisoner's dilemma is discussed in detail in chapter 5 and in appendix C.

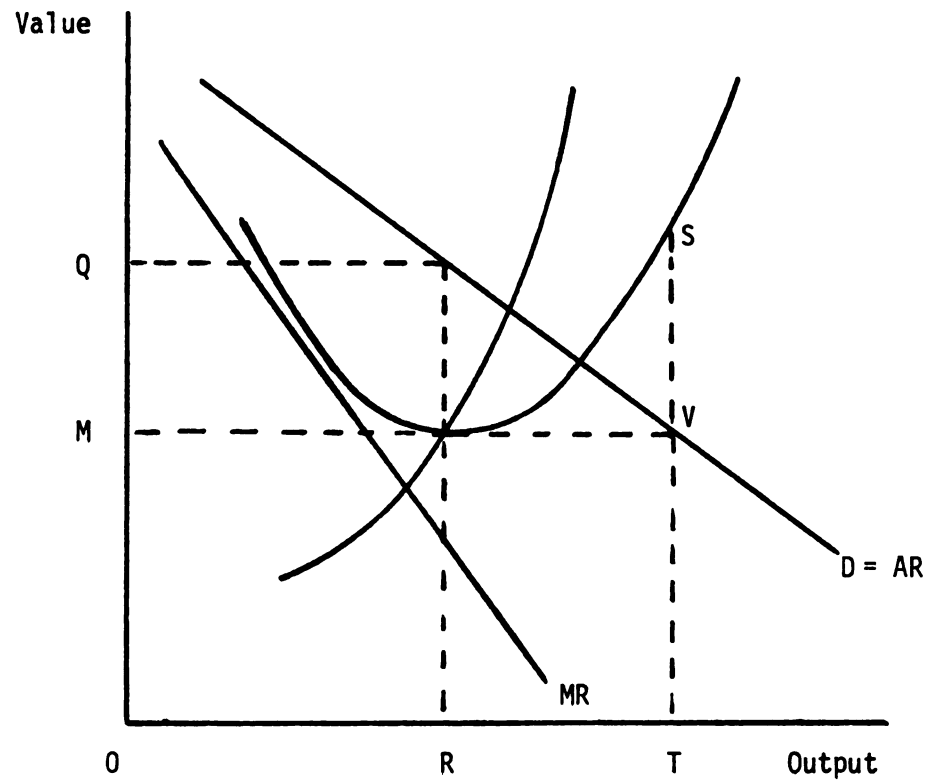


Figure 1.5 Possible Short-Run Price and Output Levels
for a Supply Cooperative

SOURCE: Adapted from Kaarlehto (1956), p. 40.

cooperative.) Kaarlehto implied that understanding how such conflicts were resolved required an intimate knowledge of cooperatives' internal decision-making processes.

Trifon (1961), criticizing Phillips, stressed that cooperatives are organizations whose actions represent more than the simple aggregate of the harmonious actions of their individual member firms. He illustrated potential conflicts among participants by using Phillips's model to derive expressions for the marginal revenues and marginal costs that would accrue to: (a) an individual co-op member, (b) the other members of the cooperative, and (c) the co-op as a whole if the individual member changed his patronage by a small amount. From these expressions it became clear that an individual member neither bore the full marginal cost of his actions nor received the full marginal return. Because of this, under certain circumstances co-op members would have an economic incentive to try to restrict the output that other members sold through the cooperative.

Trifon argued that if such conflicts were resolved through voting in the cooperative on a one-person, one-vote basis the outcome would differ from the equilibrium predicted by Phillips. In an approach suggestive of game theory, Trifon outlined the strategy that a short-run profit-maximizing co-op member would follow in bargaining with other members regarding the level at which to set co-op output. Trifon showed how the outcome of this bargaining process would generally differ from Phillips's "optimum" outcome.

Trifon argued that in order to understand the behavior of an individual cooperative one had to look at the nature of the decision being made; the environment in which the cooperative was operating; and the internal structure of the cooperative, especially its methods of resolving internal conflicts. He also argued that in practice cooperative

management often had substantial scope for decision making independent of direct member control. Anticipating some of the arguments of contingency theorists (see Perraut), he hypothesized that the degree of independent decision making by management depended on the structures of the industries in which the members and the cooperative operated, the technical complexity of the processes undertaken by the co-op, and the degree of conflict between co-op members.

Where, for instance, the industry in which the patrons operate is atomistic, there may be a great disproportion between the scale of operation of the cooperative plant and that of the individual members. The tasks facing the management of the cooperative venture, both say, in combating monopoly and implementing innovations, may call for strategies and technical judgment far beyond the experience and possibly the competence of most members. Where such is the case, the members of the cooperative must exercise their authority mainly by critically following the policies of their professional management, rather than by giving it directions... more independent task still may be assumed by a cooperative management where the interests of the individual members become acutely conflictory, due to sharply rising unit-costs, saturation of the market, decline in numbers, or other reasons. There, the hired management of the cooperative venture may have to devise workable compromises and possibly act as a neutral guardian of everybody's interests (p. 235).

Trifon (n.d.) also hypothesized that member conflicts in cooperatives increased as the individual member's share of the market increased. Co-ops consisting of relatively few, large members exhibited much of the instability and strategic interdependence typical of cartels.

More Recent Literature on the Cooperative as a Coalition

A few cooperative theorists in the 1960s (for example, Helmberger and Hoos, 1965, p. 184) informally discussed potential conflicts among cooperative participants, and a model of the cooperative as a coalition implicitly underlay research on product pooling carried out during this

period (for example, Sosnick, 1963).¹ Further formal modeling of the cooperative as a coalition, however, did not occur until the 1970s. Most of this work was conducted outside of the U.S. and had relatively little influence on U.S. researchers.²

Pichette, building on Kaarlehto's and Trifon's work, used marginal analysis to investigate circumstances in which conflicts between members were likely to arise. These included situations where the cooperative's average cost of producing a service was rising and hence present members favored restricting membership while potential members favored expansion, and situations where the cooperative handled products that were inputs for some members and outputs for others (for example, funds in a credit union). In these circumstances, Pichette argued, a unique equilibrium would not automatically be reached; rather, a bargaining process similar to that outlined by Trifon would take place. Pichette stressed the need to go beyond marginal analysis to understand decision making in cooperatives, although he himself did not develop any nonmarginalist models.

Perraut attempted to apply some nonmarginalist concepts from the behavioral theory of the firm, the theory of public goods, and the theory of collective action to cooperative decision making. He particularly stressed the importance of growth as a goal of "management-dominated" cooperatives.

¹The literature on pooling is discussed in chapter 7.

²Knoeber and Baumer were among the few U.S. theorists who, in a formal model of cooperative behavior, raised the issue of group choice in farmer cooperatives. Their model, however, assumed that all group choices were determined by independent, majority-rule votes and that the distribution of member preferences was single-peaked. The group decision could therefore be determined by examining the preferences of the median member; hence, their model became simply a variant of the single-objective models reviewed above, with the objective of the median member serving as the cooperative's maximand.

Several Scandinavian scholars have investigated group choice in large cooperatives, which play a major role in the Scandinavian economies. The work of the Scandinavian theorists and of several West German theorists is summarized by Ollila, and the following discussion is based largely on his review.

The Scandinavian authors have paid particular attention to the issue of member control of large cooperatives and have framed this question more broadly than most U.S. authors, who often discuss simply whether a cooperative is "member-controlled" or "management-controlled." Pestoff, for example, pictured the cooperative's behavior as resulting from the interplay of four major forces on the organization: members' desires, the goals of the personnel (which includes organized labor as well as management), the demands of the market, and the influence of the state (which is particularly important in Scandinavia, where cooperatives often bargain with the state over agricultural policy and price supports). Røkholt (1982b) developed an evolutionary model of the cooperative (similar to Shaffer's [1980] environment-behavior-performance model of industrial organization), in which the influence of these different groups and their dependence on the cooperative changed over time, based on the cooperative's past performance, which was itself a function of previous patterns of influence. Both Pestoff and Skår^o argued that as cooperatives grow and become more technologically complex, the degree of member influence in the organization decreases due to the higher information costs of monitoring the organization. At the same time, because of the growing macroeconomic importance of these organizations, there is pressure on the government to convert them to quasipublic enterprises. (This tendency is clearly more important in Scandinavia than in the U.S.)

Skår and Utterstrom pointed to increasing heterogeneity of the membership as an additional reason for the declining influence of members relative to that of management. Even if management and the board want to represent "member interests" faithfully, given a highly heterogeneous membership, it is not easy to discern what those interests are; therefore, the board and management may make policies that are inconsistent with the majority's desires. These decisions are not reversed by the membership because of the high transaction costs of organizing member referenda and the like.

The Scandinavian theorists have also examined the factors influencing member participation in farmer cooperatives, including the member's decisions to join, to patronize, and to participate politically in the governance of the organization. The influence of voting rules on preference articulation, particularly in large federated cooperatives, has received particular attention. The general conclusion of several of these authors (Røkholt, Isaksen, Møgelhøj) is that with increasing size and complexity of the cooperative, an "average" member's relative influence in the organization decreases, but at the same time the potential rewards from influencing the cooperative increase because of the organization's greater economic and political power. This suggests that incentives exist for small, well-organized coalitions of participants having intense interests in particular issues to try to "capture" the cooperative; none of the Scandinavian theorists, however, seems to have investigated this possibility. Instead, they have concentrated on how information costs, the socialization of co-op participants, and participants' socioeconomic background affect member participation.

Several West German scholars have also examined cooperatives as organizations containing a diversity of interests. Wiese and Fleischmann attempted to extend industrial-organization models of cooperatives by investigating how the internal structure of cooperatives affect their ability to compete with investor-owned firms. Fleischmann contended that in relatively competitive markets cooperatives tend to encourage more rapid innovation than do IOFs because of the better trust and flow of information between management and patron, the effect of "cooperative loyalty" on overcoming free-rider problems that often reduce firms' incentives to innovate, and cooperatives' ability to attract innovative managers because of the greater upward mobility for talented personnel in cooperatives than in family-owned IOFs.¹

In spite of these and other advantages, Wiese argued that cooperatives would not entirely dominate most markets. As the market share of cooperatives increased, the marginal net benefit to a potential member of joining the cooperative decreased, in part because it is often possible to act as a free rider with respect to many of the cooperative's activities (for example, its bargaining and market-balancing activities). Therefore, Wiese argued, at some point an equilibrium market structure would arise in which both cooperatives and IOFs would be present.

Eschenburg (1971, 1974) and Kuhn focused on potential conflicts within the cooperative and on its mechanisms for resolving them. Eschenburg (1971, p. 2) argued that cooperative theory "must be a theory

¹In contrast to Fleischmann's argument, it is commonly alleged in the U.S. that cooperatives often attract poorer managers than do IOFs. Fleischmann, however, was referring to a situation in which the competing IOFs were small family-owned businesses, which is not usually the situation in the U.S.

of conflict" and criticized as unrealistic much of the standard theory, which implicitly assumes a harmony of interests among co-op participants. In order to demonstrate his point, Eschenburg developed a standard neo-classical model of a cooperative and showed that in general the optimum price and output levels for the cooperative as a whole did not correspond to those preferred by a rational profit-maximizing individual member. The member was faced with the dilemma of choosing between acting in his own individual interest or acting in the group interest.

Eschenburg next introduced transaction costs into his model and argued that because of these, if the cooperative was to be economically efficient, it had to move away from decision making based on unanimity towards majority rule and delegated authority (cf. Buchanan and Tullock). This raised the question of whether management, to whom authority was delegated, always acted in a manner consistent with the members' preferences. Eschenburg rejected the hypothesis, common to most standard cooperative theory, that managers always act in the members' best interest. He pointed out that given heterogeneous individual preferences there may be no unambiguous ranking of group preferences (cf. Arrow). In such situations, Eschenburg argued, management had no clear path to follow even if it wanted to maximize "member benefits," and hence was likely to set its own goals. Given its ability to manipulate information in the cooperative, management could often convince the members that its actions were indeed in their best interest.

Because of management's penchant to pursue its own objectives, Eschenburg suggested that a degree of "cooperative disloyalty," i.e., a willingness and ability of the members to patronize IOF competitors, could often be useful in disciplining the actions of management and

furthering the members' own interests. Eschenberg also stressed that the behavior of individual cooperatives was largely dependent on their internal organizational structures, and hence no single theory of cooperatives was likely to be comprehensive.

Kuhn modeled group choice in farmer cooperatives as an n-person cooperative (bargaining) game, in which the members bargained over the allocation of net benefits from their joint actions. In this model management played the role of a mediator, allocating the cooperatives' receipts in a manner that induced the members to remain within the organization.¹

Kuhn developed mathematical expressions for the economic value to the cooperative of a member's patronage and for the economic value to the member of the cooperative's services; he used these to outline the types of threats and counterthreats that could be made during bargaining between a member and the rest of the cooperative over the allocation of the cooperative's costs and benefits. He stressed that large patrons would have considerably more bargaining power than small ones; therefore, cooperatives comprised of a few large members could be particularly unstable. Kuhn's model suggested that in such organizations, each member would try to extract large concessions from the cooperative and that the cooperative's management and financial reserves would be largely devoted to mediating these disputes rather than to pursuing other goals. Once transaction costs were introduced into his model, however, the bargaining predicted by Kuhn became less intense.

¹This view of management as a disinterested arbiter ignores the possibility of the manager aligning himself with certain factions of the membership in order to gain support for his own goals.

Kuhn argued that in order for the cooperative to survive, the group-choice mechanisms within the organization had to be able to mediate potential member conflicts. In particular, he believed that strict adherence to one-person, one-vote could often lead to decisions that would give larger patrons incentives to leave the cooperative.

Zusman, an Israeli economist, also argued that understanding the behavior of farmer cooperatives required investigation of group-choice mechanisms because "...whenever members are not identical, conflicts among them are likely to arise. In view of Arrow's possibility theorem, it is even doubtful that a co-operative objective function actually exists" (p. 221).

Zusman examined how an agricultural marketing cooperative might go about allocating the cost of producing a joint service among its members. He investigated whether, given simple, nonstrategic, majority-rule voting on this single issue and a unimodal distribution of member preferences, any of several commonly suggested allocation rules would be agreed upon. He found that while some of the rules corresponded to stable voting equilibria, the exact way in which costs would be shared depended on: (1) how the membership was distributed with respect to the criterion by which costs were allocated (for example, patronage or size of land ownership), and (2) the costs of using the cooperative compared with other marketing outlets. The greater the difference between the average cost of using alternative market outlets and that of using the cooperative, the greater the possibility of the majority "exploiting" the minority by forcing the minority to bear a higher share of the cooperative's costs.

Because Zusman's analysis dealt with group choice of only a single issue, about which the membership had unidimensional, single-peaked

preferences, no voting paradoxes arose. In this situation, there existed a well-defined social welfare function, and maximizing it essentially involved maximizing the income of the cooperative's median member. In most agricultural cooperatives, however, policy decisions involve several interrelated issues, about which members may have quite diverse preferences.

Issues such as the pricing of various product qualities under pooled marketing, the location and nature of marketing facilities, and the sharing of marketing risks have distributional as well as efficiency implications. It is then likely that a social welfare function (Carson's W) does not exist, and the co-operative becomes a complex polity, in which interest groups are formed and various political interactions occur among them...

A simple majority voting rule is then transformed into a bargaining relation (Zusman, p. 233).

Understanding cooperative behavior, Zusman concluded, often required moving away from models that assumed maximization of a cooperative objective function and towards those that took explicit account of the bargaining that occurs among the participants in farmer cooperatives.

Very recently, Murray (1983a, 1983b, 1983c) drew on insights from the German "conflict school" of cooperative theory (for example, Eschenburg, Kuhn) to analyze the behavior of British agricultural cooperatives. Murray examined the conflicting goals of the farmer-members, board members, and management, especially as they affect the financing of the cooperative. He argued that because of the imperative facing farmer-members to invest heavily in their own farm operations, the members have an incentive to underfinance their cooperatives. Managers, on the other hand, favor capital accumulation, as this increases managerial flexibility and growth of the cooperative, which is strongly correlated with managerial rewards. Understanding cooperative behavior therefore

involves understanding how these conflicting goals are reconciled. As will become apparent in the following chapters, Murray's analysis is similar in many ways to the analysis developed in this study.

Conclusions and Outline of this Study

Cooperative theory has nearly come full circle. The early models of the cooperative as a form of vertical integration viewed decision making in cooperatives as being entirely decentralized, residing solely with the farmer members. The "cooperative as firm" models, on the other hand, saw the cooperative as maximizing a single objective, set for it by a "peak coordinator." Recent authors, viewing the cooperative as a coalition, have reintroduced a degree of pluralism into models of cooperative decision making, but have done so in a broadened and institutionally richer framework than that of the early models. Not only has the list of potential participants been broadened to include managers, other personnel, competitors, nonmember customers, and the state, but the complexity of the decision-making process itself has been more fully portrayed.

This study, which investigates the allocation of costs and benefits from the activities of farmer cooperatives, builds on the more recent literature on the cooperative as a coalition. But because cooperatives do represent a form of vertical integration by their stockholders and because these organizations are legal entities separate from their member firms, insights from the literature on "the cooperative as a form of vertical integration" and "the cooperative as a firm" will also prove helpful in developing an expanded theoretical approach to farmer cooperatives. The approach taken in this study involves mainly deductive theorizing from basic behavioral postulates. Information collected during interviews with cooperative managers, board members, farmer-members,

and others in agribusiness is also relied upon, however, for insights into cooperative behavior and to illustrate conclusions derived from theory.

The study is organized as follows. As a first step in analyzing farmer cooperatives, chapter 2 briefly examines different ways of defining these organizations. Several distinguishing characteristics of farmer cooperatives become apparent, and the chapter traces through some of the implications of these characteristics for the behavior of participants in cooperatives. Chapter 3 then lays out, in broad terms, the elements of a behavioral model of benefit-cost allocation within farmer cooperatives.

The very existence of farmer cooperatives suggests that there are net benefits to collective action by farmers, and chapter 4 investigates what those benefits include. In so doing, the chapter outlines the conditions under which farmer cooperatives are most likely to arise and the incentives for farmers to join them.

Chapter 5 formalizes many of the elements of the general model presented in chapter 3 by developing a game-theoretic analysis of the allocation of benefits and costs within farmer cooperatives. Game theory, however, makes several restrictive assumptions, including perfect knowledge, unchanging preferences, and zero transaction costs. Chapter 6 relaxes these assumptions and analyzes how doing so modifies the results of the game-theoretic analysis. Chapter 7 then uses the analytic approach developed in the preceding chapters to examine the experiences of several cooperatives in designing rules for product pooling and joint cost allocation. Chapter 8 summarizes the major conclusions of the study and

draws implications from them for the design of alternative allocation rules in farmer cooperatives and for needed further research.

CHAPTER 2

THE NATURE OF THE COOPERATIVE ASSOCIATION

"Definitions [of the cooperative]...have varied from the strongly emotive to the intentionally practical but actually unhelpful, and from the convoluted to the gloatingly iconoclastic " Bateman, Edwards, and LeVay (1979b), p. 54.

In order to understand decision making in farmer cooperatives it is first necessary to understand how farmer cooperatives differ from other types of businesses. This chapter outlines the distinguishing characteristics of farmer cooperatives and based on those characteristics develops hypotheses that are more fully explored later in this study. The chapter contains three parts. The first part briefly reviews alternative definitions of farmer cooperatives and identifies several characteristics common to these organizations. The second part traces through some of the consequences of these characteristics for the behavior of participants in these organizations and develops hypotheses regarding how that behavior will vary in different circumstances. The final part summarizes the major findings of the chapter and explains how they relate to the analysis presented in succeeding chapters.

Defining a Farmer Cooperative

Cooperatives are frequently defined as businesses that are owned by their patrons and that follow at least some of the Rochdale Principles, which are listed by Roy (p. 258) as:

- (1) net margins distributed according to patronage;
- (2) democratic control--one-man, one-vote;
- (3) limited return on stock;
- (4) limitation on the number of shares owned;
- (5) open membership;
- (6) trading on a cash basis;
- (7) membership education in the cooperative way of doing business;
- (8) political and religious neutrality;
- (9) no unusual risk assumption; and
- (10) goods sold at regular retail prices (with net margins rebated to members) rather than discounting prices at retail.

There are practically no modern cooperatives that follow all the Rochdale Principles. The problem of defining a cooperative as a business that follows some of these principles is that any two cooperatives thus defined may not have any characteristic in common. "Rather, we shall be left with a crisscrossing network of similarities very like what Wittgenstein referred to as 'family resemblances,'" (Bateman, Edwards, and LeVay, 1979b, p. 56).

Furthermore, while some of the Rochdale Principles may be important in fundamentally defining the structure of cooperatives, others simply represented prudent business practices at the time of the Rochdale Pioneers. The prohibition on credit sales, for example, may have been appropriate during the 18th Century, when the banking and credit system was relatively undeveloped, but prohibiting present-day cooperatives from extending credit would place them at a severe competitive

disadvantage. Similarly, the requirement that cooperatives remain politically neutral may have been appropriate when these organizations were first forming and were sometimes viewed as subversive. Today, with heavy government involvement in many parts of the agricultural economy, investments by cooperatives in influencing the political process may yield higher returns to their members than investments aimed at improving operational efficiency. From the members' point of view (if not society's), political neutrality of the cooperative would be irrational. Certain other Rochdale Principles (such as the requirements that there be "no unusual risk assumption" and that goods be sold at "regular retail prices") are so vague as to be nonoperational.

Even the more "fundamental" of the Rochdale Principles are not always followed by farmer cooperatives. Every agricultural cooperative, for example, follows some form of closed membership, at least insofar as membership is restricted exclusively to farmers. (This is implicit in the requirement that farmer cooperatives be owned by their patrons. As explained more fully below, closed ownership, in the sense of there being restrictions on who may own stock in the business, is a distinguishing characteristic of cooperatives.) Many agricultural marketing cooperatives further restrict membership because of limitations in processing capacity, the desire to ensure product quality, or other reasons. Not all farmer cooperatives follow the one-person, one-vote rule either; some permit voting based on patronage or stock ownership (usually subject to certain limits), and federated cooperatives often practice one-member, one vote. Because the members of federated cooperatives are local cooperatives which may vary in their number of patrons, one-member, one-vote does not always equate with one-person, one-vote.

Given the ambiguity of using the Rochdale Principles to define a cooperative, Schaars (cited by Roy, p. 259) argued that there were only three essential characteristics of a cooperative:

- (1) service at cost to member-patrons;
- (2) democratic control by member-patrons [where the exact meaning of "democratic" is left undefined]; and
- (3) limited return on equity capital.

A cooperative, in Schaars's view, was a member-controlled business in which the return to investment was distributed primarily according to patronage rather than according to ownership of equity in the organization.

In the United States, federal and state statutes define the conditions a business must meet in order to be considered a legal farmer cooperative. For example, the Capper-Volstead Act specifies that in order to qualify for a limited exemption from the antitrust provisions of section six of the Clayton Act, a farmer-owned marketing cooperative must be "operated for the mutual benefit of the members" and meet at least one of the following conditions (USDA, 1976, p. 293):

- (1) one-member, one-vote; or
- (2) dividend on stock limited to eight percent per annum.

The Capper-Volstead Act further specifies that in order to qualify, a cooperative's dollar volume of trade with nonmembers may not exceed that with members.

The Capper-Volstead Act permits voting in a cooperative on a basis other than one-member, one-vote if the annual dividend paid on capital stock is limited to no more than eight percent. Many state incorporation statutes, however, limit the extent of voting based on patronage

or stock ownership. Sixteen states require one-member, one-vote, while others place a limit on an individual member's voting power if it is based on patronage (Baarda, p. 73).

The principle of one-person, one-vote, as instituted by the Rochdale Pioneers, was an attempt to prevent domination of cooperatives by members who had much more capital to invest in the organization than did others. Although cooperatives represent a pooling of both capital and patronage, this principle states that nominal political control of the organization should be related to neither; rather, formal decision-making power should be equally distributed on a per-capita basis. This may be acceptable to most members when the membership is relatively homogeneous with respect to contributions of capital and patronage,¹ but when the members vary widely in their patronage and capital contributions, one-person, one-vote raises important equity issues, which are discussed later in this chapter.

Given the variation in cooperatives' practices, it is probably impossible, as Bateman, Edwards, and LeVay (1979b) concluded, to devise a concise definition of a cooperative that would be valid for every organization that appears, on the basis of everyday observation, to act like a cooperative. The approach taken in this study is similar to that of Schaars: three characteristics common to most farmer cooperatives are identified and used to define a "typical" farmer cooperative. There are undoubtedly cooperatives that do not exhibit all of these characteristics. As Eschenburg (1971, pp. 84-85) pointed out, given the diversity of these

¹Emelianoff (cited by Whitney, p. 56) stressed that the Rochdale Pioneers "were perfectly equal...in their poverty."

organizations, no one definition or theory of cooperatives is likely to be comprehensive.

For the purposes of this study a farmer cooperative is defined as a business with the following characteristics:

- (1) The stockholders, who are farmers, are the major customers of the business.¹
- (2) The return on a stockholder's investment is gained primarily via patronage with the business. There are three reasons for this:
 - (a) The business pays a strictly limited dividend on equity capital invested in the organization.
 - (b) Net margins (gross revenues minus costs, including the cost of any dividend paid on equity capital) are distributed among stockholders in proportion to their patronage with the business rather than in proportion to their stock ownership.¹
 - (c) There is very limited or nonexistent secondary market for the equity securities of the organization. The lack of a secondary market prevents stockholders from capturing capital gains in the value of their stock

¹A member who supplies raw-product to a marketing cooperative can be considered a customer of the cooperative's marketing services. Similarly, a member of a bargaining cooperative can be thought of as buying the cooperative's bargaining services. Therefore, the term "customer" will be used in this chapter to include not only members of supply cooperatives, but of marketing and bargaining cooperatives as well.

²The frequently mentioned cooperative principle of "service at cost" is subsumed under this characteristic. How the cooperative defines its costs and the level of those costs are obviously important in determining what "service at cost" really means. As will become apparent later in this chapter, "service at cost" does not always mean "service at minimum cost."

and leads to a fundamentally different concept of "ownership" in cooperatives than in IOFs.

Because the return on investment is gained primarily through patronage, the demands on the cash flow of the organization are also different than in an IOF, as explored below.

(3) The formal governance of the business by the stockholders is structured "democratically" in the sense that:

(a) Voting power is not proportional to stock ownership.

The limitation on "voting one's stock" may be in the form of a one-member, one-vote decision rule, or voting may be proportional to patronage or stock ownership but subject to some limit (such as restricting any one member from having more than five percent of the total votes).

(b) There are strict limitations on the number of nonstockholders who may serve on the board of directors.

The next part of the chapter examines some of the implications of these characteristics for the behavior of participants in farmer cooperatives.

Implications for Participant Behavior

Each of the three characteristics of farmer cooperatives just identified results in differences between the incentives faced by participants in cooperatives and those faced by participants in investor-owned firms. These differences in turn may lead to differences in the behavior of the two types of organizations. The following discussion outlines hypotheses regarding differences in participant and organizational

behavior and some evidence to support those hypotheses; the case study in chapter 7 presents further evidence regarding some of the hypotheses. Thorough testing of all the hypotheses, however, would require greater empirical investigation than undertaken in this primarily theoretical study.

The following examination of behavioral differences between cooperatives and IOFs assumes that the prevailing market structure is something other than perfect competition. In perfect competition, market forces are perfectly coercive, determining exactly what is produced and how factors are combined in production. Because market forces dictate everything, the internal organization of firms becomes irrelevant. There is but one profitable way of organizing economic activity (that described by the general equilibrium), and every firm is reduced to "a production function to which a profit maximization objective has been assigned" (Williamson, 1981, p. 1564). Only when some of the assumptions of perfect competition, such as perfect knowledge and perfect mobility of factors, are relaxed can structural differences between competing firms persist. Only when the consumer is no longer sovereign can managers' and stockholders' desires influence the actions taken by a firm.

On the other hand, this study does not assume away the influence of market forces on cooperatives and investor-owned firms. A shortcoming of some of the literature on organization theory and member control of cooperatives is its almost exclusive emphasis on the influence of managers, personnel, and stockholders in determining firm behavior, ignoring the constraints imposed by the market. Much of the tension that arises in cooperative decision making, however, derives from the need to reconcile the desires of co-op participants with the demands of the market.

In general, however, the differences outlined below between the behavior of cooperatives and that of IOFs will be greater the lower the degree of market competition or rivalry and hence the lower the power of the market to dictate organizational behavior.

Relaxing the perfect competition assumption allows us to examine the role that customers' demands, as opposed to managers' or stockholders' goals, play in determining the behavior of cooperatives and IOFs and to consider the importance of opportunism in market transactions. For a firm to survive in a market system its behavior must at least roughly correspond to what its customers demand. This correspondence can be achieved by modifying the firm's activities to correspond with the customers' demands (the model of consumer sovereignty), by modifying the customers' demands through advertising and the like to correspond with the firm's activities (the Galbraithian model), or by some combination of the two. In imperfectly competitive markets, however, a firm may survive even though its actions are not perfectly congruent with its customers' demands.

In the absence of perfect competition a firm's transactions generate rents, and how these rents are distributed between the firm and its customers depends on the relative bargaining power of the two parties.¹ A firm may capture a high proportion of these rents (for example, by producing lower quality merchandise for a given price than would be necessary in order for the firm to stay in business); as long as the customer

¹This view of market transactions is formalized in the game-theoretic analysis of chapter 5. The "transactional rents" referred to in this section equal the sum of the consumer and producer surpluses generated in the transaction.

receives at least some of the rent he does not have an incentive to break off the transaction even though he may feel that the firm does not take his preferences fully into account in planning its activities. To the extent that the rents arising in the transactions between a firm and its customers are allocated to the customers (for example, via a patronage refund in a cooperative), the firm can be said to incorporate the customers' preferences into its decision making.

In the absence of perfect competition, opportunism can exist in market transactions. In the presence of incomplete contracts (necessitated by imperfect knowledge of future contingencies), situations may arise in which a firm can act opportunistically by unilaterally redistributing part of the transactional rent in its own favor. For example, a component in a piece of equipment sold by a firm may fail "prematurely." If the component is not covered by a guarantee, the firm can charge a high replacement cost, absorb part of the cost of repair, or fix the equipment for free. Each option corresponds to a different distribution of the transactional rent between buyer and seller. The course of action taken by the firm will depend on how opportunistic the firm is and on the constraints placed on it by market competition. Again, as long as the customer retains at least a share of the rent, he does not have an incentive to break off the transaction even though he may feel cheated. Therefore, given imperfect competition, opportunistic behavior can

persist even between a buyer and seller that maintain a long-term relationship.¹

Behavioral Differences Due to Stockholders being Major Customers

To the extent that stockholders influence a firm's decisions, one would expect the decisions of a firm to be different if its stockholders were its major customers than if they were not. Cooperative theorists from the 1940s through the 1970s have stressed some of these differences by pointing out how the objective function of cooperative might differ from that of IOFs (see chapter 1).²

Different Scope for Optimization

The scope for optimization in a farmer cooperative is potentially broader than in a competing IOF that is not vertically integrated into farming. A profit-maximizing farmer would be interested not in running his farm and the cooperative as separate profit centers but in optimizing the performance of the integrated farm/cooperative operation. (A maxim of systems analysis is that optimizing the performance of individual subsystems rarely leads to the optimum performance of an overall integrated system [Churchman, pp. 16-27].)

¹In acting opportunistically, a rational firm takes into account how its actions will affect its future as well as its current income. For example, will its current actions encourage entry of competing firms or stimulate its customers to search for alternative suppliers? In other words, the firm views the transactional rent as an expected present value of a future income stream. Such an outlook may reduce fly-by-night behavior, but in the absence of perfectly competitive or perfectly contestable markets (see chapter 4) it will not necessarily eliminate all incentives to act opportunistically.

²The characteristics of cooperatives outlined in this section would also apply to an IOF whose stockholders were its major customers.

If optimizing individual subsystems rarely leads to a global optimum, then why don't the stockholders of an IOF insist that their firm coordinate its actions with those of the other firms in which the stockholders have an equity interest? For example, why don't stockholders of Mobil Oil who also own stock in General Motors insist that Mobil hold down its gasoline prices so as to encourage the sale of large, highly profitable cars by GM? The answer lies in the diversity of the stockholders of a typical IOF. If all held stock in both Mobil and GM such behavior might occur, but usually the only thing that stockholders in an IOF have in common is their equity interest in that particular company. In such cases the only common interest they have is that of maximizing the individual firm's earnings; hence the company usually does not coordinate its actions with those of other independent firms, although it does coordinate with its subsidiaries.

In a farmer cooperative the stockholders have at least one additional characteristic in common beyond their equity interest in the firm: their identity as customers of the firm. Therefore, some coordination between the cooperative's actions and those of its stockholders' businesses may be possible, but the extent to which this occurs depends on information and other transaction costs, including the cost of reaching agreement among the farmer-members about what constitutes acceptable behavior for the cooperative. These decision costs may be high when the members vary widely with respect to their objectives and available resources; as a result, cooperatives with highly heterogeneous memberships may act more like independent optimizers, pricing their services in a manner similar to an IOF. This may be particularly true of cooperatives that handle products that are outputs for some members and inputs

for others, such as cooperatives that buy grain from some members and sell it as livestock feed to other members. In such cooperatives one group of members may view its interests as being diametrically opposed to those of another group, making it nearly impossible for the membership to reach a consensus on how the cooperative should coordinate its activities with those of the member firms. Nonetheless, in most cases the stockholders of a farmer cooperative are likely to have more objectives in common than are the stockholders of an IOF, and therefore some degree of farm/cooperative coordination is possible. Because of this, the behavior of cooperatives is likely to differ from that of IOFs, particularly with respect to the firm's classification of costs as either fixed or variable and the firm's pricing behavior.

Fixed versus Variable Costs

To the extent that stockholders of the cooperative influence decision making in the organization, items that represent fixed costs for the stockholder-customers may receive greater consideration in the cooperative's decisions than they would in the decisions of an IOF, which can transform, via a market transaction, its customers' or suppliers' fixed costs into variable costs for the firm. An agricultural processing cooperative, for example, will likely give greater emphasis to providing its supplier-members a "home" for their product than will an IOF because the cooperative takes account of the need of its stockholders to amortize their fixed on-farm production investments. An IOF, on the other hand, usually does not have to deal directly with its suppliers' fixed costs; they are transformed, via a market transaction, into the raw-product price that the IOF pays, which the firm considers as a purely variable cost.

This tendency of farmer cooperatives to give greater weight to their stockholder-customers' fixed costs results in the capital of cooperatives being less mobile than that of other firms. Farmer cooperatives tend to concentrate their investments in agribusiness activities closely related to the farming activities of the member-stockholders because the stockholders might suffer substantial capital losses if their farming activities were not adequately supported. These capital losses would not appear on the income statements of the stockholders of an IOF serving these farmers; hence, there would be little pressure on IOF management to invest in these agribusiness activities if more profitable opportunities lay elsewhere. One would therefore expect IOFs to shift their resources in and out of agribusiness more frequently than would cooperatives, whose assets are in a sense tied to those of their stockholder-members.

This limited mobility of cooperative capital also accounts for the alleged tendency of agricultural marketing and processing cooperatives to be more raw-product oriented than their IOF competitors. In an IOF, pressure from the stockholders to increase the firm's profits may lead management to develop new processed products. In doing so it surveys the market for processed products, identifies niches for new products, and then buys the raw materials needed to produce those products. In a processing cooperative the direction of pressure is likely to be reversed: stockholder-members often seem to believe that the best way to increase their profits is through fuller use of their fixed on-farm assets, which usually translates into greater raw-product production. Management is then faced with pressures to develop new uses for the raw product in order that it can be disposed of profitably. Innovation in marketing

cooperatives therefore tends to take the form of identifying new uses for the members' raw products rather than of identifying profitable opportunities for developing new processed products and then buying whatever raw products are needed to capitalize on those opportunities. Marketing cooperatives, in other words, are likely to be more innovative than IOFs in developing new uses for raw agricultural products produced by their suppliers, but less innovative in responding to consumer demands, unless these demands are consistent with increased use of the members' raw products.¹ (In contrast, agricultural supply cooperatives may be very innovative in meeting consumer demands because the consumers of the final products produced by these companies are these companies' stockholders [see the section below on "Better Information Flows"].) To the extent that product innovation in marketing and processing cooperatives is successful in raising the returns to raw-product producers it may stimulate further investment in raw-product production, leading to further pressure to innovate. Like Alice in Wonderland, managers of

¹For example, one major midwestern dairy processing cooperative has the technology to produce artificial cheeses and contingency plans to do so, but only as a defensive strategy to preserve its market share should its IOF competitors greatly increase their marketings of artificial cheeses in response to a perceived consumer demand for these products.

processing cooperatives may find themselves running faster and faster to stay in the same place.¹

The integrated nature of a farmer cooperative may also lead to different managerial behavior in a cooperative than in an IOF because the cooperative may have to bear certain costs that it could shed onto others were it not owned by its customers. For example, a cooperative may be less able to drive a hard bargain with a unionized labor force than is an IOF. The cost of a strike can be very high to the stockholders of a farmer cooperative, as it can deny them access to the cooperative's services at a critical time in the crop cycle. Whereas an IOF might try to weather a strike by simply shutting down, thereby shifting some of the cost of the strike onto its farmer-customers, a cooperative manager who tried this strategy would likely face strong pressure from the stockholders to settle the strike quickly. The stockholder-customer identity forces the manager to take a more integrated view of the firm's costs and benefits.

¹This is illustrated by the experience of the California Almond Growers' Exchange (CAGE), an open-membership marketing cooperative that historically has agreed to market all the almonds its members produce. As a result, CAGE's management has faced strong pressure to develop new uses and markets for almonds. It has responded by developing approximately 5,000 different almond products (each container size is considered a separate product) and by arranging export sales to 88 foreign markets. In part because of CAGE's early success in product innovation and marketing, raw-product returns to growers improved, who responded by tripling acreage and doubling yields between 1962 and 1982. As a result, by 1982 the almond industry faced carryover stocks equal to over twice the maximum annual consumption of almonds ever recorded up to that time (Baccigaluppi).

Pricing Behavior

Because cooperatives represent a form of vertical integration, their pricing behavior may differ from that of IOFs. Prices charged or paid by cooperatives have some of the characteristics of transfer prices in a vertically integrated or conglomerate firm in that potentially they can be adjusted to minimize the income tax burden on the stockholders. For example, stockholders in high marginal tax brackets may pressure cooperative management to retain net margins of the organization as unallocated reserves, so that the tax liability for the earnings accrues to the cooperative (which may be in a low marginal tax bracket) rather than to the members, as would occur if the margins were allocated to the members.¹ The cooperative may even eliminate some of the combined member/cooperative tax liability by converting potential earnings into nontaxable forms, such as consumer surplus. This can be achieved by using earnings from some of the cooperative's operations to subsidize the price of consumer goods and services sold to members.² This suggests that cooperatives have an incentive to provide certain amenities to their members (cut-rate life insurance, etc.) that are not directly related to farm production.

Because the prices charged by cooperatives are in the nature of transfer prices, the scope for opportunism may be less in cooperatives than in IOFs. If a cooperative is truly controlled by its

¹See appendix A for definitions of "allocated" and "unallocated" reserves as well as a discussion of the other cooperative terms used in this study.

²Subsidizing the price of production inputs sold to members would not reduce the members' income tax liability because the cheaper inputs would result in higher farm profits.

stockholder-customers, then there is little incentive for management to try to redistribute transactional rents unilaterally in the cooperative's favor because these rents would eventually be rebated back to the members. Trifon (n.d.) stresses this point in arguing that it is impossible for a cooperative to exploit its members.

In reality, management of a cooperative may be able to capture part of the cooperative's rents in the form of salary and perquisites, and the distribution of the remaining rent among the member-owners may be unequal due to pooling practices and joint cost allocation procedures. Therefore, some incentives for opportunistic behavior may remain. Even these may be muted, however, by the ability of aggrieved stockholders to voice complaints to the board of directors about opportunistic behavior on the part of management. Although Trifon's argument about the impossibility of exploitation in a cooperative is an overstatement, the structure of the organization may make such opportunistic behavior less likely.¹

Because most cooperatives require members to pay a membership fee or purchase stock before they can patronize the organization, cooperatives are potentially well-designed to practice the two-part pricing necessary to achieve marginal-cost pricing, and hence economic efficiency, in the presence of overhead costs. If the production of a good involves both fixed and variable costs, then pricing the good purely as a variable cost leads to "wasteful underconsumption" by resulting in the marginal cost to the buyer exceeding the marginal cost of producing the

¹Cf. Zusman's argument, reviewed in chapter 1, that under certain conditions the majority of members in a cooperative may exploit the minority.

good (Clark, pp. 26-27). A cooperative could potentially overcome this problem by charging each member a fee, based on his or her projected patronage, that would cover the fixed costs of producing the goods or services purchased by the member, and then pricing those goods or services at marginal cost. Some fruit and vegetable processing cooperatives price their services to members in a manner similar to this. Members are required to purchase stock in the cooperative in proportion to their estimated raw-product deliveries, where the price of the stock depends on the type of raw-product delivered and the value of the cooperative's assets involved in processing it. Members are also charged a per-unit retain, which may approximate the variable cost of processing the product.

In practice, there are several reasons why cooperatives may be reluctant to price their goods and services in this manner. First, assessing a member his share of the cooperative's fixed costs in this manner would make the allocation of overhead costs more explicit, and management and the board may want to avoid this because the allocation of overhead costs may become a contentious issue among the members. Second, given the capital intensity of most of the industries in which agricultural cooperatives are involved, the initial membership fee would have to be substantial. Competitive pressures in the industry may push the cooperative to keep its membership fee low in order to attract new members. In this sense, competitive pressures may work against economic efficiency. This suggests that where competitive pressures are less and cooperatives are therefore able to charge relatively high membership fees and price according to marginal cost, these firms will tend to

operate closer to plant capacity than will either competing IOFs or co-operatives operating in more competitive environments.¹

Some Qualifications

A cooperative's ability to benefit from its broader scope for optimization may be limited by two factors: (1) the structure of incentives facing individual farmer-members in certain circumstances, and (2) a dearth of common interests among a highly heterogeneous membership.

Several cooperative theorists (Kaarlehto, Eschenburg, Lopez and Spreen) have noted that in many situations the interest of the membership of a cooperative as a whole does not correspond with that of individual members. In order for a farmer cooperative to take advantage of its broader scope for optimization, the operations of the cooperative have to be coordinated with those of the members' farm firms. If incentives exist for the members to operate their farms in a totally independent manner (for example, expanding production even though all members would benefit from a mutual reduction of output), the benefits of coordination will be lost. A number of such prisoner's dilemma situations are discussed in chapter 5; for the moment, suffice it to say that such behavior is more likely the larger the number of members and hence the greater the difficulty of detecting noncooperative behavior by an individual member.

¹This hypothesis might be difficult to test. Cooperatives that are particularly profitable for reasons unrelated to how they price goods and services to members may face a strong demand for membership. These cooperatives may use high membership fees as a means of rationing limited plant capacity; hence, a positive correlation between high membership fees and effective use of plant capacity might not be due entirely to the efficiency-inducing effects of two-part pricing.

Coordination of the cooperative's activities with those of its member firms may also be reduced if the membership is highly heterogeneous, as discussed above. With a highly heterogeneous membership, particularly one in which the members perceive themselves as being in opposing camps, it may be difficult to get members to agree on anything other than running the cooperative as a separate profit center. In game-theoretic terms (see chapter 5 and appendix C), the core of the bargaining game between stockholders may collapse to only one solution--independent profit maximization of the stockholders' individually and jointly owned firms. This does not necessarily mean that the farmer-members are poorly served by such cooperatives. The stockholders may be happy with the cooperative's performance in the same sense that an investor in an IOF is happy with his firm's performance. To the extent that the cooperative operates as a separate profit center, however, the potential gains to the cooperative's stockholders from the organization's broader scope for optimization are lost.

Pooling Issues and Income Distribution

In multiproduct or multiservice cooperatives, one of the most important consequences of the stockholders being customers of the firm is that the stockholders become vitally interested in the firm's pricing of individual goods and services, not simply in its overall financial performance. Whereas the income a stockholder derives from an IOF depends on the firm's "bottom line," the net income of a cooperative's stockholder often depends more on the prices of the individual goods and services he purchases from the cooperative than on the organization's overall profitability. Because the prices charged by the cooperative

enter the stockholders' profit functions as costs, questions of pricing, product pooling, and joint cost allocation become issues of vital interest to the stockholders. Unlike their counterparts in an IOF, the stockholders of a cooperative are intensely interested in the income-distribution consequences of their firm's marketing and cost-allocation decisions.¹

Because members of the cooperative who produce different products will have different preferences for how the cooperative should set prices and allocate costs, price setting and cost allocation become much more delicate issues for management of cooperatives than they are in IOFs. Instead of representing merely strategic questions about how best to improve the firm's financial performance, these decisions directly affect the stockholders' willingness to patronize and contribute financially to the organization. This stockholder sensitivity to pricing and cost-allocation has two implications. First, price setting and cost allocation are likely to be more costly processes in cooperatives than in IOFs. Not only do cooperative stockholders often demand to be involved in these decisions (for example, via the board of directors), but because of the diversity of stockholder interests it may be difficult to reach a consensus about what the appropriate pricing and cost-allocation rules should be. In contrast, in an IOF, management often makes these decisions with no stockholder input whatsoever. Second, a cooperative's ability to cut prices and employ cross-subsidies to gain market

¹Members' concerns about these decisions are likely to be greatest when the members face financial difficulties and hence cannot "afford" to cross-subsidize their co-members. During periods of prosperity, quarrels among the membership about pricing and cost allocation are likely to be less intense.

share may be much more circumscribed than that of an IOF. The stockholders who, through their patronage of particular goods and services, finance the subsidies for the discounted items may object to carrying an "unfair burden" in the cooperative's quest for an expanded market share. As a result, cooperatives may be less able than IOFs to enter new fields of endeavor where gaining a toehold in the market requires initial price-cutting.¹ This reinforces the tendency of cooperatives to have a more narrow range of activities than do IOFs due to the limited mobility of cooperative capital discussed above.

Limited Pool of Equity Capital

A major consequence of tying stock ownership to patronage in farmer cooperatives is that the potential pool of equity capital for cooperatives becomes sharply circumscribed. Whereas an IOF can raise additional equity capital by selling stock to the general public, an agricultural cooperative can increase its equity base only by convincing existing stockholders to subscribe additional capital or by attracting new stockholders who also qualify as members of the cooperative under the organization's bylaws. This means attracting active farmers; depending on the cooperative's bylaws, the pool of potential members may be further restricted to farmers engaged in certain types of production.

If the cooperative's activities are becoming more capital intensive, attracting new members will not solve the cooperative's need for additional equity capital. In this situation the cooperative requires an

¹In the U.S., federal tax regulations regarding "netting" (see appendix A) may further restrict cooperatives' ability to use cross-subsidies (Baarda, personal communication).

increase in capital per unit of patronage, that is, an increased commitment of capital from existing members, in addition to substantial capital contributions from new members. Members may be reluctant to subscribe additional capital to the organization because doing so denies them the use of this capital in their individual farm enterprises.

The equity base of a cooperative, once eroded (for example, because the cooperative became involved in a price war with its competitors), is harder to rebuild than that of an IOF. A cooperative cannot rely on simply selling new stock to investors who previously held no equity in the firm; rather, it must go back to its current members and convince them to put up more capital.¹

As a result of the difficulty of raising equity capital in cooperatives, managers of cooperatives, particularly supply cooperatives, may be reluctant to initiate risky activities, such as price cutting, that potentially could lead to an erosion of the cooperative's capital base. In the words of one cooperative manager, "Because equity cannot be enticed into cooperatives, equity is more sacred: it must be guarded more carefully" (Van Nostrand, p. 86). In supply cooperatives managers may therefore prefer to use net margins to expand services to members in a way that is not directly linked to patronage rather than to rebate the margins as cash and risk being perceived by competitors as price cutters. As discussed above, the desire to reduce members' tax burdens and to limit the incentives for members to expand their production may reinforce such managerial behavior. In certain types of marketing cooperatives,

¹There are additional reasons, discussed later in this chapter, why cooperatives have difficulty attracting equity capital.

however, the common practice of accepting all the raw-product the members produce may result in managers having to cut the price of their processed products in order to move their inventory. The threat that such price cutting poses to the cooperatives' equity base has led many marketing cooperatives to reconsider their policy of providing a "home" for their members products, as discussed in chapter 6.

To the extent that cooperative managers resist initiating price cuts they may simply be following the Rochdale Principle of selling "at regular retail prices," which Roy (p. 259) states was developed primarily to discourage cooperatives from launching mutually destructive price wars. If the cooperative includes the cost of providing the nonpatronage-related services to its members as part of its overhead cost, which is apportioned among the other goods and services the cooperative produces, the organization may still claim that it is providing its members "service at cost," but that cost is clearly not minimum cost.

Risk Aversion

Farmers invest in agricultural cooperatives as a means of strengthening their farm businesses. The investment represents a deepening of the farmers' financial commitment to a particular line of business. The tying of patronage to stock ownership in cooperatives prevents the stockholding function in the organization from being handled by specialized agents (such as independent investors in an IOF) who are either more risk-preferring than the customers or who can spread their risks by diversifying their portfolios (Carson; Condon and Vitaliano). Because the investors in cooperatives tend to "have all their eggs in one basket"

they may pressure management to adopt more conservative business strategies than those of competing IOFs. Furthermore, because of the immobility of cooperative capital discussed above, it is more difficult for cooperatives than for IOFs to spread their risks by diversifying into totally unrelated activities; hence, management itself may prefer more conservative business strategies.¹ Although both stockholders and management may push for some diversification of the cooperative's activities (see chapter 4), because of the reasons just cited one would expect farmer cooperatives to be more risk averse than their IOF competitors, particularly if the latter are divisions of large diversified firms.

Better Information Flows and Product Specification

The identity of the customer with the stockholder in cooperatives may lead to better information flows between patron and management and better product specification. Part of the supply cost of a product is the cost of determining the characteristics of the product desired by customers. This cost may be lower in cooperatives because cooperatives are often structured in a way that makes it easier to collect such information. Unlike many IOFs, a cooperative usually has a list of its patrons and may be able to collect a substantial amount of information about their production practices and needs by asking the members to fill out questionnaires upon joining the organization and through periodic

¹Dunn, Ingalsbe, and Armstrong report that in general farmer cooperatives tend to be less diversified than the IOFs with which they compete (p. 245).

member surveys.¹ The members may give more truthful information to the cooperative than they would to an IOF because as stockholders they are more assured that the cooperative will not use the information to act opportunistically towards them.² Furthermore, members of cooperatives have more channels open to them to communicate their desires to the firm than do customers of an IOF. In addition to the firm's management and customer representatives, co-op patrons have access to the firm's formal governance structure through the board of directors. Exercising customer "voice" may therefore be cheaper in a cooperative than in an IOF (Hirschman, 1970).

Because of their structural characteristics cooperatives may therefore elicit better information from their customers about desired goods and services than do IOFs. This may be particularly important in anticipating changes in demand for farm inputs. Whether cooperatives can effectively respond to the improved information they receive depends in part on the costs of reaching decisions in cooperatives regarding whether or not to innovate, a point discussed in more detail below. One would expect that cooperatives that allow their managements substantial discretion with respect to product innovation (subject to board veto) would

¹It is remarkable that many cooperatives do not avail themselves of these information-gathering possibilities.

²Some incentives for dissembling may remain, depending on how the members believe the costs of developing and producing new products will be shared among the members of the cooperative. For example, consider corn farmers who are members of a supply cooperative whose patrons include producers of many different commodities. If the corn farmers believe that because of the cooperative's cost-sharing practices, the cost of developing an improved corn herbicide would be borne by all the members, the corn producers may have an incentive to overstate their need for such a product, since they would have to pay only a fraction of the cost of its development.

exhibit greater innovation and produce goods more finely attuned to their customers' needs than do competing IOFs. On the other hand, co-operatives that require board or membership approval before product modification can begin may be less innovative than their IOF competitors due to the high cost of group decision making in the cooperative.

Greater Customer Loyalty

Because the customers of cooperatives are stockholders who may have substantial investment in the company, they may exhibit a greater degree of loyalty to their firm than do the customers of an IOF, as evidenced by a greater willingness of co-op customers to continue to patronize their firm when competing firms offer more favorable prices. Such loyalty can facilitate the cooperative's planning of new facilities by improving its ability to project the demand for its goods and services. At the same time, loyalty may reduce marketing costs for cooperative members who, because they assume that the cooperative will act in their best interest, forgo the search costs involved in gathering price and product information from several different firms (Lee, p. 67).

Increased loyalty, however, depends in large part on the stockholder-customer perceiving that the rate of return on his investment in the cooperative is contingent upon his continued patronage. This rate of return has two components: the return of capital, that is, the recovery of the initial investment; and the return on capital, that is, the additional net earnings engendered by the investment (Gittinger, p. 66). In an agricultural cooperative the return of capital, in an undiscounted sense, depends on the cooperative's equity redemption program. The return on capital is derived through patronage, through limited interest

payments on capital invested in the organization, and through the cooperative's provision of public and semipublic goods, such as lobbying, to its members. The current return gained through patronage is represented by the difference between the cooperative's prices (net of any patronage refund) and those of competing IOFs.

If the cooperative's net prices are less favorable than those of competing IOFs, if the rate of interest paid on capital invested in the cooperative is less than the member's opportunity cost of capital (as it usually is), and if it is possible to act as a free rider with respect to the cooperative's provision of public and semipublic goods, then the individual member's short-run return on his capital invested in the cooperative is negative. If he believes that the speed with which his cooperative equities will be retired does not depend on his continued patronage, then the perceived return of his capital is unaffected by his patronage decisions. Given these conditions, there is no reason, based on current financial considerations, why the cooperative member should be any more loyal to "his" firm than is the customer of an IOF. If the member's perceived rate of return on his investment in the cooperative is negative or is not contingent upon his continued patronage, he may rationally regard the investment as a sunk cost and therefore not take it into account in making current patronage decisions.

This conclusion is most likely to be valid if the cooperative has an open-membership policy and if the member believes that market prices will be unaffected by his patronage decisions. In this situation, a member who does not patronize the cooperative in the current year can freely patronize it in succeeding years if the cooperative's prices become more favorable, and he believes that his patronage decision in the

current year will not affect the future prices offered by either the co-op or competing IOFs. Given these conditions, a member will base current patronage decisions solely on current prices. On the other hand, if exit from and reentry into the cooperative is costly (for example, if the member of a processing cooperative has to reapply for membership if he fails to deliver raw-product in a given year) or if the member believes that his current patronage decision will materially affect future prices (for example, by weakening the cooperative's ability to enforce workable competition in the market or by denying the cooperative the volume it needs to achieve economies of size which would permit it to operate at lower per-unit costs), then in making patronage decisions the member has to consider not only current cooperative and IOF prices but expected future prices as well. Here the role of member expectations becomes important in determining cooperative loyalty. Older members who have vivid memories of what marketing conditions were like before the cooperative existed may be more loyal to the organization than are younger members. The older members may believe that IOFs, unencumbered by competition from a strong cooperative, would offer very unfavorable prices to farmers, while younger members may be less sanguine about that conclusion. To the extent that member-relations programs and other attempts to instill "cooperative ideology" in the membership change members' beliefs about the importance of cooperatives as "competitive yardsticks" they may therefore affect member loyalty.¹ Even so, members may still have incentives to free ride with respect to the cooperative's

¹Cooperative ideology may foster increased cooperative loyalty in several other ways as well. See chapter 6 for details.

competitive-yardstick activities, relying on other members' patronage to keep the cooperative strong enough to compete effectively with IOFs.

Based on the preceding analysis one would expect member loyalty to be greater in those cooperatives that made a member's rate of return on investment in the cooperative contingent upon his continued patronage. In cooperatives maintaining a revolving fund for equity redemption, this could be accomplished by giving priority to the revolvment of equities belonging to members who maintain their patronage (and possibly also to those owned by members who have retired). The analysis also suggests that loyalty will be lower where the costs of switching patronage are low. In this sense the Rochdale Principle of completely open membership (with its attendant implication that no penalties should exist for switching patronage back and forth between co-ops and IOFs) may hinder the viability of cooperatives.¹

Other Pressures on Management²

Implicit in the discussion of many of the preceding issues was the notion that managers in farmer cooperatives face different types of pressures from the stockholders than do managers of IOFs. Because the stockholders of a cooperative are the firm's customers, there are pressures on cooperative managers in addition to those outlined above. For example, the stockholder-patrons of a cooperative are intensely interested in technical aspects of the firm's products and services (e.g., the composition and quality of the fertilizers it sells), as these affect the

¹The topic of cooperative loyalty is pursued further in following chapters.

²This section draws heavily on Perraut.

profitability of the members' farming operations. Shareholders may therefore demand that their manager be fairly conversant in technical matters, as opposed to being solely a financial expert, as is often the case in IOFs.¹ Whereas IOF customers who are interested in the technical characteristics of the firm's products can be referred to the firm's technical staff, cooperative shareholders may have greater power to demand to talk to "the guy at the top."

In addition, because many managerial decisions that would be considered merely strategic in IOFs have important effects on the income distribution among the stockholders in a cooperative cooperative managers may be called upon much more frequently than their IOF counterparts to justify these decisions to stockholders. Furthermore, because the stockholders may frequently disagree among themselves about what the proper decision should be, the manager may face discontented stockholders no matter what he decides. If stockholder disagreements become extreme, he may also have to play the role of arbiter or peacemaker among the stockholders in order to hold the firm together. All this implies that managers in cooperatives "are more interdependent and interactive with user owners and execute more interpersonal and leadership roles" than their IOF counterparts (Perraut, p. 94). Much of the time of cooperative managers, particularly those of large, diversified cooperatives, may be spent on member relations. This perhaps puts these organizations at a competitive disadvantage because their chief executive officers have less time than IOF managers for strategic planning and administration.

¹ This is reinforced by the lack of a secondary market for cooperative stock, which prevents shareholders from capturing capital gains that in an IOF often depend on management's financial prowess.

The pressures on cooperative managers may also differ than those of IOF managers because the stockholder's return on investment in a cooperative is gained primarily through patronage and because the formal governance of cooperatives is structured "democratically." Both possibilities are discussed in the following sections of this chapter.

Behavioral Differences Due to the Return on Investment being Gained through Patronage

As mentioned at the beginning of the chapter, there are three reasons why a stockholder's return on investment in a cooperative is gained primarily via patronage:

- (1) The cooperative pays a strictly limited dividend on equity capital invested in the organization.
- (2) Net margins are distributed according to patronage.
- (3) There is a limited or nonexistent secondary market for the equity securities (stock) of the cooperative.

This section examines how these three factors combine to affect the behavior of co-op participants.

Tendency to Underfinance the Cooperative

To the extent that farmers invest in an agricultural cooperative in order to obtain the right to patronize the firm, they view the value of their investment in the cooperative as instrumental, depending not on the capital's productivity in the cooperative's operations per se, but on how that productivity accrues to the members via patronage. Assuming that the cooperative pays no dividend on invested capital, that is, that members derive benefits from the cooperative solely through patronage, the marginal return to member i from capital invested in the cooperative can be expressed as follows:

$$(2.1) \quad MVP_{Kic} = \frac{dNR_i}{dKic} = \frac{dNR_i}{dPA_i} \cdot \frac{dPA_i}{dKic}$$

where

MVP_{Kic} = marginal value product to member i of his capital invested in the cooperative;

NR_i = net returns to member i accruing from membership in the cooperative;

Kic = capital invested by member i in the cooperative; and

PA_i = member i 's volume of patronage with the cooperative.

Equation (2.1) states that the marginal value product a farmer receives from investing in a cooperative is the product of two factors:

- (1) the rate at which his net returns change with a change in patronage ($\frac{dNR_i}{dPA_i}$) and
- (2) the rate at which his patronage changes with a change in his investment in the cooperative ($\frac{dPA_i}{dKic}$).

As long as it is profitable for a farmer to increase his patronage, that is, as long as $\frac{dNR_i}{dPA_i} > 0$, the farmer can raise the return on his capital invested in the cooperative by increasing his patronage relative to his investment, that is, by increasing $\frac{dPA_i}{dKic}$. This incentive to increase patronage relative to capital investment, if left unchecked, would lead to severe underfinancing of the cooperative. Members would contribute only enough capital to gain the right to patronize the cooperative and then expand their patronage as long as it was profitable to do so. The rest of their capital would then be available for investment in their farm enterprises or in other ventures (cf. Murray, 1983a, 1983b, 1983c). In order to prevent members from behaving in this way, cooperatives have developed mechanisms such as capital retains and issuing patronage

refunds in the form of stock that attempt to force members to align their capital contributions with their patronage.

Payment of dividends on capital also increase a member's incentive to invest in the cooperative. If the cooperative pays a per-unit dividend equal to r , then equation (2.1) becomes:

$$(2.2) \quad MVP_{Kic} = \frac{dNR_i}{dK_{ic}} = \frac{dNR_i}{dPA_i} \cdot \frac{dPA_i}{dK_{ic}} + r \cdot dK_{ic}$$

The additional term, $r \cdot dK_{ic}$, increases as the member's rate of investment in the cooperative increases, offsetting (to some degree, depending on the level of r) the tendency to maximize patronage relative to investment in the cooperative.

If members' capital contributions are not uniformly proportional to patronage the setting of the dividend rate r is likely to be a contentious issue among the membership. This can be demonstrated as follows (see Trifon, 1961, pp. 225-31). Assume that the cooperative pays a dividend r on all n members' capital invested in the organization and that all other net earnings of the cooperative are distributed according to patronage. Then the net returns that member i receives from the organization in a given year equal:

$$(2.3) \quad NR_i = (GR_c - C_c - r \sum_{i=1}^n K_i) \cdot \frac{PA_i}{\sum_{i=1}^n PA_i} + rK_i$$

where

GR_c = the cooperative's gross revenues;

C_c = the cooperative's costs, excluding the cost of member-supplied inputs; and all other variables are as defined above.

In other words, member i receives: (a) a share of the co-op's net receipts $(GR_c - C_c - r \sum_{i=1}^n K_i)$ proportional to his share of the total

patronage of the cooperative and (b) a payment of r for every dollar he has invested in the co-op during that year. To see how the member's net returns would change if the dividend rate were increased, differentiate equation (2.3) with respect to r to yield:

$$(2.4) \quad \frac{dNR_i}{dr} = - \sum_{i=1}^n K_i \frac{\frac{PA_i}{n}}{\sum_{i=1}^n PA_i} + K_i = \sum_{i=1}^n K_i \left[\frac{\frac{K_i}{n}}{\sum_{i=1}^n K_i} - \frac{\frac{PA_i}{n}}{\sum_{i=1}^n PA_i} \right]$$

Member i 's income will increase with an increase in the dividend rate (that is, $\frac{dNR_i}{dr} > 0$) if the expression $\frac{\frac{K_i}{n}}{\sum_{i=1}^n K_i} - \frac{\frac{PA_i}{n}}{\sum_{i=1}^n PA_i} > 0$, which will be

true if $\frac{K_i}{PA_i} > \frac{\frac{\sum_{i=1}^n K_i}{n}}{\sum_{i=1}^n PA_i}$, that is, if member i has more capital invested in

the cooperative relative to patronage than the average member. Conversely,

ly, if $\frac{K_i}{PA_i} < \frac{\frac{\sum_{i=1}^n K_i}{n}}{\sum_{i=1}^n PA_i}$, member i 's income from the cooperative will fall if

the dividend rate is increased. One would therefore expect "overinvested" farmers (for example, those close to retirement whose patronage has decreased in recent years) to push for an increase in the dividend rate and "underinvested" farmers (typically young members whose patronage is increasing) to oppose such a move. Only those farmers whose capital investment relative to patronage equaled the mean capital-patronage ratio of the cooperative would be indifferent regarding the level at which the dividend rate was set. The development of mechanisms such as the base capital plan that attempt to align capital contribution to patronage can therefore be seen as an attempt by the cooperative to reduce conflict in the organization over payments to capital as well as an effort to assure

adequate capital retention in order to finance growth, which may be a major goal of cooperative managers and board members.¹

The Lack of a Secondary Market for Cooperative Stock

Although a number of authors have discussed how the absence of a secondary market in ownership rights affects the behavior of participants in worker-managed firms, only a few (for example, Condon and Vitaliano) have attempted to extend that discussion to farmer-owned cooperatives. Discussions with participants in farmer cooperatives, however, suggested that the consequences of not having such a market may be extremely important.

Why No Secondary Market?

Although state cooperative incorporation statutes usually grant the board of directors the right to specify the conditions under which stock in a cooperative can be transferred, there are no statutory provisions to prevent the board from sanctioning a secondary market in cooperative equities (Baarda, personal communication). In practice, however, few secondary markets exist, and those that do exist generally deal in accrued retains and revolving fund certificates, not stock certificates that confer the right of patronage.

¹This analysis appears at first glance to reinforce the point, first made by Emelianoff, that payment of dividends in cooperatives only makes sense if members vary in their ratios of capital contribution to patronage. If all members contributed capital exactly in proportion to their patronage, dividends would be unnecessary in order to equalize member returns per unit of patronage. Nonetheless, payment of dividends may still be useful in helping overcome the tendency of members to decapitalize the cooperative. See the discussion of the "horizon problem" below.

There may be several explanations for the lack of a secondary market. In most cooperatives, the bylaws expressly prohibit the transfer of the cooperative's stock without the board's approval. Possible reasons for such a provision include:

- (1) The desire to ensure that only farmers are members of the cooperative and hence that the organization maintains its farmer orientation.
- (2) In a marketing cooperative, the desire of the collectivity, as expressed through the board, to control the quality of the product produced by the members. A few members who produce poor quality products could impose heavy costs on the cooperative's marketing operations, including the possible erosion of the cooperative's reputation as a reliable supplier.¹
- (3) The desire of the board and management to exclude potential members for other reasons--capacity constraints on the plant, a lack of "cooperative spirit" on the part of the potential applicant, and so on.

In addition, a few cooperatives stand ready to buy or sell their stock at par value. These cooperatives continue to issue new stock to members rather than issuing a fixed amount of stock and letting its subsequent value be determined in a secondary market.

Some state incorporation statutes limit the amount of stock or other equity securities a member may own, often to five percent of the total

¹Implicit in this argument is the assumption that it is cheaper to ensure product quality by thorough screening of potential members than by relying solely on mechanisms such as docking members who deliver poor quality products.

issued by the cooperative; such limits may also hinder the development of a secondary market. In addition, under certain circumstances cooperatives may be required to register their securities with the Securities and Exchange Commission if they want to allow their stocks to be traded across state lines. The cost of such registration, which can vary between \$50,000 and \$100,000, may preclude the development of a secondary market for the stock of smaller cooperatives (Cobia et. al., p. 59). Even if the board of directors did permit a secondary market in cooperative stock, because of the limited geographic domains of many cooperatives and the requirement that members be farmers, the resulting market could be extremely thin. Furthermore, because of the limited return paid to equity capital in cooperatives, securities that were traded probably would have to be substantially discounted from their face values. For whatever reasons, secondary markets in cooperative equities are rare, leading to the consequences outlined below.

The Horizon Problem

A stock certificate of an IOF confers to the holder a residual claim on the earnings of that firm in perpetuity. A well-functioning secondary market will therefore value the stock in terms of the expected present value of the firm's future net earnings. Stockholders can at any time realize the capitalized value of those future earnings by selling the stock. Actions that increase the firm's future earnings potential raise the value of the stock, allowing stockholders to capture capital gains. The access to these capital gains via the secondary market gives stockholders a strong incentive to be concerned about the future earnings as well as the present earnings of the firm. Stockholders want

the firm to balance its investments in terms of their productivities in generating present earnings versus future earnings, with the market rate of interest serving as the mechanism to achieve the equilibrium.¹

A stock certificate of a farmer cooperative, in contrast, grants to the holder a residual claim on the earnings of the firm only so long as: (a) the board of directors deems the holder qualified as a member of the cooperative, and (b) he continues his patronage. Depending on the equity retirement policies of the cooperative, the stock certificate may also confer a fixed claim to the member's original investment in the cooperative, usually payable in nominal terms after several years. (Equity retirement programs are discussed later in this chapter and in appendix A). Because there is no secondary market for the stock, increases in the cooperative's future earnings capacity do not affect the value of the cooperative's stock. The absence of a secondary market prevents the stockholder from directly realizing, at any time he chooses, his full share of the expected present value of the cooperative's future income stream.

If belonging to a cooperative increases a farmer's future earnings capacity he may, in the current period, be able to realize some of the future value of the cooperative's activities by borrowing against his future earnings. This is often a poor substitute for a secondary market in the cooperative's stock, however, because lenders base their loans to the member not on the expected present value of the cooperative's future earnings over the cooperative's lifetime, but only over the period during

¹ Ignoring tax considerations and information costs, a perfectly functioning secondary stock market combined with perfect stockholder control would lead an IOF to equate the marginal value product of capital invested in generating current income with the marginal value product of capital invested in generating capital gains. The capital gains would be calculated by discounting the expected stream of future earnings by the market rate of interest.

which the farmer is expected to be an active member. If the farmer is close to retirement he may be able to tap only a small percentage of his accrued investment in the cooperative through the capital market.

As a result of the illiquidity of cooperative stock, shareholders in cooperatives are forced to obtain most of their ownership benefits via current patronage. This may lead members to pressure the cooperative to increase current earnings at the expense of future earnings. Members may be reluctant to finance long-term investments by the cooperative if they believe that these investments will generate most of their benefits after the current members have retired.¹ One would therefore expect older members, in particular, to pressure management to increase current earnings.

The lack of a secondary market for cooperative stock thus prevents the smooth intergenerational transfer of ownership of the organization and leads members to try to develop mechanisms to increase the liquidity of their investment in the cooperative. These may include discouraging the cooperative from investing in projects with long gestation periods or, conversely, encouraging the liquidation of the firm's assets, in effect converting future earnings potential into current income.

Observers of the labor-managed firm have identified this tendency to emphasize current cash flow at the expense of future earnings as a major problem in worker-owned firms, labeling it "the horizon problem" (Jensen and Meckling, Condon and Vitaliano, Furubotn). In a farmer

¹This assumes that the members act entirely selfishly. Concern about bequeathing a viable farming operation to one's heirs or community may attenuate this conclusion. See below.

cooperative the horizon problem may be manifested by members pressuring management to:

- (1) Increase the proportion of the cooperative's cash flow devoted to current payments to members relative to investment (for example, pressuring the management of a marketing cooperative to have a large "cash payout"). This tendency is analyzed in chapter 5.
- (2) Enter into price wars with competitors, even if such cutthroat competition impairs the long-term viability of the cooperative.
- (3) Speed up equity retirement programs and increase the dividend paid on capital invested in the organization, both at the expense of retained earnings. As pointed out above, higher dividend rates will be favored only by members who are "over-invested" in the cooperative relative to the average and will be opposed by "underinvested" members, who prefer that most of the cooperative's cash flow be devoted to benefits that are distributed according to patronage.
- (4) Liquidate the cooperative's assets, in whole or in part. Pressures for total liquidation may be muted by provisions in most state incorporation statutes that specify that in the case of a total liquidation a cooperative's assets must be distributed among past as well as current patrons. Pressures for a

a partial liquidation of the firm's assets, however, may remain.¹

Several mechanisms may partially substitute for a secondary market in cooperative stock, thereby attenuating the horizon problem in farmer cooperatives.² If cooperative membership can be sold with the farm, then the expected future earnings of the cooperative will be capitalized into the value of the farm and the horizon problem will be largely overcome. Such effective salability of cooperative membership could be achieved if the farm were incorporated and the corporation, rather than the farmer who owned it, was the member of the cooperative. A change in the ownership of the corporation, by itself, would not change the corporation's status as a member of the cooperative (Baarda, personal communication). In this sense, corporate agriculture, far from being the antithesis of cooperative agriculture as some authors claim (for example, Kravitz), may actually reinforce the long-term viability of farmer cooperatives. Nonetheless, corporate membership in the cooperative would not entirely offset the horizon problem because in order to realize the full discounted value of the cooperative's future earnings the owners

¹For example, the manager of a major agricultural processing cooperative told the author that one board member (who had recently joined the cooperative) had proposed selling one of the cooperative's brand names, which had an estimated market value of \$30-\$50 million, to an IOF. The member reasoned that the terms of sale could specify that the cooperative would sell its raw agricultural product to the IOF at little reduction in the present field price, and the sale would allow current members to capture the \$30-\$50 million as current income. Management resisted the suggestion on the grounds that it was unfair to previous members of the co-op, who, over 65 years, had built up the value of the cooperative's brand name but would not share in the proceeds of the sale.

²Some of the following points have been discussed by Condon and Vitaliano, pp. 38-42.

of the corporation would have to sell their farm; they could not simply decide to sell their cooperative membership and still operate the same farm. In this sense, their investment in the cooperative would remain illiquid. It would not be totally illiquid, however; the farm corporation could borrow against the cooperative's future earnings because these would be capitalized into the farm's value. Corporate membership in the cooperative may therefore go a long way in reducing the horizon problem.

Other factors may also partly offset the horizon problem. Even if membership in the cooperative cannot be transferred, if the cooperative has a completely open-membership policy, then the value of the cooperative will be fully capitalized into the value of the farm. If membership is not fully open but the probability of gaining membership is higher if one buys the farm of a member (for example, if the cooperative wants to hold down its transport costs by restricting membership to a certain geographic area), then the discounted value of the cooperative's future earnings will be partially capitalized into the farm's value. If the cooperative, through its competition with IOFs, leads to higher farm-product or lower farm-input costs in the area, the present value of the cooperative's future activities will also be partially capitalized into the value of both members' and nonmembers' farms. (The higher farm values will reflect only a partial accounting of the cooperative's future activities because if the cooperative's only benefit were to force IOFs to offer farmers more favorable prices, and these prices were available to both members and nonmembers, nobody would have an incentive to maintain their membership in the cooperative; everyone would try to be a free rider.

The existence of the cooperative suggests that it offers members appropriate as well as public goods.)

The horizon problem may also be attenuated if members derive satisfaction from bequeathing a more viable farming operation or structure of agriculture to their heirs or community. For example, if the cooperative permits members to transfer membership intergenerationally within families, older members may be willing to help finance long-term investments in the cooperative even though these members will not directly benefit from the investments. The older members may derive satisfaction from knowing that their heirs will have access to a strong cooperative and may feel as though they are repaying a debt to their predecessors in the cooperative who acted similarly. To the extent that the cooperative, through various socialization processes (e.g., member relations programs) can convince members to generalize their "feelings of family" to the entire membership of the cooperative rather than view the cooperative as just another firm, the horizon problem may be reduced even more. Such a generalization is probably more likely to occur in small cooperatives where the members know each other well than in organizations with large, diverse memberships.¹

The forgoing analysis suggests that the horizon problem may be more serious in cooperatives with the following characteristics:

- (1) many of the members have high discount rates (for example, older members and members facing cash-flow squeezes);
- (2) the per-member capital investment in the cooperative is large;

¹See chapter 6 for a more in-depth analysis of this point, based on game theory.

- (3) the cooperative has a closed membership;
- (4) few of the member firms are legally incorporated;
- (5) the intergenerational transfer of membership within families is prohibited; and
- (6) the cooperative has a large, diverse membership.¹

On the other hand, in smaller cooperatives, especially those in which the members have strong ties to one another (for example, because of a common religion or set of social beliefs) and in which there is a strong tradition of family farming, the horizon problem may pose fewer difficulties.

The preceding discussion, which focused on how the lack of a secondary vest in the firm, implicitly assumed that management faithfully implemented the members' desires. To the extent that management is interested in growth of the cooperative, however, its interests are opposed to those of members seeking to decapitalize the firm. Ironically, if management is successful in pursuing its own goals of growth rather than the goals of the membership, the manager may act as the guardian of the cooperative's long-term viability. If, as suggested later in this study, management has more leeway to pursue its own goals in large, diversified cooperatives, the importance of the horizon problem in such organizations may be reduced (cf. Murray, 1983a, 1983b, 1983c).

Equity Retirement and the Demand on Cash Flow

Because cooperative certificates are generally not redeemable via a secondary market, many cooperatives in the U.S. have committed

¹See the following paragraph for an important qualification to this last statement.

themselves to retiring member equities via equity redemption programs.¹ Such programs partially address the problem of intergenerational transfer of ownership of cooperatives. In addition, redemption of equities may effectively provide a retired member of the cooperative with a pension (at least for a few years) whose payments depend on the financial performance of the cooperative after the member retires. The member therefore has an interest in the long-term viability of the cooperative, which may attenuate the horizon problem.

Equity redemption programs redeem a member's investment in the cooperative, usually at face value, either several years after the investment has been made or when the member's ratio of capital contribution to patronage rises above the average for the cooperative. The most common types of equity redemption programs are revolving funds, percentage-of-all-equities plans, and base capital plans, which are described briefly in appendix A. (For details see Cobia, et al.)

Systematically retiring member equities places an additional demand on both the cooperative's capital structure and its cash flow. If a stockholder in an IOF redeems his ownership right in the IOF via the stock market, the size of the firm's equity remains unchanged; only its ownership changes. Redemption of equities by a cooperative, on the other hand, reduces the firm's equity. As a result, a cooperative that operates a systematic equity redemption program must also systematically acquire new capital contributions from members to maintain the organization's

¹In 1974, 32 percent of the agricultural cooperatives in the U.S. operated systematic equity redemption programs (that is, they redeemed member equities on a regular basis) and an additional 39 percent operated special equity redemption programs, for example, redeeming equities upon a member's death. The remaining 29 percent had no equity redemption programs whatsoever (Cobia, et al., p. vii).

equity structure. Unlike an IOF, which can time the issuance of new stock to coincide with favorable market conditions, the cooperative is forced to obtain additional member capital year-in and year-out, a task that one cooperative manager described as "an onerous obligation" and one that may make it more difficult to attract capital to cooperatives than to IOFs.

To the extent that a cooperative systematically retires member equities, equity retirement becomes a claimant on the firm's cash flow. In an IOF the major claimants on cash flow include the firm's fixed and variable costs (including raw-material costs), which stockholders want the firm to minimize for a given output; dividend payments to stockholders; and retained earnings to finance growth. Occasionally there may also be pressure from stockholders to use some of the cash flow to buy back stock so as to bid up its market value. In a farmer cooperative the claimants on cash flow are more varied, including:

- (1) payments for the firm's inputs purchased from outside the cooperative (costs that stockholders want the firm to minimize for a given output);
- (2) payments for member-supplied inputs (payments that most stockholders do not want the firm to minimize);
- (3) patronage dividends (in addition to those included in (2));
- (4) dividend payments to member capital;
- (5) retained earnings;
- (6) equity redemption; and
- (7) provision of other benefits that are distributed among the members in a manner unrelated to patronage.

Because equity redemption competes for cash flow with all these other demands, members who have heavily invested in the cooperative and hence have a strong stake in equity redemption (typically, older farmers) may find themselves in conflict with "underinvested" members, who prefer that cash flow be devoted to other uses, such as increasing raw-product prices or lowering input prices. Equity redemption may therefore be an important source of conflict in the organization. If, as in many agricultural cooperatives, retired farmers are barred from voting, the board may give equity retirement a low priority relative to other uses of cash flow. One would therefore expect the horizon problem to be more serious in cooperatives that bar retired members from voting than in those that do not.

Inability to Use the Stock Price to Discipline Management

A common rule for investors in IOFs states, "If you don't like what management is doing, sell your stock." If enough stockholders follow this advice, the value of the stock declines, imposing capital losses on those who bought their stock at a higher price but still hold it. In an effort to recoup those losses or at least avoid further erosion in their asset values, stockholders may coalesce into a bloc that attempts, via a proxy fight, to displace the current management with one more to their liking. Alternatively, outsiders may be tempted to take over the IOF via a tender offer if they believe that the current management is leaving unexploited substantial earning opportunities. In either case, it is not simply the potential of higher future earnings for the firm that induces "renegades" to try to displace current management. An important added incentive is the knowledge that if the stock market "agrees" with the renegades' analysis, those who initiated the takeover will be rewarded

with substantial capital gains, as the market will capitalize the increase in expected future earnings into the value of the stock (Alchian and Demsetz, p. 788).

Fluctuation in the value of an IOF's stock therefore serves as an important disciplining mechanism on management, indicating the degree of stockholder satisfaction with current managerial policies. Many firms reinforce the potency of this disciplining mechanism by offering stock options to top management, which makes the earnings of these personnel contingent upon the stock's value. Tying the manager's earnings to the firm's performance, as judged by the stock market, may thus reduce managerial shirking (Alchian and Demsetz).

The possibility of capturing capital gains or suffering capital losses in the stock market also creates incentives for the development of a specialized market in information about the managerial resources and earnings potential of publicly-traded IOFs. The business press, a consequence of the secondary market for IOF stock, serves as an additional disciplining mechanism on the management of IOFs.

The lack of a secondary market for cooperative stock denies the cooperative these tools for influencing managerial behavior. Cooperative stockholders have no simple indicator like a stock price by which they can evaluate how well management has enhanced the future earnings capacity of their firm. If they evaluate management primarily on the current prices the cooperative charges for its services (for example, if the manager's salary in a processing cooperative depends on the cash raw-product price paid to members) then the manager may be induced to decapitalize the firm in an attempt to increase current earnings. This may simply reinforce the horizon problem, as the manager becomes a

collaborator of those stockholders seeking to increase current earnings at the expense of future income.

Denied the stock price and the business press as concise indicators of managerial performance, stockholders in cooperatives have to develop other ways of monitoring managerial behavior, including requiring the board of directors to play a more active role in the firm's affairs. Some of these control mechanisms are discussed below in the section on "democratic control."

The inability to provide stock options in a cooperative suggests that cooperatives may be less successful than IOFs in attracting "asset managers," people skilled in promoting firm growth through acquiring both competing and unrelated firms. Although mergers of agricultural cooperatives have been frequent in recent years, these mergers have often been marriages of desperation, aimed at preserving services to farmers in areas where one of the merging cooperatives was close to bankruptcy. In contrast, IOF mergers often involve firms deemed undervalued in light of their earnings potential. The difficulty of designing compensation packages that automatically reward cooperative managers for increasing their firms' long-run earnings capacity may make it more difficult for cooperatives to attract top-flight management, but it may also spare them managerial abuses aimed at inducing short-term fluctuations in stock prices (unwarranted attempts to take over other firms and so forth).

The impossibility of benefiting from capital gains in a cooperative may also reduce the incentive to found a cooperative even when the net social benefits of doing so exceed the net social cost (Shaffer, 1982, p. 3). Whereas an entrepreneur who founds a successful IOF is rewarded with substantial capital gains as the net worth of the firm increases, no

such reward exists for the founder of a cooperative. Rather, the motivation to found a cooperative may be more a sense of social injustice than immediate personal gain (see chapter 4). Because individual material incentives to start a cooperative may be lacking even when ample social justification for the cooperative exists, there may be a legitimate role for governmental subsidies to encourage the formation of cooperatives.

Tendency to Restrict Membership

Observers of the labor-managed firm (e.g., McGregor; Sisk; Bateman, Edwards, and LeVay, 1979b) have noted a tendency of these organizations to restrict their memberships and increasingly hire nonmember labor, gradually transforming themselves into IOFs. These firms, which grow primarily through retained earnings, usually pay little or no rent to nonlabor resources, such as capital, generated internally by the firm. As long as the marginal productivity of these resources is positive and the marginal product of labor is not increasing, it pays current members to try to reduce the membership because the rents from the nonlabor resources will then be shared among fewer people, increasing each person's share. McGregor has documented the tendency of plywood cooperatives in the Pacific Northwest and agricultural production cooperatives in the South Pacific to behave in this manner.

In agricultural marketing cooperatives the member-supplied input is the raw agricultural product, not labor. If these cooperatives behave as Helmberger and Hoos hypothesized, paying members the average net revenue per unit of raw-product, then by the logic outlined above, the members have an incentive to reduce the proportion of member product handled by the cooperative, restricting membership and buying an

increasing amount of raw-product from nonmembers. Such behavior may be attenuated by the payment of dividends on member capital. If, however, the dividend is less than the marginal product of the capital, then part of the economic return to capital is transferred to the members in the form of higher raw-product payments.

When members quit patronizing the cooperative they usually cannot withdraw their capital immediately; depending on the equity redemption program of the cooperative, they may have to wait for at least a few years, and possibly forever, for the return of their investment. In the interim, the return generated by those members' capital, net of any dividends paid to them, is transferred to current members in the form of higher raw-product prices or other member benefits. If the cooperative can price-discriminate between members and nonmembers (for example, extending patronage refunds only to members), the economic return to capital generated through retained earnings will also only accrue to members. If current members can pay nonmembers a price for their raw-product that approximates its marginal product, then the current members have a double incentive to replace retiring members' contributions of raw-product with raw-product purchased from outside the cooperative. Not only can the current members capture some of the return to the retired members' capital, but by decreasing the membership they can also reduce the number of people with whom they have to share the return to internally generated capital.

The more closely aligned the dividend rate is with the marginal productivity of capital in the cooperative the lower is the incentive for current members to behave in this way. Statutory provisions, such as the requirement of the Capper-Volstead Act that agricultural marketing cooperatives conduct at least 50 percent of their dollar volume with

members and the IRS requirement that Section 521 exempt cooperatives (see appendix A) treat member and nonmember patrons equally, may further limit such behavior. Economies of size in marketing can lead to increasing marginal returns to raw-product (i.e., situations in which the marginal product of the raw produce exceeds its average product), which eliminate the incentive for such behavior and prevent the restriction of membership from being carried to its logical extreme, the conversion of the cooperative into a single proprietorship. Nonetheless, one would expect some farmer cooperatives, particularly those in which the productivity of capital is high relative to the dividend rate, to attempt to increase the ratio of member to nonmember business. Such behavior would be more likely during rapid inflation when the real dividend rate paid on member capital is likely to be very low, possibly negative.

The Nature of Ownership in a Cooperative

Much of the preceding analysis suggests that the tying of stock ownership to patronage results in a fundamentally different concept of ownership in cooperatives than in IOFs.¹ A stockholder in an IOF possesses a fully transferable claim on the net earnings of that firm in perpetuity. In contrast, a cooperative stockholder generally holds a non-transferable claim on the net earnings of his firm that is valid only as long as he continues to patronize the cooperative. Once his patronage

¹On possible differences between the concepts of ownership in investor-owned firms, patron-owned firms, worker-owned firms, and state-owned firms see Shaffer (1983). In this section, the term "cooperative stock" includes cooperative stock certificates and other equity securities such as certificates of interest, revolving fund certificates, patronage refund certificates and retain certificates. For an explanation of these terms see appendix A.

ceases, his capital invested in the cooperative may be refunded to him, possibly with interest, but he is no longer entitled to an ongoing stream of benefits from that investment. This has led one critic of farmer cooperatives to charge that the term "cooperative equity capital" is "an accounting misnomer for junior, subordinated revolving debt" (Cortopassi), a view consistent with Roy's conception of member equity as a loan from the members to the cooperative (see chapter 1).

The view that "cooperative equity capital" is nothing more than revolving debt implies that there is no true stockholder equity in the organization and raises the question of who really "owns" the cooperative. Before addressing this question, one should perhaps ask whether "ownership" itself is a useful analytical concept. Agency theorists eschew the concept, preferring instead to discuss the nature of the fixed and residual claims various agents hold on an organization's cash flow (Condon and Vitaliano). While the agency approach is useful in pointing out the influence of fixed claimants (e.g., creditors) as well as residual claimants (e.g., stockholders) on an organization's behavior, it really does not obviate the need for some concept of ownership. Claimants, after all, hold rights to the firm's cash flow because society has recognized the claimants' right to exchange resources with the firm for that cash flow. Some concept of property rights or ownership is therefore necessary to understand fixed and residual claims.

Schmid (p. 6) states that "Ownership means the owner has the opportunity to create costs for others who are affected by the owner's acts and to create benefits for the owner through use or exchange." In this sense, a cooperative stockholder does possess ownership rights in the organization: through use of the cooperative the member can share in

the income the cooperative derives from creating costs for others (for example, by selling its products) and create benefits for himself (for example, through savings on input purchases).

Nonetheless, the ownership claim of a cooperative stockholder differs from that of a stockholder in an IOF in several important ways. These differences are best seen by contrasting the claims conferred by stock ownership in a cooperative with those conferred by ownership of both stock certificates and debt instruments of an IOF. Whereas stock in an IOF confers a fully exchangeable residual claim on the firm's earnings in perpetuity, an IOF debt instrument, such as a debenture, confers a fixed claim on the firm's cash flow for a specific period. Cooperative stock has characteristics of both these types of instruments, as well as its own unique characteristics.

To the extent that stock ownership in a cooperative is a prerequisite of patronage, cooperative stock confers both a residual claim on the firm's earnings as long as the member maintains his patronage and a fixed claim on the firm's cash flow, if the cooperative has committed itself to retiring the equities of "overinvested" members. The residual claim on the firm's earnings usually has very limited transferability, and if members are not required to keep their capital contributions in line with patronage the claim will not be proportionate to investment. When a member ceases to patronize the cooperative, the cooperative stock becomes similar to a debt instrument of an IOF, representing solely a fixed claim on the firm's cash flow. The cooperative stock certificate, however, is a much less enforceable fixed claim than an IOF debt instrument because it is subordinate to other cooperative debt instruments, such as debentures, and because in most states cooperatives' boards of

directors have the discretion to decide when and if equity certificates are to be retired and what rate of interest, if any, they should earn in the interim (Cobia, et al.).

Because cooperative equity represents both a residual claim on the firm's cash flow and a debt obligation, statements of owners' equity on cooperatives' balance sheets convey ambiguous information. It is not always clear whether the net worth of a cooperative has risen because of the willing investment by stockholders in their cooperative or because the cooperative has failed to redeem the stock of its retired members (see appendix B). Furthermore, because of the nonmarketability of cooperative stock, ownership in a cooperative is a less liquid and possibly less secure asset than other forms of equity, both for individual farmer-members and for local cooperatives that own stock in regionals. To the extent that lenders are unaware of the nature of cooperative equity, they may grant cooperatives loans based on evaluation of standard balance-sheet ratios when the cooperatives are financially unable to handle the new debt.

On the other hand, the lack of a secondary market for cooperative stock prevents appreciation of the cooperative's assets from being reflected back to the stockholders or showing up on the firm's balance sheet, where assets are generally carried at book value. Stockholders' balance sheets simply list the stock at par value; hence, appreciation of the firm's assets does not affect the stockholders' net worth, borrowing capacity as judged by balance-sheet ratios, or the value members

receive for their retired equities.¹ The failure of the cooperative's balance sheet to reflect the market value of the firm's assets may limit the firm's ability to borrow. It may also create incentives for the firm to reorganize periodically as a new corporation in order to obtain a re-appraisal of its assets and hence increase its borrowing capacity.

The net effect that these characteristics of cooperative stock have on the firm's access to the capital market is thus ambiguous. The foregoing discussion suggests, however, that cooperative balance sheets convey less precise information about a firm's financial structure than do those of IOFs. To the extent that this ambiguity discourages lenders from dealing with cooperatives, some specialized lending agencies such as the Bank for Cooperatives may be justified.

Behavioral Differences Due to Democratic Control

Democratic control of cooperatives has two aspects: limits on voting one's stock or patronage (or equivalently, limits on stock ownership) and restrictions on nonmembers serving on the board of directors.

Limits on Voting Stock

Allocating voting power in a cooperative on a basis other than stock ownership or patronage prevents the concentration of nominal political control of the organization in the hands of those who contribute the bulk

¹This raises the question of who "owns" the appreciated assets of the firm, since the market value of the firm's net worth exceeds the value of outstanding stock. State incorporation statutes generally stipulate that if the firm is liquidated, the net worth of the firm has to be distributed among the stockholders; in this sense they own the firm. Their inability to gain access to these assets short of liquidation, however, contributes to the horizon problem discussed above,

of the capital or patronage. Supporters of cooperatives have usually justified such restrictions on the grounds that they "prevent the domination of capital in the cooperative." This diffusion of political power, however, raises the possibility that a majority of members, who may contribute only a small part of the patronage or capital of the organization, may impose policies that exploit the minority of large patrons by redistributing organizational rents in favor of the majority. The scope for such exploitation is limited by the possibility that large members may withdraw their patronage and take their business elsewhere. Thus, exploitation of the minority by the majority is less feasible where potential market competition is intense (including the possibility of disaffected members setting up their own firms) than where the cooperative holds a secure local monopoly.

Potentially more dangerous is the possibility that the quality of decision making by the board of directors may suffer as a result of this diffusion of political power. If board members believe that they are dependent for their reelection on the mass of small patrons, each of whom has only a small stake in the cooperative's investment decisions, the board may treat those decisions more cavalierly than if voting power were proportional to capital contribution. Limitations on voting one's stock may put nominal control of the cooperative in the hands of those who do not have to bear the full consequences of their decisions, at least in the short run. Again, potential competition may limit the extent of such behavior in the long run, as cooperatives that habitually make poor decisions lose their members. In addition, as discussed in chapter 6, large patrons may be particularly adept at influencing the board and management through informal channels (see also Bartlett, pp. 130-56).

The diffusion of political power is one reason why coalition building is much more important in the decision-making process of cooperatives than in that of IOFs. Because cooperative stockholders are likely to be interested in decisions that IOF stockholders would consider purely strategic and hence delegate to management, cooperative stockholders, via the board, are likely to be involved in a broader range of decisions than are their IOF counterparts. Moreover, because these decisions often involve distributional issues, the membership is unlikely to be of one mind concerning what action should be taken. In such situations, the diffusion of voting power in the cooperative makes coalition building necessary; simply convincing a few large patrons of the correctness of one's views may be insufficient to ensure that they will prevail.

The need to build coalitions suggests that the transaction costs of reaching decisions may be higher in cooperatives than in IOFs. As a result, cooperatives may be less able to react quickly to market opportunities than are their IOF competitors. Cooperatives that delegate greater decision-making authority to management may thus be better able to compete with IOFs, albeit at the cost of less direct member involvement in decision making. In delegating decision-making authority to management and the board, cooperative members have to balance the reduction of transaction costs against the risk that management and the board may act contrary to the members' wishes (see chapter 3 and Ollila, pp. 24, A15-16). Because the cost of group decision making is likely to increase with the size and diversity of the group, the proportion of decisions delegated to management and the board is probably higher in large, diverse cooperatives than in small homogeneous ones.

The diversity of member views and the need to build coalitions suggest that logrolling (tying the negotiation of one issue to another) may play an important role in cooperatives. Given divergent member preferences, logrolling can expand the scope for agreement (Raiffa). It also reduces the predictive power of models of cooperative behavior that assume that members vote on each decision independently. The issues of logrolling and coalition building are analyzed in more detail in chapters 5-7.

Limits on Nonstockholders Serving on the Board of Directors

"The difference between a stockholder-controlled corporation, a consumer co-operative, and a producer co-operative lies to no small extent in who controls the board of directors" (Carson, p. 566). In an effort to ensure member control, most farmer cooperatives prohibit or severely restrict nonstockholders from serving on the board of directors. This is particularly true of local cooperatives; federated regional cooperatives sometimes permit managers of locals to serve on the board of the regional. In addition, some state cooperative incorporation statutes provide for public representation on cooperative boards; often the public representatives are drawn from land-grant universities.

Because of the restrictions on board membership, agricultural cooperatives typically have fewer inside and outside directors than do IOFs. Inside directors are management employees who also serve on the board. Inside directors bring to the board technical expertise about the firm's operations, but because they are management employees, they may not function independently in appraising management's proposals and performance. Outside directors are board members who are neither

stockholders nor management employees. They are often chief executive officers of other firms or other prominent individuals who bring to the board a broad business perspective and personal prestige. Because outside board members typically face many competing demands on their time, because they have no direct financial interest in the corporation, and because they may perceive their position as honorary, demanding a certain decorum, they may not always devote sufficient effort to analyzing critically management's performance (Garoyan and Mohn, pp. 11-14, Shaffer, 1983).

The board members of a farmer cooperative are users of the firm's services; hence, they bring two sets of concerns to the board: owner concerns and user concerns. Owner concerns revolve around the security and overall profitability of the stockholders' investment in the cooperative. User concerns include issues of product quality and the pricing of member services, which affect the profitability of the cooperative to the individual user. Because of the limitation on dividend payments and the stockholders' inability to capture capital gains in a cooperative, user concerns are likely to attract much of the board's attention. Unlike an IOF board, which functions primarily as a trustee of the stockholders' investment, a cooperative board serves as both a trustee for the investors and a representative of the firm's customers, providing an important channel by which user concerns can be conveyed to management.

Since members of the board are users of the firm's services, they may bring to the board some of the technical knowledge about the firm's services and operations that inside directors provide in IOFs. If the cooperative's operations are complex or extend far beyond the farm, however, it is likely that farmer directors will lack the expertise in

marketing, manufacturing, or retailing that inside and outside directors could provide. This leads to a dilemma in farmer cooperatives: to the extent that farmers participate in leadership roles in the board, they may contribute to poor decisions and hamstringing management; to the extent that they do not participate, ownership is separated from control (Helmberger, 1966, p. 1431).

Restricting board membership to stockholders limits the pool of potential directors. If board-member skills are a scarce commodity, one can well imagine an inverted U-shaped curve relating average effective member control, as exercised through the board, to the number of members in the cooperative (Figure 2.1). In small cooperatives the pool of board-member talent may be so limited that it is difficult to constitute a board that can effectively monitor managerial behavior. Managers in these small co-ops may therefore "run the show." As a cooperative becomes larger, the pool of board-member talent expands, allowing selection of a board that can play a more active role in the cooperative's decision making. At some point, however, a cooperative may become so large and complex that no part-time board, no matter how talented, can fully monitor managerial behavior. Management in these large cooperatives may therefore have considerable scope to pursue its own goals.¹

Cooperative boards of directors not only have a different structure than IOF boards, but for several reasons they also typically play a much more active role in their firm's decision making than do IOF boards. First, as discussed above, cooperative stockholders, and hence the board,

¹The structure of the cooperative (e.g., its complexity) may be more important than size per se in determining the degree of member control. For details see van Ravenswaay.

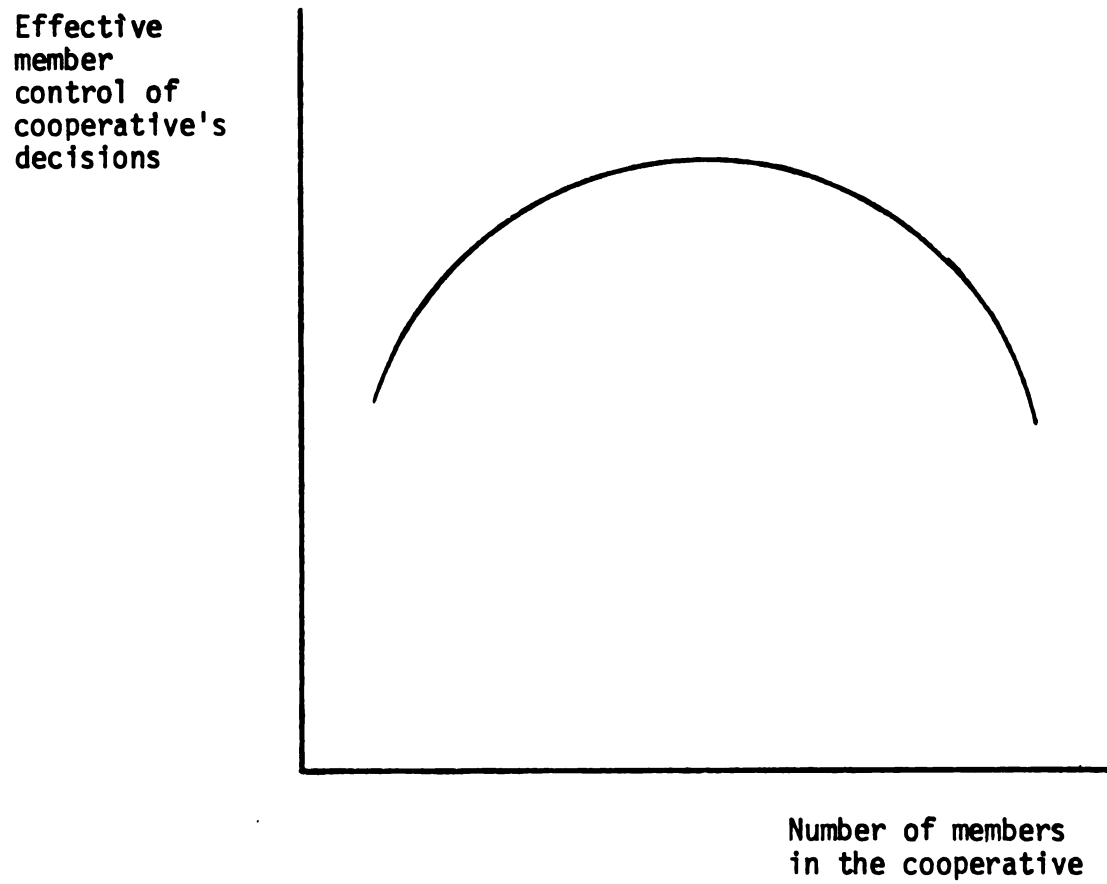


Figure 2.1 Hypothesized Relationship between Member Control and Size of the Cooperative

are intensely interested in issues such as price-setting that would be considered merely strategic in an IOF and therefore be left to management. Second, the difficulty in cooperatives of devising simple indicators of managerial performance and automatic incentive systems (such as stock options) leads to the need for greater direct monitoring of managerial behavior by the board. Stockholders in a cooperative are interested in many facets of the firm's performance beyond just profits (net margins); a board that evaluated its manager solely on the basis of net margins would give him an incentive to raise the price of member services and run the cooperative as a separate profit center rather than trying to coordinate the cooperative's operations with those of its member firms. Similarly, evaluating the manager's performance based solely on the current price of member services could exacerbate the horizon problem and lead to member conflict over which services should have their prices discounted the most. Rather than focus on any one indicator of the manager's performance, the board has to balance several aspects, which may change as the distribution of power among the membership changes. Doing so requires the board to be more integrally involved in the affairs of the firm than is the board of an IOF.

The lack of a secondary market for cooperative stock makes it difficult for farmers who have a substantial investment in the cooperative to completely exit the organization; even if they quit patronizing the cooperative their capital is still committed to the organization. Large patrons' limited ability to exit the organization may lead them to pressure the board to be more directly involved in the affairs of the firm. Because these stockholders cannot discipline the manager by immediately withdrawing their capital from his control, they are forced to rely more

on member voice to convey their concerns to management (Hirschman, 1970). In this process, the board serves as their mouthpiece. Members who have only a small investment in the cooperative, on the other hand, may find exit much easier, particularly if the cooperative has several competitors. Such members may simply leave management of the co-op to the managers and rely mainly on exit to discipline managers who get out of line.¹

Conclusions

The characteristics of farmer cooperatives discussed in this chapter suggest many hypotheses regarding how the behavior of cooperatives may differ from that of investor-owned firms. Cooperative capital may be less mobile than that of IOFs, there may be serious problems in inducing cooperative stockholders to act in the long-term interest of their firm, and the roles and behavior of cooperative managers and board members may differ markedly from those of their IOF counterparts. Information flows between the firm and its customers may be better in cooperatives than in IOFs, cooperatives may be more innovative in developing new uses for agricultural products, and cooperatives may be better able to achieve economic efficiency through two-part pricing.

Several of the hypotheses raised in this chapter are investigated in more detail in the following chapters. The problem of defining what constitutes "acceptable behavior" in a cooperative having a heterogeneous membership is analyzed using game theory in chapter 5. Difficulties cooperatives face because of the horizon problem are investigated in

¹This suggests that those who have large investments in the cooperative have a much stronger incentive to become involved in the governance of the organization than those who do not. This hypothesis is explored in chapter 6.

chapters 5 and 6, and the analysis in these chapters suggests possible ways of overcoming these difficulties. Chapters 5 and 6 also pay considerable attention to the problem of cooperative loyalty and to the influence of member expectations and organizational ideology on the degree of loyalty members show to their associations. The problem of coalition building in cooperatives and the influence of transaction costs on member control are tackled in chapters 4, 6, and 7, and chapters 5 and 7 also further analyze the income-distribution consequences of cooperatives' pricing and cost-allocation practices.

Not all of the hypotheses raised in this chapter are mutually consistent. For example, the limited ability of cooperatives and cooperative stockholders to diversify their investments may lead cooperative decision-makers to be more risk averse than decision-makers in IOFs; on the other hand, the horizon problem may give stockholders incentives to push their cooperatives into reckless price wars in an effort to increase the members' current return from the organization (in the form of more favorable short-run member prices). As stressed throughout this chapter, whether a given hypothesis is true depends in large measure on the detailed structure of the incentives facing different cooperative participants. Understanding these incentives requires a more elaborated model of cooperative behavior than developed thus far in this study. Chapter 3 begins to develop that model.

CHAPTER 3

TOWARDS A MODEL OF DECISION MAKING IN FARMER COOPERATIVES

"The fundamental problem of cooperation stems from the fact that individuals have only partially overlapping goals."
Ouchi, p. 130.

Understanding the behavior of farmer cooperatives requires knowledge not only of the structural elements of cooperatives outlined in chapter 2 but of the various participants in these organizations and their motivations as well. This chapter describes the elements of a model of cooperative decision making that serves as the basis for the analysis in the following chapters. The model combines elements of game theory with aspects of managerial decision theory. The model is game theoretic in that it does not constrain different co-op participants to have mutually congruent goals, it allows all participants to pursue their own goals, and it recognizes that the outcome of any one participant's actions is dependent on the behavior of other actors in the system. The model draws on managerial decision theory in that it assumes that information is costly and that decision makers are constrained by bounded rationality--they are not the omniscient actors portrayed by standard game theory.

The first section of this chapter describes the basic approach used in building the model and contrasts it with the approach taken in previous models of cooperative behavior. The approach adopted here involves identifying the actors in the system, making postulates about their

motives and environment, and reasoning from these postulates towards a game-theoretic/decision theory model of decision making. The second section describes in more detail the major actors in the model, and the third section discusses the model's assumptions concerning the actors' motivations. The fourth section outlines the model's assumptions about the nature of the environment and suggests some implications of these assumptions for the behavior of different actors and for the behavior of the cooperative as a whole. A final section summarizes the basic elements of the model.

Basic Approach

As outlined in chapter 1, many formal models of decision making within cooperatives view decisions as resulting from a process of optimization by a single agent or group of agents (for example, farmer-members in the Phillips model or the co-op manager in the Helmberger-Hoos model) who act independently, as if their actions did not affect the behavior of other participants in the system. The models ignore the interdependence of actions partly because they assume that the goals of different actors in the system are perfectly congruent. Given goal congruence, interdependence of actions becomes unimportant because all actions reinforce achievement of the same goal.

More recent theoretical work by authors who view the cooperative as a coalition suggest a more complex decision process in which co-op members, boards of directors, and managers pursue goals that may not always be perfectly congruent. Each group of actors recognizes that the consequences of its behavior depends in part on the behavior of other actors in the system. This recognition of interdependence leads to bargaining and strategic behavior.

This suggests that the decision process within a cooperative, rather than simply involving a constrained optimization of a single objective function, resembles a multiperson nonzero-sum game. The players include member-owners of the cooperative, board members, and members of management.¹ The game involves several potential strategies on the part of the players, corresponding to various degrees of participation in cooperative activities. There are potential aggregate net benefits from participating in a cooperative (for example, benefits from economies of size and vertical integration), yet for these benefits to be realized they must be distributed among the players in a way that induces them to participate adequately in the cooperative.

The model outlined here views cooperatives as coalitions of farmers who have entered into joint off-farm production of goods and services in the hope of benefiting from economies of size, the advantages of vertical integration, and other rewards of group action (see chapter 4). In order to achieve these goals, farmers hire management to run the day-to-day operations of the cooperative and elect a board of directors to set co-op policy and oversee the activities of management. Management and the board thus become part of the cooperative coalition, although their goals may not always coincide with those of the member-patrons.

A major task in making a cooperative work is discovering behavior that everyone can live with--behavior that preserves the aggregate benefits of cooperative production while allocating the individual costs and benefits of that production in a manner that induces members to remain in

¹Other players may also be involved. See Table 3.1.

the group. In the parlance of game theory, co-op participants seek a solution that lies within the core of the game, if a core exists (see chapter 5 and appendix C). The task is more difficult than that facing an investor-owned firm, where stockholders are mainly concerned with the overall profitability of the firm. In a cooperative, member-owners are usually specialized producers of a few commodities and their concern focuses on the profitability of producing and selling those commodities, not the profitability of the co-op's entire product line. (How concerned an individual member-owner will be with the co-op's overall profitability will, of course, depend on how costs and benefits are allocated among members--e.g., through pooling arrangements.)

Because owners of IOFs are primarily interested in the firm's profitability, most of them are likely to evaluate the firm's performance using a small number of common performance indicators, such as the after-tax profit rate and the stock price/earnings ratio. In other words, firm profits act as a yardstick along which many different dimensions of firm performance are measured.¹

In a cooperative, performance dimensions are less commensurable for the group of owners as a whole for at least two reasons. First, in most cooperatives, net margins are allocated among different pools, which correspond to different lines of business activity. The way in which products and services are grouped into different pools and the allocation

¹Portfolio theory suggests that considerations other than just profit rates (such as stability of earnings) are also important to investors, both in IOFs and cooperatives. The argument outlined below does not deny the importance of these other considerations; it simply hypothesizes that owners of cooperatives (as a group) perceive fewer dimensions of firm performance that are easily commensurable in terms of firm profits or other indicators than do owners of IOFs. See chapter 2 for details.

of joint costs among pools affect the return an individual member receives from the co-op. The profitability of the cooperative as a whole becomes less important to the individual member than the profitability of the pools in which he participates.

Second, if farmer-owners of cooperatives optimize, logically they should optimize over their combined farm/co-op enterprise, not over the co-op enterprise alone. But because each farmer has a different set of resources, production technology, and, perhaps, goals no single pattern of behavior by the cooperative is likely to lead to optimum performance of every member's farm/co-op operation. This is especially true the more diverse the membership. An example is Land O' Lakes, where the decision to promote margarine may have been viewed as "optimal co-op behavior" by members who grew soybeans, but at least initially was viewed as suboptimal behavior by members who were dairy farmers. Even in supply cooperatives, decisions regarding product mix are likely to be more complex than in IOFs. A profit-maximizing IOF would weight each customer's preference by the customer's contribution to firm profits. Cooperative management must also take into account the customer's influence in the governance of the cooperative.

For both these reasons, decisions regarding product mix, levels of production, pricing strategies, and the allocation of joint costs are more sensitive in cooperatives than in IOFs. Instead of being merely strategic questions about how best to improve the firm's financial performance, these decisions directly affect farmers' incomes and hence the willingness of co-op participants to remain within the coalition and to continue to patronize the cooperative.

The Actors

Table 3.1 lists some of the potential actors in a model of decision making within a cooperative. The model outlined here concentrates on the first three groups listed: farmer-members, boards of directors, and management. Clearly, the other actors cannot be entirely ignored--they help define the environment in which decisions within the cooperative are made. For example, nonmember input suppliers and IOF competitors help determine the market prices a cooperative faces, and the response of input suppliers and IOF competitors to the cooperative's behavior helps define the consequences of that behavior. Government agencies, such as the Justice Department, may intervene if the cooperative engages in anticompetitive practices. Actors 4 through 8, in short, impose on the cooperative a set of constraints that define a feasible region within which a decision may occur. Within that feasible region, a decision process involving farmer-members, the board of directors, and cooperative management occurs. The major focus of this study is on the decision process within the cooperative, and hence attention will center on these three groups. The other participants and the constraints they impose on the cooperative, however, will not be ignored. The attention given to them will depend on the specific problem under discussion.

The model does not assume that all actors within a given category, such as farmer-members, necessarily have the same interests, face the same constraints, and hence behave in the same manner. Each group can be stratified along several dimensions (for example, farmers may vary in the crops they grow, the size of their operations, their degree of indebtedness, and their risk preferences), and the model allows for intra-group as well as intergroup conflicts.

TABLE 3.1

POTENTIAL ACTORS IN A MODEL OF
COOPERATIVE DECISION MAKING

1. Farmer-Members
 - a. Patron Members
 - b. Nonpatron Members
2. Board of Directors
3. Management
 - a. Headquarters Staff
 - b. Field Staff
4. Nonmember Input Suppliers
 - a. Hired Labor
 - i. Union leaders
 - ii. Rank and file
 - b. Credit
 - c. Materials/Services
5. Nonmember Customers
6. Nonmember Beneficiaries
7. IOF Competitors
8. Government
 - a. Administrative Agencies
 - b. Supporting Agencies (e.g., Cooperative Extension Service)
 - c. Courts

Behavioral Postulates

The model assumes that co-op members, directors, and management personnel rationally pursue their own self-interest. For this statement to mean anything we must define rationality and self-interest.

Rationality

Rationality implies the ability to reason soundly. Most game-theoretic studies incorporate three elements into their definition of rationality (Rapoport, et al., pp. 4-5). First, each player is assumed to have a consistent set of preferences over the set of possible outcomes of the game. These preferences are defined over the entire outcome set (that is, over all possible outcomes accruing to every player), not just the direct payoffs received by the individual player; "it is a response to the total situation and may therefore take into account what happens to other players. In this fashion, such notions as altruism and spite are included" (Luce and Raiffa, p. 48). Second, game-theoretic models assume that each player is fully aware of the rules of the game and of the utility functions of all other players. Third, these models assume that in choosing among alternatives a player will attempt to maximize expected utility.

The model outlined here incorporates the first assumption of the game-theoretic models, but not the second two. (The latter are incorporated, however, in the more formal game-theoretic analysis of chapter 5). In this chapter rationality is taken to mean that actors behave in a manner that they believe will further achievement of their goals, which are ranked according to a consistent preference set. Rationality does not mean that the actors will always behave in a way that moves them

closer to their goals. Actors may possess imperfect information when they make decisions or they may make systematic errors in perception (see Maital, pp. 168-71); however, if they believe the actions they adopt will further the attainment of their goals, such actions are rational by this definition.

Game theoreticians stress that in situations of mutual interdependence where the interests of different actors are partially conflicting and partially coincident the definition of rationality may seem ambiguous (Rapoport, et al., pp. 1-6). For example, in a prisoner's dilemma, individually "rational" behavior leads to universally less preferred outcomes. The difficulties of defining rationality in a game-theoretic model are discussed in more detail in chapter 5 and in appendix C. For the moment suffice it to say that rationality implies that if mutual interdependence of actors in an economic system is obvious, all actors will take this into account when planning their behavior. Many oligopoly models (Cournot, Bertrand, Edgeworth, Stackelberg, and Sweezy) essentially attribute rationality to only one market participant by allowing him to search for an optimal behavioral rule while constraining all others to react mechanically to his behavior. This model allows strategic behavior by all participants, who simultaneously search for optimal behavioral rules.¹ Strategic lying, cheating on agreements, and many other types of behavior are thus admitted as potentially rational in this model. Opportunism, what Williamson (1979b, p. 234n) calls "self-interest seeking with guile," and the difficulty it poses for long-term contracting therefore become important parts of this model.

¹For a discussion of the earlier oligopoly models, see Bacharach, pp. 71-72.

In assuming that actors rationally pursue their own self-interest, the approach adopted here appears consistent with traditional optimizing models of economics and at variance with Heiner's recent work. Heiner holds that consistent patterns of behavior derive not from optimization but from the frequent inability of actors in an economic system to distinguish preferred from less-preferred behavior; they may eschew preferred behavior if they are unsure about the circumstances in which they find themselves. For example, even if an actor reaps benefits from coordinating his actions with some aspect of the environment, if he perceives changes in the environment very imprecisely and faces high costs for acting inappropriately, he may adopt the behavioral rule of ignoring that aspect of the environment when making his decisions. Uncertainty, or "the factors that standard theory places in the error term are in fact what is producing behavioral regularities, while optimizing will tend to produce sophisticated deviations from these patterns" (p. 585). As will become clear in chapter 6, Heiner's approach is consistent with an optimizing model, like the one presented here, that includes consideration of the costs of processing information and implementing decisions.

Self-Interest

Defining Self-Interest

Self-interest, like rationality, is difficult to define operationally. The new household economics (e.g., Becker) hypothesizes that all consumer and producer actions aim at maximizing utility. Similarly, game theory, which studies decision making under conditions of strategic interdependence, assumes that players decide their strategies based on the levels of utility they receive from various outcomes. (These utilities are the "payoffs" of the game [see chapter 5 and appendix C].)

From the standpoint of building a behavioral model, saying that people strive to maximize utility explains everything and explains nothing. Its counterpart is the tautology of revealed preference--"people do what they prefer to do, which is proof that they prefer to do it." While this may be true, it is not very helpful in predicting behavior. Unless one knows the argument and general shape of the utility functions little can be said about how people will act.

Specifying Actors' Utility Functions

For a model to be usefully predictive it must yield hypotheses that are potentially falsifiable (Popper, pp. 40-41). In building a predictive model of cooperative decision making, this requires that assumptions about the arguments and shapes of the utility functions lead to some specific predictions about how the actors will behave in the situations under study. For example, suppose one is investigating why a group of farmers chose to band together to market their products jointly in an attempt to increase their market power rather than banding together to lobby for government price supports. The assumption that farmers derive utility from participating in collective activities would not yield any testable hypotheses about which of these two alternative courses of action farmers would choose. It would not be, in this situation, falsifiable because it could explain either course of action equally well.

This emphasis on falsifiability does not imply that the model developed here will be strictly determinate. Nonetheless, to keep it from being completely indeterminate, assumptions need to be chosen carefully.

Begin with the assumption that all actors in the cooperative derive utility from both the pecuniary and nonpecuniary returns from their economic activities, i.e.,

$$(3.1) \quad U = U(R_p, R_n) \quad \frac{\partial U}{\partial R_p}, \frac{\partial U}{\partial R_n} > 0$$

where

R_p = pecuniary benefits

R_n = nonpecuniary benefits¹

Further assume that both farming and participation in the cooperative yield pecuniary and nonpecuniary returns. Nonpecuniary returns include things like plush office carpeting, prestige in the community, and fresh country air. A final assumption is that actors, in evaluating their pecuniary returns, consider the expected present value of net returns from their economic activities, i.e.,

$$(3.2) \quad R_p = E\left(\sum_{t=0}^{\infty} \alpha^t \pi_t\right)$$

where

$\alpha = \frac{1}{1+r}$ and r = the individual's rate of time preference; and

π_t = the individual's profit function in time t .²

Some Implications of this Specification

The following points should be noted about equations (3.1) and (3.2).

Expectations and Profits

Equation (3.2) asserts that farmers, board members, and managers think in terms of the expected net returns or profits from their

¹This approach is similar to the agency theory analysis of Jensen and Meckling.

²Nonpecuniary benefits are probably evaluated in a discounted sense as well, even though they are not considered monetary income. Note that the model does not state that actors maximize the expected value of future income; they may also take into account other considerations, such as the variability of income flows. Thus, the model potentially admits risk averse behavior.

activities. Therefore, the process by which these actors form their expectations about the profitability of different courses of action may be a major determinant of their behavior. As discussed below, in an uncertain environment incentives often exist for certain actors (for example, co-op managers) to try to influence others' expectations by providing them with subsidized information about the possible outcomes of different courses of action.

Actors' Time Horizons

The model also hypothesizes that the utility of co-op participants is a function of the present value of a multiperiod net benefit stream, not just current net benefits. Therefore, it may be rational for participants to engage in actions that are unprofitable in the short run (for example, continuing to buy supplies from their co-op even though an IOF currently offers lower prices) if they believe this will lead to larger long-run net benefits. Indeed, long-run rationality may lead farmer-members of cooperatives to develop conventions to deal with recurrent prisoner-dilemma situations in which there are short-term individual profit incentives to behave in ways that lead to declines in collective long-run profits (see Schotter). One factor that may lead one group of farmers to behave differently towards these conventions than does another group is a difference between the two groups' rates of time preference (see chapters 5 and 6).

Pecuniary versus Nonpecuniary Benefits

Equation (3.1) states that the utility of co-op participants is a function of both pecuniary and nonpecuniary returns. Consider a farmer who is also a member of a co-op's board of directors. The cooperative

generates both pecuniary and nonpecuniary benefits. Many of the nonpecuniary benefits of the cooperative (fancy offices, plush rugs, etc.) accrue to management and the board. Suppose that the board member receives some proportion β of these nonpecuniary benefits, while as a farmer-member of the cooperative he pays a smaller proportion α of the total and marginal costs of generating these benefits. The board member therefore has an incentive to increase the proportion of the co-op's resources spent on the perquisites relative to the resources spent to generate pecuniary benefits. This incentive is constrained, however, by two disciplining mechanisms. First, co-op members who are not members of the board have an incentive to monitor the board's behavior and pressure it to increase the resources spent on pecuniary benefits (McCall, pp. xiv-xv). Second, if the proportion of resources devoted to generating nonpecuniary benefits rises above some level γ (where $\alpha < \gamma < \beta$), it may induce other members to run for the board in an attempt to capture some of those benefits for themselves. Hence, political struggles may arise in the cooperative over "empire building," managerial or board slack, etc.¹

Constraints on Utility Maximization

Expression (3.1) is maximized subject to certain constraints. These include the income constraints of the various actors and ideological constraints on the participants' behavior.

¹This argument can be generalized. In the absence of disciplining mechanisms, whenever a group of co-op participants captures a proportion β of some type of benefit of cooperative activity but pays a smaller proportion α of the marginal cost of generating that benefit, incentives exist for the group to pressure for expansion of that class of benefits.

Income Constraints

An actor's ability to maximize his utility is constrained by his net income, which depends in part on the cooperative's policies regarding pooling, pricing, employment practices, and so on. Because an individual member may have some ability to influence these policies, the income constraint may not be absolute. Through spending resources to influence the co-op's policies, a member (or a coalition of members) may be able to relax the income constraint. The model predicts that a rational actor will apply the equimarginal principle in deciding how much effort to expend trying to influence co-op policies--he will spend resources to influence these policies up to the point where the expected return (in utility) to an additional unit of effort aimed at modifying co-op policies just equals the expected return to devoting the marginal effort to other activities and leaving the existing income constraint unchanged.

Similarly, when incentives exist for co-op management and the board to try to increase co-op income, the model predicts that they will also apply the equimarginal principle in deciding how to allocate their efforts. These efforts can be devoted to increasing co-op income within the existing framework of laws and other regulations or to trying to modify the existing rules of the game in a way that will raise the co-op's income. For example, the model predicts that a co-op's management will devote more of the organization's resources to lobbying for increased price supports than to improving the processing and marketing efficiency of the organization if the expected rewards (in terms of the managers' utility) are greater for lobbying than for increasing firm efficiency.

The Role of Ideology

Cooperative ideology includes the shared norms and beliefs of co-op members. In the short run, ideology can be thought of as constraining the behavior of utility-maximizing individuals by lowering the utility actors receive from pecuniary or nonpecuniary benefits that are obtained "unethically." For example, although it might be individually profitable for a farmer to steal supplies off the loading dock of his cooperative, he may refrain from doing so because of the high psychic cost of acting "immorally." Ideology, which is learned and internalized through a process of socialization, changes over time, thereby changing the constraints on individual behavior. Chapter 6 discusses the relationships between cooperatives' ideologies and long-run rationality.

Attitudes Toward Risk

Actors' risk preferences will also affect behavior, but the model makes no a priori assumptions regarding the nature of these risk preferences. Specific risk preference assumptions can be added later as special cases of this model.

Methods of Mutual Discipline

The behavior of a given coalition member is constrained by the countervailing disciplinary actions that other members can take. Following Hirschman (1970) many of these disciplinary actions can be classified as involving exit and voice.

Exit

A farmer-member of a cooperative may express his dissatisfaction with the organization by exiting from it. Various types and degrees of

exit are possible: the farmer may reduce or eliminate his patronage, he may withdraw his capital contribution to the cooperative to some degree, and he may quit contributing other services to the organization, such as his participation on various membership committees. Patronage, capital, and political exit may be combined with each other and may be used in combination with voice--for example, partial withdrawal of patronage combined with the threat of complete withdrawal from the cooperative if the board or management does not take certain actions.

The degree to which a member can withdraw capital previously committed to the cooperative, in order to discipline management or the board, may be limited by the lack of a secondary market for cooperative securities and by the long time required for an inactive member to get his capital back from a revolving fund or base capital plan (see chapter 2). However, to the degree that the capital structure of the cooperative is financed through per-unit retains and patronage refunds issued in the form of ownership certificates, new capital contributions to the cooperative are tied to current patronage. Withdrawal of patronage therefore implies withdrawal of further capital contributions to the cooperative, which may enhance the effectiveness of patronage exit as a way of disciplining the board and management.

A major shortcoming of exit as a disciplining tool is that when used alone it often conveys very little information about why the member left the organization. Most products and services are bundles of characteristics, and exit by itself usually says little about which characteristics the exiting member found unsatisfactory. The threat of exit, however, combined with voice (articulation of complaints) may be a powerful way of disciplining others in the organization. Indeed, certain features of

cooperatives, originally designed to enhance member voice (e.g., regular meetings between field representatives and farmer-members), may make it easier to use such threats.

Board members and managers may also use exit as a means of disciplining others in the organization. Board member exit can be considered a special case of member political exit discussed above--for example, a board member resigning to protest policies adopted by the cooperative. The effectiveness of managerial exit (and the threat of its use) depends on the strength of the market for cooperative managerial talent and the extent to which a manager possesses specialized knowledge about "his" cooperative's operations--knowledge that would be costly for the co-op to lose.¹ The threat of exit by both managers and members and its effect on the behavior of farmer cooperatives are major focuses of the game-theoretic analysis in chapter 5.

Voice

Members of the cooperative may react to unsatisfactory performance of the organization by voicing their complaints, either informally through lobbying (see below) or through formal mechanisms, such as voting and running for office in the cooperative. A major problem facing the board and management is determining the representativeness of the voices they hear. The rules for articulation and aggregation of member concerns determine the type of issues that reach the board and management, and it is often in the self-interest of coalition members to pay considerable attention to the design of these aggregation rules.

¹Two types of costs are involved: the cost of training a new manager and the cost of the old manager taking his knowledge to a competing firm.

Voice is not limited to farmer-members. Members of management may lobby within the organization for changes in policy, and the member-relations efforts of cooperatives may be viewed as a joint effort of management and the board to articulate their views to the farmer-owners.

As suggested above, the greater informational content of voice compared with exit may make voice preferable to exit as a way of improving firm behavior where the producer is unsure about the nature of the product desired by customers. The customer may also be unsure of the exact product characteristics required to address a particular problem; in this situation voice is needed if the producer and consumer are to work together to design an appropriate product (Hirschman, 1981, p. 220). Much of the conventional wisdom about cooperatives providing goods that are more finely attuned to customers' needs is based on the hypothesis that cooperatives have characteristics that enhance member voice within the organization (see chapter 2).

Hirschman argues that the relative costs of exercising voice and exit determine the mix of these two disciplining mechanisms that customers use. For example, where there are few competing firms, exit is costly and voice is more likely to be used. This suggests that within large cooperatives members located at the geographic fringes of the cooperative will use exit more frequently than will members located in the heart of the cooperative's territory, where alternative market outlets are fewer.

In some instances, however, it may be difficult to discuss the "costs of using voice" unambiguously. Hirschman hypothesizes that in certain circumstances one cannot neatly divide the benefits of achieving a goal from the act of striving for it. "Whenever the public interest

is involved, voice will not be felt as a cost but as a benefit by some people at some time" (Hirschman, 1981, pp. 217-18). If certain members of the cooperative view the organization as providing needed public goods, such as an improved income distribution, these members may perceive the exercise of voice as a reward in itself. Therefore, one reason why there may be greater use of owner voice in cooperatives than in IOFs is that some of the owners may view the cooperative as a social movement and not merely a business enterprise.

Environmental Postulates

Information and Decision Costs¹

Types of Costs

The model assumes that it is costly to: (a) obtain information, (b) process information, and (c) reach and implement decisions. The model further assumes that decision costs rise with the number of people directly involved in the decision process.² Incorporating information and decision costs in the model involves relaxing game theory's perfect knowledge assumptions and drawing on ideas from decision theory (see chapter 6).

Implications for Behavior

The assumptions about information and decision costs have the following implications for the behavior of actors in this model.

¹This section draws on many ideas discussed by Bartlett and Buchanan and Tullock.

²The decision process involves searching for a decision rule given the information at hand. Part of this search involves determining how much weight should be given to different types of information in the decision process. As the number of people directly involved in decision making increases, negotiation over what constitutes an appropriate decision rule becomes more complex and costly.

Partial Ignorance of Actors

First, it is not logical for actors to try to base their decisions on full information. If knowledge is costly it is rational to obtain more information only so long as the expected value of the information in improving a decision exceeds the expected cost of obtaining and processing the information and incorporating it into the decision. The subjective probabilities upon which actors base their expectations, however, are themselves computed on the basis of incomplete information. The result is that all decisions are made in the context of some undetermined amount of ignorance (see Heiner). Omniscient economic man is replaced in this model by Simon's administrative man, who makes decisions based on incomplete information and limited computational ability (or equivalently, nonnegligible computational costs).

Use of Standard Operating Procedures and Ideology

If information is costly, then it is rational at times to base decisions on simple rules of thumb. Rules of thumb, or standard operating procedures (SOPs), are devices that economize on the costs of collecting and processing information and of reaching and implementing decisions in the face of uncertainty about what the value of additional information would be in generating better decisions (cf. Heiner). SOPs allow decisions to be made without costly investigation of the idiosyncratic details of each situation (Cyert and March).

Ideology, the shared norms and beliefs of a group, includes a set of socially accepted SOPs. Ideology includes many SOPs that guide decision making in a variety of situations regardless of the idiosyncracies of each situation. Ideological statements such as "we should rely on the

market whenever possible" are thus devices that may originally spring from a rational desire to economize on information and decision costs.

A major problem facing organizations, including cooperatives, is deciding when certain SOPs, including parts of their ideology, are obsolete in the sense that the likely benefits that would accrue from developing new decision rules would outweigh the likely costs. Heiner's analysis, discussed in chapter 6, sheds considerable light on this issue. Such decisions are not based solely on what is most efficient for the organization as a whole, however. SOPs result in a certain distribution of income within the organization, so changing them involves bargaining and power plays within the cooperative. Chapters 5 and 6 discuss this bargaining in more detail.

Uncertainty and Influence

Bartlett has stressed another implication of costly information--the possibility of influencing others' decisions by changing the relative prices of information they face. In this model, the amount of information an agent incorporates into his decision depends on his evaluation of the cost of that information relative to the expected benefit the additional information will have on the quality of his decision. By subsidizing the price of information favorable to one's cause and increasing the cost of unfavorable information one can lead the agent rationally to include more of the favorable and less of the unfavorable information in his decision-making process. Advertising, lobbying, and obfuscation may thus be rational behavior in this model, representing attempts to change the relative prices of information decision makers face.

Delegation of Responsibility and Control of the Cooperative

The existence of decision costs within an organization make it rational for individuals to delegate certain decisions to others--i.e., to move to a decision rule other than unanimity (Buchanan and Tullock, p. 6). As an organization grows, the cost of collective decision making increases, and at some point the cost to the individual of participating in the decision-making process exceeds his expected benefits from participation. At that point it is rational for him to delegate decision-making authority to others. This is what Buchanan and Tullock (p. 213) identify as the economic rationale for representative government. At the same time, it is in the organization's interest to have authority delegated at this point because if a member does not have a large individual stake in a decision he will rationally forgo the expense of fully informing himself about the issue being decided (Alchian and Demsetz). As a result, decisions may not only be more costly to reach in direct democracy than in representative government but their quality may suffer as well. In a cooperative, representative government is manifested by the membership delegating certain policy-making authority to the board of directors.

Bartlett (pp. 21-22) argues that in all but the smallest governments (or, by analogy, organizations) the forces that make representative government more economic than direct democracy also make it rational for a bureaucracy to arise. The expected costs to the representatives of participating in certain day-to-day decisions involved in running the organization exceed the benefits these representatives perceive from making such decisions. Therefore, the representatives delegate these

responsibilities to a bureaucracy that is paid to make the day-to-day decisions. In cooperatives this bureaucracy is the management.

The desire to economize on decision costs therefore gives rise to boards of directors and hired management in cooperatives. The running of the cooperative through a system of delegated authority rather than direct democracy has several implications for the behavior of the cooperative and its members.

First, the degree to which an individual member-owner will want to participate directly in particular co-op decisions (as opposed to delegating authority to others) will depend on his perceived costs and benefits of participation. Since these are likely to vary among members, so will the desire to participate in decision making, either through formal mechanisms (e.g., by running for the board of directors or voting in co-op referenda) or informally, by altering the relative prices of information faced by those who have the formal authority to decide. The model therefore suggests that even if a co-op has a large membership, certain decisions may be effectively controlled by a small minority of members if those members have a large stake in the outcome of the decision while other members have a more diffuse interest. Indeed, incentives may exist for those with the strongest interest in a decision to try to increase their relative influence in the decision process by raising the cost to others of participating (e.g., through scheduling meetings during peak harvest times).

The question of "member control" of the cooperative is therefore quite complex. It is not simply a question of whether management, the board, or the entire membership makes major policy decisions. Rather, it is a question of the relative influence different individuals in the

organization have over particular decisions. If we define "member" broadly to include members of the board and management as well as individual farmer-members, then the question this model asks is "which members control which decisions?" not simply whether the cooperative is "member-controlled."

For a one-member, one-vote cooperative in which each issue is voted on independently, the model predicts that member-owners will delegate a decision to the board when a majority perceives that the costs of participating in the decision exceeds the benefits derived from participation. Votes typically are not made independently of each other, however. It is likely that a bargaining process involving vote-swapping takes place during the writing of the cooperative's bylaws, in which members debate which functions should be delegated to the board. This bargaining could be quite complex; hence, it is difficult to predict from a simple model which responsibilities member-owners will delegate to the board (or analogously, which responsibilities the board will delegate to management).

Although the stake an individual owner-member or board member may have in a particular delegated decision may be small, his stake in the aggregate of all delegated decisions is substantial, as these constitute most of the actions taken by the cooperative. The owner-members and the board, therefore, have incentives to try to monitor the general decision-making practices of those to whom they have delegated decision-making authority. What these members seek is not "control" in the sense of dictating the outcome of individual decisions (since this would negate the economies of delegation), but rather the ability to veto

decisions if the delegated decisions impose net costs on the membership greater than some threshold level.¹

Although member-owners and the board seek to monitor the behavior of those to whom they have delegated decisions, this is made difficult by the costliness of information. Because of the large number of decisions involved, monitoring may be particularly difficult in large, complex organizations. Much of the information necessary to monitor the performance of the cooperative is generated by management during the course of daily business operations. Management is therefore in the position to change the relative prices facing member-owners and the board of information management considers favorable and unfavorable to itself (see chapter 6).²

This suggests that, ceteris paribus, management (with respect to board-delegated decisions) and the board (with respect to owner-delegated decisions) will have more latitude to pursue its own goals under the following conditions:

- (1) the more difficult it is for those who delegated the decision to interpret the available indicators of the cooperative's performance. For example, certain types of investments may

¹The hypothesis that the board or management is free to make decisions so long as the cost of those decisions does not rise above some threshold value suggests that managers and board members have leeway to make certain individual decisions that may not be consistent with member goals. This is similar to Salisbury's view (p. 55) that leaders of interest groups have latitude to pursue their own goals, which may be independent of the goals of their constituents, as long as the organizations they head generate monetary or psychic benefits to the membership in excess of the costs of membership.

²For example, even though the board commissions an independent annual audit, much of the auditor's analysis is based on figures provided by the cooperative's bookkeeper, a management employee.

have long gestation periods before they begin yielding easily measurable benefits. In the interim, evaluating the investment may involve monitoring complex engineering or financial indicators, which require specialized training to interpret. Those who have the greatest incentive to make investments in this type of specialized training are those who can exploit it daily in their jobs, i.e., members of management. Lacking strong incentives to invest in the training necessary to understand the complexities of the cooperative's operations, co-op members may be reduced to exercising their oversight authority "mainly by critically following the policies of their professional management, rather than by giving it directions" (Trifon, 1961, p. 235). Management may even try to enhance its control over the cooperative by avoiding the development of easily interpretable performance indicators and by arguing that certain information should be withheld from the membership because of the information's potential strategic value to competitors.

- (2) the more complex the cooperative's structure. The more complex the cooperative's structure (perhaps partly a function of the cooperative's size) the more activity there is to monitor and hence the higher the information processing costs to those who

seek to evaluate the cooperative's performance.¹ To some extent this problem can be overcome by modifying the cooperative's organizational structure so that monitoring different lines of activity becomes easier--for example, by making greater use of divisionalization.

- (3) the less consensus there is among the board or the membership regarding what constitutes good performance. Evaluating the cooperative's performance involves comparing perceived performance to a norm. The more diverse the membership, the more costly it is to reach a consensus on appropriate performance norms and hence the more costly it is to evaluate the co-op's performance.

The membership and boards of many cooperatives have developed mechanisms to reduce these monitoring costs. Provisions for outside members on the board of directors (usually experts from agribusiness or the land-grant universities) and the use of ad hoc advisory panels by the board are aimed at improving the board's technical competence to evaluate the cooperative's operations. A potentially more powerful tool used by most cooperatives is the attempt to internalize the monitoring process within management itself by inculcating within management an organizational ideology compatible with the goals of the board or the member-owners. The development and inculcation of an organizational

¹ Empirical evidence does not seem to support the hypothesis that an increase in the size of a cooperative per se leads to a lower level of member control. Rather, the structure of the cooperative (for example, its use of for-profit subsidiaries that generate net revenues not allocated to any particular member) may be more important in determining whether the manager can pursue his own goals. For details, see van Ravenswaay and Mirowsky.

ideology is discussed in chapter 6. At this point suffice it to note that this process involves mutual reinforcement among the participants in the cooperative (see Skinner); therefore, it is misleading to say that the board simply "teaches" a cooperative ideology to members of management. For example, although the board may have a policy of hiring a person as general manager only if he has had several years' experience working in cooperatives and hence understands "the cooperative philosophy," that experience likely involved working primarily with other people in management, whose goals may not be coincident with those of the board. Furthermore, many of the board members' ideas about what constitutes "the cooperative way" may have been shaped years earlier when they attended young-farmer leadership programs organized in part by management.

Transaction Costs

The model assumes that effecting transactions, either through a market or within an organization, uses resources. Many of these transaction costs arise because of imperfect or costly information, but some have other origins, such as the costs of enforcing contracts. The existence of transaction costs has the following implications for the behavior of cooperatives.

Institutional Design as Economic Optimization

The model assumes that actors are rational economic agents who select among alternative courses of action based on the costs and benefits attendant on each alternative. If these costs include transaction costs, the cost of organizing transactions under alternative institutional

arrangements or governance structures,¹ then the choice of an appropriate institutional framework for the transaction becomes part of the optimization process. In other words, part of the economic calculus of the actors in this model involves deciding whether a particular transaction is best mediated through markets, bureaucracies, or some hybrid of the two. Indeed, the major thesis explored in chapter 4 is that cooperatives arise in part because they are a means of economizing on transaction costs, especially the costs of intraorganizational information flows and the enforcement of contracts. Nonetheless, because the choice of governance structure is a group choice, the relative power of different participants in the organization plays a large role in addition to efficiency concerns. The relative importance of these two factors depends in part on how coercive the organization's environment is; the more rivalrous or competitive the market, the more important become questions of financial, if not economic, efficiency in organizational design (see chapter 2).

Implications for Co-op Behavior and Control

The design of the specific practices of a cooperative affects the cost of carrying out various transactions by the cooperative and, indeed, whether the cooperative will undertake a particular transaction at all.²

¹Williamson (1979b, p. 235) defines governance structure as "the institutional framework within which the integrity of a transaction is decided."

²The model postulates that the decision to undertake a transaction involves weighing the expected benefits and costs of doing so. (These expected costs and benefits are assumed to be adjusted to take account of risk preferences.) If the expected costs of entering into a transaction, either through a market or within an organization, exceed the expected benefits, the transaction does not occur. Market failure and, analogously, "institutional failure" are thus simply extreme examples of the effects on markets and organizations of transaction costs (c.f. Williamson, 1981, p. 1541).

Furthermore, when the objectives of various participants in an organization differ, the existence of transaction costs helps protect the utility of those who have the initial right to decide an issue (Schmid, p. 89). For example, the model suggests that a cooperative manager would have greater scope for pursuing his own goals if he is allowed to initiate major projects subject to board veto than if he must obtain explicit board approval for every major project. The imposition of transaction costs on the board (the costs of monitoring the manager's behavior and of organizing board meetings to consider questionable behavior by the manager) loosens the constraints on managerial behavior.

The behavior of a cooperative, therefore, depends on who has the initial rights to decide issues in the cooperative, who has to bear the transaction costs involved in modifying decisions, and how high these transaction costs are. The details of how the decision rules of the cooperative are structured, in other words, strongly influence the behavior of the cooperative and who controls that behavior. Rational self-interested agents will, therefore, be concerned with the details of how these decision rules are structured. The model suggests that actors with the greatest stake in a particular type of decision will expend the most resources in trying to influence the details of the decision rules.¹

¹ Elitzak and Boynton asked members of seven midwestern dairy, grain, and farm supply cooperatives about the types of cooperative decisions over which they would like to have greater control. The area of decision making in which the largest number of members expressed a desire for more direct participation was the nomination of members for board and delegate elections--decisions involving who gets to design the decision rules of the cooperative.

Summary

The model outlined in this chapter views the cooperative as a coalition of players engaged in a nonzero-sum game. The model focuses on how the coalition members go about distributing the surplus generated by their joint activities. The surplus is defined as the difference between the returns the coalition receives by acting jointly and the returns members would receive by acting as individuals or in smaller subcoalitions. The problem of distributing the cooperative surplus is distinctly game-theoretic. Although the utility of all actors in this model is an increasing function of pecuniary benefits, and thus all members have at least some interest in increasing their share of the cooperative surplus, excessive demands by any one group of coalition members may cause other members to leave the coalition, leading to the loss of the surplus. The model focuses on how coalition members determine which allocations of costs and benefits lie within the core of the game (i.e., which allocations do not give some members of the coalition incentives either to exit or to use their voice to change the rules of the game) and how the bargaining process occurs within the core. The information-theory components of the model deal with how coalition members determine which options should be considered and how they evaluate the likely pay-offs of different courses of action.

Chapter 5 develops the game-theoretic aspects of this model in more detail, while chapter 6 explores how incorporating information and other transaction costs modifies the conclusions of the game-theoretic analysis. Both of these chapters, as well as the model just presented, assume that there are aggregate net benefits from cooperative action by farmers. Before proceeding any further with model building, it is useful to

examine what those net benefits are. Exploring the benefits to farmers of forming or joining a farmer cooperative is the task of chapter 4.

CHAPTER 4

INCENTIVES TO FORM OR JOIN A FARMER COOPERATIVE: A TRANSACTION-COST APPROACH

"The process of cooperation is as important as the result of cooperation, and to strip farmers of the former will ultimately strip them of the latter," Kravitz p. 3.

"I regard a farmer-owned, farmer-controlled cooperative as a legal, practical means by which a group of self-selected, selfish capitalists seek to improve their individual economic positions in a competitive society " Babcock, p. 153.

If, as assumed in chapter 3, economic actors are rational, they will only participate in farmer cooperatives if these organizations appear to offer advantages unavailable or more costly elsewhere. These may range from the purely monetary advantages stressed by Babcock to the less quantifiable benefits of democratic participation emphasized by Kravitz. This chapter examines the benefits farmers may derive from cooperation and discusses why these benefits may not be available from other forms of economic organization, such as investor-owned firms. By examining the conditions under which cooperatives can provide greater benefits to their participants than other forms of organization the chapter also highlights the situations in which farmer cooperatives are most likely to arise.

In analyzing farmers' incentives to form or join cooperatives this chapter focuses on how cooperatives can increase farmers' returns by reducing transaction costs and by redistributing rights in farmers' favor.

The chapter also examines how the incentives to maintain a farmer cooperative may differ from the incentives that led to its formation in the first place.

The chapter is divided into eight sections. The first section discusses the transaction-cost approach to analyzing organizational structure. This approach posits that differences between the structures of various organizations are not random; these differences reflect attempts by participants in the various organizations to minimize their transaction costs. Four principles affect the costs of carrying out transactions in different types of organizations: the asset fixity principle, the uncertainty principle, the externality principle, and the hierarchical decomposition principle, and sections two through five of the chapter examine each of these principles in detail.

The asset fixity principle, discussed in the second section, states that when assets become specialized to a particular use or user, so that the salvage values of the assets diverge from their acquisition prices, there are incentives for the owners of these assets to integrate vertically in order to incorporate under a single ownership the transactions involving the services generated by those assets. The asset fixity principle incorporates many of the traditional justifications for farmer cooperatives, including the arguments that cooperatives provide farmers with countervailing power, preserve farmers' market options, and protect farmers from the opportunism of their trading partners. This principle also suggests that cooperatives may be more likely than investor-owned firms to promote new farm enterprises and may, in the presence of poorly integrated labor and capital markets, serve as important outlets for trapped entrepreneurial talent.

The uncertainty principle, discussed in the third section of the chapter, states that a high level of uncertainty may reduce the efficiency of autonomous market contracting relative to some form of integrated ownership, such as a farmer cooperative. This section analyzes how farmer cooperatives may possess particular advantages in dealing with risk, especially through their ability to practice contingency pricing via patronage refunds and to offer their patrons some degree of income insurance through product pooling.

The externality principle, which is discussed in the fourth section of the chapter, states that firms may vertically integrate in order to overcome externalities imposed upon them by their trading partners. Two situations in which farmers may use cooperatives to overcome such externalities are examined: vertical integration in order to assure product and input quality in adjacent market stages and vertical integration in order to provide farmers with needed public goods.

The final organizational principle discussed is the hierarchical decomposition principle, which is examined in section five of the chapter. This principle deals with how organizations are structured internally to minimize decision and management costs. The principle suggests that cooperatives may offer farmers certain advantages over IOFs by promoting better information flows between the producer and user of services and by allowing certain decisions to be decentralized at the farm level while others remain centralized at the cooperative level. The hierarchical decomposition principle also provides insight into the conditions under which centralized as opposed to federated cooperatives are likely to arise.

In addition to analyzing how cooperatives may reduce farmers' transaction costs within a given set of property rights, the chapter also addresses how cooperatives may attempt to redistribute rights in farmers' favor. The sixth section of the chapter examines two aspects of this issue: political action by farmer cooperatives and how farmer cooperatives relate to the "democratic ideal."

Once a cooperative is formed, the incentives for maintaining and expanding it may differ from the incentives that led to its creation in the first place; the seventh section of the chapter explores this issue. A final section summarizes the major findings of the chapter.

A Transaction-Cost Approach

In examining why certain transactions between farmers and the rest of the economy are mediated by farmer cooperatives, this chapter draws heavily on the analysis of transaction costs (e.g., Coase, Williamson, Ouchi). A transaction occurs whenever "a good or service is transferred across a technologically separable interface" (Williamson [1981], p. 1544). The transaction-cost approach focuses on how the characteristics of a transaction affect the costs of handling it through markets, through bureaucracies, and through other forms of organization. Transaction costs include the costs of gathering and processing the information needed to carry out a transaction, of reaching decisions within the organization, of negotiating contracts with other parties, and of policing

and enforcing those contracts.¹ The transaction-cost approach argues that the organizational form or "governance structure" that minimizes the sum of production and transaction costs for a given activity will have a competitive advantage and hence tend to dominate that activity.

If the transaction-cost approach is correct, farmer cooperatives arise and tend to dominate certain activities because they offer advantages in mediating certain types of transactions between farmers and others in the economy. In its emphasis on organizational design as a form of economic optimization, the transaction-cost approach has a strong affinity to the induced institutional innovation model (Hayami and Ruttan) and the "new institutional economics" (Roumasset), which see institutions as evolving to capture untapped efficiencies in society. A shortcoming of all three of these approaches is their tendency to take cost structures as given, paying little attention to the ability of different organizational forms to change the distribution of property rights and hence the definition of "efficiency" (Bromley, McNeil).

The approach adopted here attempts to broaden the transaction-cost approach to look at organizational design not simply in terms of optimizing within a given set of property rights but also in terms of the ability of different organizational forms to change the distribution of rights

¹Williamson (1981) pointed out that all transaction costs derive from a combination of bounded rationality (which reflects both imperfect information and a limited capacity to analyze it) and opportunism, which he defines as "self-interest seeking with guile." Given imperfect information about future contingencies, all contracts are necessarily incomplete. If people were never opportunistic, however, incomplete contracts would not lead to contract-enforcement problems; contracts would simply state that if unforeseen contingencies arose the parties would act in a manner acceptable to all.

in favor of those controlling the organization. Within this broadened approach, the chapter examines the traditional arguments for farmer cooperation, outlining the conditions under which agricultural cooperatives may provide benefits to their members that are unavailable or more costly elsewhere.

The traditional justifications for farmer cooperation can be subsumed under one or more of the following four principles for efficient organizational design (where efficiency is defined as the ability to minimize transaction costs): the asset fixity principle, the uncertainty principle, the externality principle, and the hierarchical decomposition principle.

The Asset Fixity Principle

Williamson (1981, p. 1548) stated the asset fixity principle of efficient organizational design as follows:

The normal presumption that recurring transactions for technologically separable goods and services will be efficiently mediated by autonomous market contracting is progressively weakened as asset specificity increases.

An asset becomes more specific to a particular use or user as the cost of transferring the asset to alternative uses increases. This cost may reflect technical characteristics of the asset itself (for example, a die may be used to produce a specific part of a machine), the spatial dispersion of production, or poorly functioning factor markets. As an asset becomes more specific, its salvage value diverges from its acquisition value. As long as the value of the asset in use lies between the asset's acquisition and salvage value the asset will remain fixed in

its current use; the owner will have no incentive to invest or disinvest in the asset in response to product-price changes (Johnson, 1960).¹

Asset Fixity and Opportunism

The divergence between the acquisition and salvage value of an asset gives rise to rents that are potentially appropriable through market transactions if one of the parties to the transaction acts opportunistically (Klefn, Crawford and Alchian; see also chapter 2). For example, consider a farmer who invests in specialized fruit-production equipment and trees to supply a processing plant. Assume that the annual rental-equivalent price of those assets (calculated with respect to their acquisition price) is \$300,000 and that the farmer incurs \$100,000 in variable costs per year. The farmer made these investments based on the processor's promise to pay him \$500,000 per year for his fruit, yielding the farmer a profit of \$100,000. Further assume that the most those assets can yield in their next best alternative use is a gross revenue of \$100,000 per year. Once the farmer has invested in the specialized assets the processor may be tempted to renege on the agreement and strategically lower his price because he realizes that as long as he offers at least \$200,000 it will still pay the farmer to deliver the fruit to him, even though his action imposes a capital loss of up to \$200,000 on the farmer. Obviously, the processor cannot habitually act in this way or the farmer will be both unable and unwilling to maintain his investment in fruit

¹The level of investment in the asset will remain unchanged as long as the product price received by the asset's owner is greater than the average total cost (ATC) of production calculated with respect to the asset's salvage value but is less than the ATC calculated with respect to the asset's acquisition value. For details see Johnson and Quance.

production. Nonetheless, if a large proportion of the farmer's production costs are sunk at the time of the transaction, he is particularly vulnerable to this sort of short-term opportunistic behavior by his trading partner. He therefore may have an incentive to move away from market transactions, integrating forward and internalizing the transaction within an expanded firm (Klein, Crawford, and Alchian). This suggests that incentives for farmers to integrate vertically in order to avoid opportunistic behavior would be greatest where the proportion of sunk costs to total costs at the time of the transaction are high and the product is highly perishable, making its transfer to alternative markets on short notice very difficult. Fruits, certain vegetables, and dairy products are all examples. Shaffer (personal communication) reports that potato growers allege that potato processors have sometimes behaved in the manner described above, and this has been a major impetus to the formation of potato bargaining associations.

Vertical integration is not the only possible way of dealing with opportunism. Traders who face the temptation of acting opportunistically might be required to post a bond that would be forfeited if they were judged to have acted opportunistically. Obviously, the costs of adjudicating such a system could be so high as to preclude its use in many instances; however, the reputation of a firm may often serve the same purpose as a bond, with the firm forgoing opportunistic behavior in order to preserve its good name (Klein, Crawford, and Alchian). The more highly agribusiness firms value their reputations as trustworthy trading partners the lower is the incentive for farmers to integrate vertically in order to guard against opportunistic behavior. This has two implications for cooperatives. First, one would expect the market share of cooperatives

to be smaller in rapidly expanding markets than in markets where demand is static or declining. If demand for an agricultural product is growing rapidly, a firm that purchases the product from farmers or sells inputs to them to produce it has a strong incentive to maintain good relations with the farmers in order to ensure that the firm can continue to benefit from the growing market. The cost to the firm of sullyng its reputation (the value of the firm's "bond") is high. In contrast, if the market is static or declining the firm's profit margins may be squeezed and it may want to withdraw its capital from the sector. If the firm markets or processes farmers' crops, it may be able to obtain easily all the raw product it needs. The cost to the firm of acting opportunistically in this situation is lower because a besmirched reputation implies a smaller loss in future profits; farmers are eager to find a market for their overabundant crops and will probably continue to sell to the firm even if it occasionally takes advantage of them. In a declining market farmers may therefore have a greater incentive to integrate vertically, via cooperatives or other mechanisms, to overcome such opportunism. The experience of the U.S. canned fruit and vegetable industry conforms with this hypothesis. During the 1950s and 1960s, when demand for canned fruits and vegetables was growing, the market share of IOFs was high. With declining demand in the 1970s and 1980s, farmer cooperatives have come to dominate the market.¹

¹ IOFs may have another important advantage in expanding markets: the ability to respond rapidly to emerging market opportunities. Cooperatives, with their higher costs of collective decision making, may be less adept at seizing such opportunities.

The second implication is that where economies of size in marketing and processing are not large, grower-packers (farmers who process or market their own produce and that of their neighbors) may offer some of the same advantages as cooperatives. Being part of the local community, these farmers are liable to social as well as economic sanctions if they act opportunistically towards their neighbors (the value of their "bond" is higher than that of other IOFs). In some segments of the processed fruit industry where substantial price fluctuations and high fixed investments create a large potential for opportunism (for example, in sour cherries), grower-packers comprise a high percentage of the remaining IOFs in processing. In fresh produce, where cooperatives play a relatively small role in spite of high fixed investments and fluctuating prices, grower-packers are also important (Ricks, personal communication).

Asset Fixity and the Exercise of Market Power

Baumol, Panzar, and Willig, in their theory of contestable markets, argued that it is the immobility of assets, rather than industry concentration per se, that allows the exercise of market power.¹ If assets were perfectly mobile so that entry into and exit from an industry were entirely costless, then the performance of the industry, at least in a static sense, would be the same as would obtain under perfect competition, even if the industry consisted of only a few firms. In such a perfectly contestable market the omnipresent threat of hit-and-run entry by potential competitors would force firms to equate prices with marginal costs

¹For concise summaries of this argument see Baumol (1982a, 1982b).

and to adopt the optimum size and scope of operations. This would have two consequences. First, cross-subsidization would become impossible because firms would be unable to earn supernormal profits in one product line with which to subsidize prices in another. Second, given certain reasonable assumptions about the shape of the firms' cost functions, the threat of potential competition would result in an industry structure that minimized the total cost of producing a given output in a given period.¹ In a perfectly contestable market, in other words, even large firms would be unable to exert market power to appropriate transactional rents.

Baumol, Panzar, and Willig stressed that in order for market power to arise, assets must be immobile on both sides of the market. Although the immobility of assets in farming creates the potential for transferring rents between farmers and their trading partners, the ability of those trading partners to capture the rents depends on assets being immobile in the trading partners' businesses as well. For example, consider an isolated valley in which there are two independent canneries, one canning pears and one canning beans. Although either cannery could enter the other's line of business at very low cost, this market is not perfectly contestable. The fear of a mutually destructive price war may lead the two canneries implicitly or explicitly to collude, avoiding competition. The fear stems from the costs of exiting from the valley should competition threaten capital losses; if these costs were zero, the pear canner, seeing his cohort enriching himself through the exercise

¹The industry structure might not always be socially efficient in an intertemporal sense, however. See Baumol, Panzer, and Willig, chapters 14-15, and Baumol (1982a), pp. 12-14.

of market power over bean growers, would "hit and, if necessary, run (counting his temporary supernormal profits on the way to the bank)" (Baumol, 1982a, p. 4). In other words, asset fixity in farming creates the potential for farmers' trading partners to earn rents by exercising market power, and asset fixity in the marketing and farm supply industries allows the trading partners to exploit that potential. The high costs of exiting from these industries discourages new entrants who would otherwise bid the share of the transactional rents going to the farmers' trading partners down to zero.

As mentioned above, immobility of assets (including human capital) may reflect poorly functioning factor markets, high costs of transferring resources due to other reasons such as transport costs, and a high degree of asset specificity. This suggests that the poorer the integration of markets and the more highly specific the assets on both sides of the market, the greater the scope for opportunistic appropriation of rents, and hence the greater the likelihood of cooperatives or other forms of vertical integration by farmers. This perhaps explains the often-observed tendency of agricultural cooperatives to attract increased membership and expand their activities during hard times, when alternative employment opportunities for farmers and their assets are few and hence exit from farming is difficult. It also perhaps partially explains the higher incidence of cooperatives in subsectors such as dairy and fruit, in which assets on both sides of the market tend to be highly specialized (milking parlors, orchards, and processing plants) than in

other subsectors, such as grain, where assets are more substitutable among uses.¹

The analysis also suggests that as product and factor markets become more highly integrated the asset fixity argument for collective action by farmers becomes less compelling, as integration of markets facilitates entry and exit, decreasing the scope for the exercise of market power. If, however, this integration is accompanied by increased asset specificity (including human capital specificity), justification for vertical integration may still remain.

The asset fixity principle is involved in two of the most common rationales for farmer cooperatives, the need to build countervailing power and the need to preserve market access.

Countervailing Power

Farmers have long bemoaned their inability to influence the prices they receive for their products and the prices they pay for their inputs. Faced with immobile assets and only a few buyers or sellers for farm products, farmers have frequently suspected their trading partners of using market power to enrich themselves at the farmers' expense. One of the most common justifications for farmer cooperation is that through collective action farmers are able to counterbalance the market power of their trading partners, leading to more equitable and efficient market outcomes (see Galbraith, 1956).

In order for the exercise of market power to elicit collective countervailing action by farmers, the farmers must first perceive the

¹See below for additional hypotheses regarding why the dairy industry relies so heavily on cooperatives.

abuses to which they are subject.¹ If marketing margins for a product are excessive, farmers may perceive them more readily if technical constraints require the product to be processed close to the farm (Dahl and Hammond, p. 255). This may be one reason, in addition to those outlined above, why cooperatives frequently dominate the processing of dairy products and highly perishable fruits and vegetables.

Incentives to Exercise Countervailing Power via Cooperatives

Obviously, one of the major incentives to establish farmer cooperatives as a form of countervailing power is to try to increase farm incomes. Cooperatives might do this in two ways: through redistributing existing income in the farmers' favor and through increasing the efficiency of the economic system. Both arguments have historically been used to justify cooperatives, with most of the emphasis given to cooperatives' distributional effects.

Advocates of collective action by farmers have long argued that markets in which farmers face highly concentrated input, marketing, and processing industries generate a fundamentally unjust distribution of income, both in terms of the income received by farmers as a whole compared to other participants in the economy and in terms of the inequality of incomes among farmers that results from merchants playing one farmer off against another. Furthermore, supporters of collective action by farmers have maintained that a system dominated by large investor-owned agribusiness firms results in an undesirable regional distribution of income. Large IOFs, it is argued, extract profits from farming

¹Chapter 6 discusses in detail the crucial role of perception in cooperative decision making.

communities and channel them to metropolitan financial centers rather than reinvesting locally. As a result, small businesses and the tax bases of farm communities wither. In contrast, say these advocates of collective action, cooperatives rebate net margins to patrons or invest them locally, leading to higher local multipliers. Even if cooperatives extract the same level of margins as do IOFs, "there is a vast difference in the spending of five-thousand dollars for a mink coat [in a metropolitan center] and the spending of the same five-thousand dollars at the grass roots by a multiple number of spenders and for family or production necessities" (Bradley, p. 1156). The formation of cooperatives, in other words, may appeal to farmers not only as a means of increasing farm income but also as a way of strengthening rural communities and redistributing power in society. Revolt against the existing order and its perceived propensity to act opportunistically towards farmers may thus be one of the forces leading farmers to form cooperatives (Helmberger, 1966).

The promise of increased economic efficiency through countervailing power may also induce farmers to form cooperatives and the state to support their creation.¹ Cooperatives may increase both farm and system efficiency in several ways. Perhaps most importantly, by decreasing the threat of opportunism in the face of fixed assets, cooperatives may encourage investment in specialized assets in farming and marketing

¹Most farmers are interested in how cooperatives affect overall economic efficiency only to the extent that such improved efficiency results in more favorable farm prices. Supporters of agricultural cooperatives, however, have often argued that the efficiency-improving effects of cooperatives' countervailing power justify state support of farmer cooperation.

facilities that can increase productivity. This advantage of cooperatives may be particularly significant where the minimum efficient size of operation in marketing and processing is large relative to the market and hence the threat of monopoly or monopsony is very real (for example, in thin markets and in situations where there are substantial economies of size in the processing of a highly perishable commodity). Bargaining cooperatives may also increase efficiency by transforming the market relationship between farmers and their trading partners from one approaching simple monopoly or monopsony to one approaching bilateral monopoly or monopsony. Some advocates of collective action (e.g., Galbraith [1956], p. 138) argue that the output and price levels under bilateral monopoly and monopsony are likely to be closer to those of a competitive market than are the price and output levels generated by "one-sided" monopoly and monopsony.

If, instead of bargaining collectively, farmers form a marketing or supply cooperative to compete directly with IOFs, such competition may improve economic efficiency by compelling the IOFs to cut their profit margins and increase their X-efficiency (reduce the proportion of inputs devoted to the production of perks, etc.). Such competition may also reduce market segmentation, reducing the ability of IOFs to capture consumers' surplus. Because supply cooperatives rebate profits to their members, these organizations may have fewer incentives to enhance profits through "puffing" in their advertising and differentiating products in ways not directly related to the products' productivity.¹ The lower

¹This conclusion depends on the design of managerial incentives.

incentive to differentiate products may explain, for example, why co-operatives pioneered the use of descriptive labeling of farm inputs such as pesticides and the distribution of open-formula feeds (Koller, p. 1139).

Can Farmer Cooperatives Exercise Countervailing Power?

In analyzing the conditions under which farmer cooperatives can be an effective means of exercising countervailing power it is useful to distinguish between cooperatives that simply bargain for terms of trade and those that vertically integrate into off-farm production.

For a bargaining cooperative to exercise countervailing power effectively it must be able to "force unfavourable consequences upon opponents who refuse to accept stated terms" (Baron, p. 110). Bargaining cooperatives based upon purely voluntary participation historically have been unable to control supply, in part due to free riders; hence, the power of these organizations to raise long-run average returns to farmers through negotiating prices with processors that lie above equilibrium levels may have been slight (Baron). Nonetheless, bargaining cooperatives may have had an important effect on how the consumer and producer surpluses generated by the transactions between farmers and processors have been shared. By constraining processors to treat farmers equally and often compelling buyers to commit themselves to a price before the harvest, bargaining cooperatives may have prevented processors from acting like discriminating monopsonists, "picking one grower off at a time" and thereby appropriating the rents that arise because of the fixed nature of many farm assets.

Supply and marketing cooperatives attempt to exercise countervailing power by directly competing with investor-owned agribusinesses.¹ In situations where rents are being transferred from farmers to marketing and farm-supply firms through the exercise of market power, competition from marketing and supply cooperatives may effectively bid down the IOFs' share of those rents in two ways. First, if cooperatives rebate earnings to members in the form of more favorable prices, IOFs may be faced with the loss of market share if they do not match the cooperative's performance. This is the "competitive yardstick" justification for farmer cooperatives. Second, cooperatives may, because of their farmer ownership, introduce or support innovations with public-good characteristics, such as public grades and standards, that do not benefit the cooperative per se but do benefit the farmer-stockholders.² Competitive pressures may force IOFs to adopt these innovations even though the firms themselves would not have taken the lead in introducing them.

In order to compete effectively with IOFs, cooperatives have to overcome barriers to entry. Two of the most important ones are capital requirements and the confidence (goodwill) of customers and suppliers (Moore). Cooperatives have advantages and disadvantages with respect to both of these. Cooperatives' difficulties in raising equity capital have been discussed in chapter 2; in the U.S. these difficulties may be partly offset by access to capital on favorable terms from the Bank for

¹See, however, the discussion in chapter 2 about the factors that may lead cooperatives to eschew vigorous price competition with IOFs.

²This is an example of the externality principle discussed below.

Cooperatives.¹ Regarding goodwill, cooperatives may often have strong support from potential farmer-members (although it is not unusual to find farmers who are ideologically opposed to cooperatives), but the cost of developing good business relationships with other customers and suppliers may act as an important barrier to entry limiting cooperatives' ability to compete with IOFs.

Thus, although vertical integration by cooperatives into marketing and supply activities may be a more effective way of exercising countervailing power than is the formation of a voluntary bargaining association, it is likely to be a more costly alternative as well. There may be advantages to tying the two approaches together, bargaining for terms of trade and using the threat of competition by a marketing or supply cooperative to induce the IOFs to bargain in good faith.² Incentives

¹There is controversy over whether Bank for Cooperatives (BC) loans really permit farmer cooperatives to borrow at below-market rates. Bank for Cooperatives loans do not include any direct government subsidy, but the BC enjoys "agency status" as part of the U.S. Farm Credit System. Agency status may allow the BC to raise money on the money markets more cheaply than it otherwise could, up to 1.5 percent more cheaply according to one BC official interviewed by the author. Some argue, however, that the advantage conferred by agency status simply offsets the higher interest rates that bankers would otherwise charge cooperatives (as opposed to IOFs) for loans. (For some of the reasons why bankers might charge cooperatives higher rates, see the discussion of cooperative accounting data in chapter 2.)

²The California Canning Peach Association, a bargaining cooperative, was instrumental in founding California Cannery and Growers (Cal Can), which was one of the nation's largest fruit and vegetable processing cooperatives prior to its filing for reorganization under chapter 11 of the federal bankruptcy law in 1983. According to a charter member of Cal Can interviewed by the author, one of the motivations for founding Cal Can was to provide a market outlet for members of the bargaining association who had lost their contracts with IOF processors because of these members' strong support of and involvement in the farmer bargaining movement. Creation of Cal Can, in other words, prevented the IOFs from using black-listing to undermine the bargaining process. (For more information on the interactions between bargaining and processing cooperatives, see Chase-Lansdale, 1980).

may also exist to enlist the power of the state to strengthen farmers' positions in bargaining for terms of trade--for example, by making such bargaining binding on all farmers, thereby overcoming the free-rider problem.

Countervailing Power and the Relief of Social Tensions

Baron has argued that the countervailing power argument is a very weak rationale for social support of farmer cooperatives. Not only is the ability of cooperatives, particularly bargaining cooperatives, to raise farmer returns very limited in Baron's view, but there is also no theoretical evidence that a situation approaching bilateral monopoly is any closer to Pareto-optimality than is a simple monopoly. Rather, Baron argued that the social usefulness of cooperatives lay in their ability to relieve social tensions in the farming community during periods of structural change in agriculture, thereby permitting a smoother evolution of the structure of agriculture. As mentioned earlier, Baron overlooked the possibility that cooperatives can raise farmer returns through reducing opportunistic behavior by buyers; nonetheless, his hypothesis that cooperatives may serve an important dynamic function through relieving social tensions may also be valid. Baron argued that cooperatives relieve social tensions by:

- (1) "providing dominant and innovative farmers with...[a] time consuming form of activity in organising co-operative marketing" that distracts them from more disruptive activities, such as organizing farm strikes.
- (2) serving an important role in educating farmers about supply and demand conditions in other parts of the food system, often

showing them (through the experience of the cooperative) that low farm prices are not the result of exploitation or conspiracy; and

- (3) giving farmers the feeling they are "doing something" to improve their lot.

Baron stressed that when cooperatives are first formed, farmers may believe that they can use them to capture significant savings. Given this initial enthusiasm, it may take several years before the meager scope of those savings becomes apparent. By that time the leaders of the cooperative are deeply involved in promoting the organization and are not likely to advocate its dissolution, in part because of the fixity of its assets and in part because of the social, psychological and monetary rewards the cooperative generates for its leadership. Even though the cooperative may not be increasing member returns, it continues to serve as a safety valve for social tensions, permitting a more harmonious evolution of the agricultural economy, which in Baron's view justifies social support for farmer cooperatives. Although cooperatives may not reduce transaction costs in a static sense, according to this argument, they do reduce the dynamic costs of economic adjustment. Cooperatives are likely to be only weak safety valves, however, suitable when tensions in rural areas are relatively slight. In periods of real disaster farmers are likely to demand improvements in their material well-being that cooperatives probably cannot deliver. This may lead to direct state administration of agricultural prices.¹

¹This conclusion is illustrated by the experiences of the U.S. during the Great Depression. As economic conditions worsened, the programs of the Federal Farm Board, which were based on cooperative marketing, collapsed and were replaced by more direct state involvement in agricultural markets during the New Deal.

Preservation of Market Options

The argument that agricultural cooperatives are needed to preserve the market options of farmers, particularly when investor-owned firms exit a market, is explicable largely in terms of the asset fixity principle. In order to preserve market outlets for their products farmers have frequently purchased IOF processing plants that were closing because of poor earnings and converted these firms into cooperatives. Similarly, during the oil crisis of the 1970s many supply cooperatives in the U.S. expanded their efforts to supply fuel to farmers (often integrating backward into refining) at a time when major oil companies were reducing services to rural areas.

Farmers are motivated to take such collective action by the prospect of suffering large capital losses on illiquid farm assets should market access be lost. Insecure markets not only raise the threat of capital losses on existing illiquid farm assets but also discourage investment in additional farm assets having long amortization periods that are needed to maintain or increase labor productivity in farming. Farmers have become more vulnerable to such capital losses with the increasing capital intensity of farming.

Investor-owned processing and input supply firms also face the need for assured input and product markets in order to avoid capital losses on current assets and to plan future investments with greater certainty. Analysis of farmer cooperatives as a means of assuring market access should therefore address two interrelated questions:

- (1) Why is vertical integration necessary to achieve secure markets?

Given the needs of participants on both sides of the market for

assured market outlets, why isn't market security obtained exclusively through contracts between buyers and sellers?

- (2) If there are advantages to vertical integration, why do farmers more frequently integrate into marketing and farm supply activities than marketing and farm supply firms integrate into farming?

It is sometimes argued that farmers can afford to operating marketing or farm-supply facilities that IOFs have abandoned in favor of more profitable investments elsewhere because farmers take into account the joint profitability of farming and the marketing or farm-supply operations, not simply the profitability of marketing or input supply alone. Whereas an IOF can exit the industry without having to take into account the costs its departure imposes on its farmer-clients, cooperatives, because of their integrated nature, to take those costs into account (see chapter 2).

This argument by itself, however, is too facile. If the joint farming-input supply (or marketing) operation is profitable but marketing or input supply alone is not, why couldn't farmers and the IOF renegotiate their contracts, redistributing some of the profits from farming so that the IOF could stay in business? Indeed, given competitive pricing of farm products, such a redistribution of profits should take place automatically through the market. There are several possibilities why this redistribution of profits may not occur:

- (1) If cost structures differ among the farms served by the IOF and if the IOF cannot price discriminate among its farmer customers, competition among farmers will redistribute rents only up to the level of the rents previously earned by the marginal

producers.¹ Intramarginal producers may still earn rents at the competitive price, and these farmers stand to lose those rents if the IOF exits the market.

- (2) If instead of pricing according to a competitive market, farmers bargain collectively with the IOF, they may refuse to make price concessions because they do not believe the IOF is in serious financial trouble, a belief engendered by an unwillingness of the IOF to open its books to the farmers. In this case an advantage of unified ownership of farming and marketing or input supply facilities would be improved information flows among system participants about the financial health of the different operations.
- (3) In collective bargaining with farmers, IOFs often have to commit themselves to a raw-product price before they know what prices they will receive for their processed products. If agricultural production and hence supplies and prices of products are volatile, the IOF can incur heavy losses, yet be severely limited in its ability to renegotiate its contracts with growers. Given highly volatile markets it is difficult for farmers to discern ex ante whether an IOF asking for concessions is genuinely in trouble or is simply attempting to act opportunistically.
- (4) There may be no possible redistribution of profits between farmers and the IOF that would simultaneously satisfy both parties'

¹A marginal producer is defined here as the highest-cost producer among those who collectively generate the minimum total volume of patronage necessary for the IOF to stay in business.

requirements for profitability, yet the overall profitability of the integrated operation may be acceptable to farmers but not to the IOF. This may be particularly true if the IOF views the marketing or farm supply activity as part of a declining industry involving risks (due, for example, to weather-induced fluctuations in agricultural production) that the IOF would rather shed in light of other investment opportunities open to it that offer steadier earnings. Farmers may be willing to accept a lower overall rate of return on investment than is the IOF in order to capture the nonmonetary rewards of farming or because they have fewer alternative investments open to them than do IOFs due to imperfections and transaction costs in the capital market.

- (5) There may be efficiencies in running input supply or marketing facilities as cooperatives rather than as IOFs. These potential efficiencies are discussed below.

Farmers of perishable crops sometimes argue that they need cooperatives to provide a secure "home" for their product. These farmers point out that in years of heavy production IOF processors purchase only that portion of the crop they can market profitably, leaving farmers to bear the costs of supply adjustment in the subsector. Although this may be true, creation of a cooperative that agrees to purchase whatever its members produce (subject to certain quality standards) does not solve the problem, as several cooperatives have learned to their detriment (see chapter 6). Such a rule may allow the burden of adjustment to be transferred among farmers, however, benefiting those whose marginal cost of production is low at the expense of high-marginal-cost producers.

If farmers are willing to take a lower rate of return on their investment in marketing or farm-supply activities than is an IOF, if pricing in these industries is competitive, and if the other costs of cooperatives and IOFs are similar, one would expect these industries to be eventually composed entirely of farmer-owned firms, as the lower rate of return on equity would be bid into a lower product price. If, in addition, farmer-owned companies have access to below-market-rate loan capital (for example, through the Bank for Cooperatives) then the transfer of ownership to farmers would be accelerated, particularly if the industry is capital-intensive. As mentioned above, barriers to entry and exit can reduce competitive pressures and hence slow this tendency. Historically, a major asset in the food industry that may have acted as a barrier to entry is a strong brand name. Therefore, one would expect the transformation from IOF to cooperative ownership to occur first in nonbranded products, which appears to have been the pattern in the U.S. canned fruit and vegetable industry.

The tendency of farmers to use cooperatives to preserve market access raises the question of whether cooperatives are oversensitive to the potential for capital losses in farming and therefore lead to overinvestment in marketing and farm supply facilities. By preserving market access when IOFs exit an industry, do cooperatives simply retard resource movement out of agriculture in response to shifts in demand?¹ The answer depends in part on the conditions under which farmers decide to invest in cooperatives. Omniscient profit-maximizing farmers would

¹Alternatively, do IOFs lead to excessive resource movement out of agriculture because they do not take into account the capital losses that accrue to farmers (and society) when these firms leave an industry?

invest in cooperatives to preserve market access only if the capital losses they would suffer without the cooperative exceeded the combined capital and operating losses of the joint farm-cooperative operation. Omniscient farmers, however, would never suffer capital losses in the first place. Given imperfect information, farmers may have a natural tendency to overestimate the potential for success of a cooperative. Furthermore, farmers who would be particularly disadvantaged by the exit of an IOF (that is, intramarginal producers--for example, those farthest from alternative markets) may become ardent supporters of cooperative action, seeing in cooperatives a mechanism by which they can shift some of their potential losses onto other producers. An articulate minority may therefore convince their colleagues to form a cooperative even though it is not in the majority's best interest.

The strong voice that stockholder-users have in the governance of cooperatives may therefore lead these firms to overinvest in certain market facilities, particularly when marketing and input-supply industries are undergoing rapid structural change. Excess capacity in cooperatively-owned fertilizer plants and petroleum refineries and excessive stocks of canned fruits and vegetables (due in part to cooperative processors' tendency to provide a "home" for whatever their members produce) are possible manifestations of this problem.

The argument that farmers form cooperatives to avoid capital losses that would accrue if market access were lost suggests, as did the countervailing power argument, that cooperatives would be more prevalent where farmers have a large number of specialized assets at risk. This may explain why vegetable processing cooperatives have historically been stronger on the West Coast, where producers are specialized in this line of

production and have invested heavily in it, than they are in parts of the Upper Midwest, where vegetable production is more of a sideline activity of dairy farmers, who until recently have invested only modestly in specialized vegetable-production equipment (Hamm [1981], p. 501).

Outlet for Trapped Entrepreneurial Talent

Cooperatives, particularly in their early stages of development, may provide an important outlet for underused entrepreneurial talent trapped in agriculture by poorly integrated labor and capital markets. Historically, most agricultural cooperatives in the U.S. initially hired farmers as their managers; these may have been talented individuals who had time to devote to the cooperative and who lacked the alternative employment opportunities or capital necessary to express their entrepreneurial talents in other ways. For example, during the first part of the 1900s farmer cooperatives in the U.S. were more successful in the Upper Midwest, where many literate but underemployed farmers could devote time and effort to their cooperatives, than in the Southeast, where the stock of human capital on farms was much smaller (Johnson, personal communication). In essence the cooperative provided a mechanism by which an otherwise unused resource (surplus entrepreneurial talent) could be tapped to create value. This benefit of cooperatives exists only so long as capital and labor market imperfections prevent this talent from being employed elsewhere. Once alternative employment opportunities exist, the social opportunity cost of the previously underemployed entrepreneurial talent is no longer zero.

Development of New Farm Activities

Another consequence of the asset fixity principle is that cooperatives may be more likely to encourage the development of new crops and farming techniques than are IOFs, particularly where the IOFs are restricted from vertically integrating into farming. The logic of this argument is as follows. A marketing or processing IOF may be reluctant to invest in improving the human capital of farmers by teaching them new production techniques because the farmers can potentially act opportunistically towards the firm, using their new skills to produce products for a competing firm. Absent slavery, it may be very difficult for the IOF to compel a farmer to sell exclusively to the firm for a long enough period to amortize the firm's investment in specialized human capital in the farmer. There is therefore an incentive to move towards unified ownership of farming and processing to reduce this potential for opportunism. If permitted, IOFs may integrate backward into farming;¹ alternatively, farmers may integrate forward into processing. If forward integration takes place via a cooperative and if farmers' return on their investment in the cooperative is contingent upon their continued patronage (see chapter 2), then they may be less inclined to act opportunistically towards the cooperative than they would be towards an IOF. This greater loyalty to the cooperative would increase the cooperative's incentive to train farmers in new production techniques. Ranade reports

¹ Around 1900 many of the large national fruit and vegetable processors in the U.S. were vertically integrated into farming, in part to assure the quality of their raw-product inputs. After the human capital to produce these products had been built up and sufficiently amortized, the firms sold their farming operations and met their raw-product needs through contracting with farmers.

that in India, where land ownership ceilings prevent multinational processing firms from integrating backward into farming, multinationals are extremely reluctant to engage in farmer extension work, while cooperative processors are heavily engaged in these activities.

The Uncertainty Principle

The uncertainty principle states that the greater the uncertainty surrounding a transaction the less likely the transaction is to be efficiently mediated by autonomous market contracting. As uncertainty increases, so does the cost of renegotiating contracts; as unforeseen contingencies arise, so does the potential for opportunistic behavior. An increase in uncertainty therefore creates incentives to shift from institutions like the spot market to contingent contracts and vertical integration.¹

Flexibility in Pricing

Because a farmer cooperative is a form of vertical integration by its owners, it may find it easier to make the prices it charges or pays farmers contingent on the firm's earnings than would an IOF. Typically, contingent pricing in cooperatives is accomplished using patronage refunds. Members pay or receive an initial price that is subsequently adjusted via a patronage refund, whose value depends on the net earnings of the firm. In some lines of business, such as fruit and vegetable processing, farmer cooperatives have extended contingency pricing beyond

¹Vertical integration can be viewed as simply an extreme form of contingency contracting. In vertical integration an employee agrees, within some limits, to obey the instructions of his boss, which may vary as contingencies change.

just paying a patronage refund. Payment for the crop itself may be spread out for a year or longer following the harvest, with the amount of the total payment contingent upon the earnings of the pool in which the crop participates (see chapter 7).

Contingent pricing has several advantages in an uncertain environment. It helps firms on both sides of the market avoid the costly mistakes of committing themselves to prices that are either too high or too low in light of changing and not-fully-known supply and demand conditions. It also renders unnecessary the costly renegotiation of contracts should one party feel it has been treated unfairly in light of the evolving market situation. In the presence of imperfect capital markets it also allows firms greater flexibility in the timing of their sales. For example, Hamm (1981, pp. 478 ff.) described how IOF processors in the canned fruit and vegetable industry often have to offer special prices to distributors early in the processing season in order to generate the cash flow necessary to pay farmers for their crops. Cooperative processors, on the other hand, are not constrained to pay farmers immediately for their crop and therefore have greater marketing flexibility.

Vertical integration is not a necessary component of contingency contracting, as cost-plus defense contracts and employee profit-sharing plans attest. In recent years many investor-owned agricultural processing firms have moved to contingent pricing of raw agricultural products similar to that practiced by cooperatives. (For details see Chase-Lansdale, 1980). Nonetheless, contingency contracting is likely to operate more smoothly as a component of vertical integration, as in a cooperative. Because farmers own the cooperative, have access to its financial accounts, and, through the board of directors, can discipline the manager, they are

less likely to believe that the cooperative is using contingency contracting to act opportunistically towards them. In contrast, unless contingency contracts between farmers and IOFs are based on a formula (rather than a promise to "pay what we can afford") and permit farmers to verify the IOFs earnings, they may give rise to disputes that are costly to adjudicate.

Nearly every manager and board member of fruit and vegetable processing cooperatives interviewed by the author cited cooperatives' ability to offer contingency contracts as a major competitive advantage, particularly where IOFs were compelled by bargaining agreements to pay a cash price at harvest. Part of this advantage probably involved the farmer-members in effect financing the cooperative's operations at a low rate of interest (by deferring their payments for raw-product); several of the respondents, however, also mentioned the increased flexibility in marketing that contingency contracting permits. As discussed by Chase-Lansdale (1980), some observers argue that in the face of farmer bargaining, IOFs have an incentive to convert themselves into cooperatives, in part to avoid bargaining agreements that obligate the IOFs to pay for the raw-product at the time of harvest.

Reduction of Risk Through Pooling

A commonly-cited advantage of agricultural cooperatives is their ability to reduce the variability of farmers' incomes through the pooling of grower returns and expenses across products, time, and space. For example, if a marketing cooperative pools its returns from selling tomatoes and peaches and if cyclical patterns of returns to the two crops do not coincide, then the returns to producers of each product may be more

stable than if the two products were marketed separately (see chapter 7 for details). This income-stabilization function may become increasingly important to farmers as they specialize, because in specializing they lose the income stabilization imparted by on-farm diversification. In addition, as purchased inputs account for a larger proportion of total farm costs, it becomes increasingly difficult for farmers to weather periods of depressed farm prices simply by tightening their belts and accepting a low return to farm labor. Farmers therefore need to develop alternative ways of dealing with fluctuating prices.

Although cooperative pooling can provide an income-insurance function,¹ for it to be an incentive to establish cooperatives this form of insurance has to be cheaper than other ways open to farmers of stabilizing their income (on-farm diversification, reliance on the capital or futures markets, and so on). Although product pooling through a cooperative may be the cheapest way of stabilizing farm incomes when capital and futures markets are poorly developed, this conclusion becomes more questionable in highly integrated economies.

Nonetheless, farmers may prefer pooling as a means of stabilizing income for at least three reasons. First, the uncertainties in agricultural production may be so great that lenders require a large risk premium when loaning to farmers, particularly if the purpose of the loan is simply to stabilize farm income. Second, pooling may involve fewer transaction costs than other forms of insurance. Pooling is passive in the sense that the farmer has to make only one decision--that of joining

¹ Provided markets are not perfectly contestable and, hence, cross-subsidies impossible (see above).

and patronizing the cooperative. Gaining income stability through the capital or futures market involves more transactions, such as determining when to take out and repay loans, buy and sell contracts, and so on. Third, farmers who believe that the demand for their crop is declining may see pooling as a way of transferring income from producers of other crops to themselves. Because it is difficult ex ante to distinguish random price fluctuations around a trend from long-term changes in that trend, pooling can lead to ongoing income transfers between producers of different commodities, as winners chronically support losers. In the words of one cooperative manager, pooling often involves "insuring yourself with the other peoples' money." These income transfers can generate disintegrative tensions within the cooperative, with consequences that are explored in chapters 5 and 7.

The fear of substantial cross-subsidies through pooling may limit the diversification of cooperatives. Members may seek some degree of pooling to stabilize their individual incomes, and management may strongly support diversification to protect the cooperative from being fatally damaged by unfavorable changes in one of its areas of operation. Members, however, may often oppose pooling their returns with those going to producers of substitute products for fear that their "competitors" will unduly benefit from the arrangement.¹ As a result, cooperatives that do diversify often do so by setting up separate pools for different products; the threat of cross-subsidies and the disintegrative tensions they engender in cooperatives may therefore lead farmer co-ops to rely

¹Chapter 5 examines some of the limits to diversification of farmer cooperatives.

on divisionalization to a greater degree than do their IOF competitors. This approach is not without its drawbacks, however, as discussed in chapter 7.

If farmers value the income-stabilization gained through pooling, one would expect pooling to be most prevalent in cooperatives handling highly perishable products whose prices fluctuate widely and hence generate very unstable income streams. Cooperatives handling storable commodities like grains might operate more on a simple buy-sell basis because their members have the option, not open to producers of highly perishable products, of trying to achieve some degree of income stability through intertemporal arbitrage of their raw-product or through relying on the futures markets. This hypothesis is consistent with the experience of U.S. agricultural marketing cooperatives: most major fruit and vegetable processing cooperatives operate on a pooling basis while most grain cooperatives simply buy and resell the grain of their members.¹

The Externality Principle

The externality principle states that a firm has an incentive to integrate vertically when participants in adjacent market stages impose negative externalities on the firm.

¹This argument suggests that the (cash) income-insurance benefit of cooperatives might also be stronger during the early stages of economic development, when agricultural markets are thin and alternative means of insurance, such as operating through the capital and futures markets, are expensive or unavailable. Cooperative pooling may provide farmers in low-income countries an alternative to on-farm diversification as a form of income insurance.

Preservation of Product Quality

A major externality arises when participants in adjacent market stages intentionally or unintentionally debase a firm's inputs or branded products. For example, if a company produces a high-quality perishable product that requires special handling in subsequent stages of the distribution system, negligent handling of the product by distributors can damage the company's reputation with consumers. Because it is often easier to control product quality within the firm than across market boundaries, the company producing the product may vertically integrate in order to gain tighter control over the distribution system. For example, during the early 1900s California citrus growers perceived that the erratic quality of their products in Eastern markets was limiting the demand for oranges and lemons. Much of the early work of the California Fruit Growers Exchange (later Sunkist) was aimed at improving the distribution channels for citrus, partly through vertical integration, to ensure that citrus reaching Eastern markets was of consistently high quality (Kirkman).

On the input side, farmers may also have an incentive to integrate vertically, particularly when new inputs are being introduced whose characteristics are difficult to determine ex ante. In such situations the scope for opportunistic behavior is large. For example, the quality of many inputs used in farming, such as fertilizers and insecticides, cannot be determined by simple visual inspection. Unscrupulous dealers may therefore be tempted to provide low-quality or adulterated inputs. When new inputs are first being introduced into a market even more ethical dealers may not devote full attention to quality control because in the short run it is difficult to demand a premium price for higher

quality products when the higher quality is not immediately apparent to the buyer. Concern about building long-term business relationships tempers the tendency to shirk on product quality; nonetheless, if the costs of entry into and exit from the input-supply business are low, incentives for fly-by-night behavior remain.¹ In such situations the cheapest way for farmers to guard against such opportunism may be to integrate vertically into the input-supply business themselves through a grower-owned organization.

Agricultural processing firms attempting to build a strong brand name may face the same problem of assuring the quality of their inputs, particularly their raw agricultural inputs. The problem may be most acute when the processor is encouraging the production of a new crop, and farmers, unfamiliar with the techniques necessary to produce a suitable product, need close supervision. The cheapest way for the processor to assure product quality may be to integrate vertically into farming or to use detailed contracts to require farmers to follow specific production practices.

Contracting leads to contract-enforcement costs, which may be lower for cooperatives than for IOFs because cooperatives potentially have more ways of punishing members who fail to live up to their contracts than do IOFs. Not only can a cooperative include the same noncompliance clauses in its contracts as does an IOF, but members who act opportunistically toward their cooperative may face social sanctions from their fellow

¹ Although the costs of entering the input manufacturing sector are substantial, the costs of entering and exiting the input distribution business may be modest. An unscrupulous input dealer could therefore buy products from a manufacturer, adulterate them, and then grab his profits and exit the industry if things got hot.

farmers as well. In addition, a cooperative can make a member's return on equity in the organization contingent upon his fulfilling the terms of the contract (see chapter 2).

Provision of Public Goods

Many of the "competitive yardstick" activities of farmer cooperatives can be viewed as public goods. Farmers, faced with unsatisfactory performance by IOFs, may integrate forward to form a cooperative whose purpose is to force the IOFs, through competition, to improve their service to farmers. If successful in enforcing competition the cooperative generates benefits that it does not capture itself but which accrue to the farmer-stockholders, as well as to other farmers in the area. No independent IOF has an incentive to act as a competitive yardstick (although the logic of a competitive market often forces such behavior); it is the integrated nature of farmer cooperatives that leads to their being formed specifically for this purpose.¹

Cooperatives' leadership in introducing products such as open-formula feeds is an example of the provision of public goods. Open-formula labeling has certain public-good characteristics in that it may discourage "trivial" product differentiation and promote comparison buying. No one firm, however, can capture a profit from adopting open-formula labeling, in part because the purpose of the innovation is to redistribute bargaining power from sellers to buyers. Furthermore, the full benefits of open

¹The public-good nature of many of the activities of farmer cooperatives leads to free-rider problems, which are analyzed in chapters 5 and 6.

labeling occurs only when the practice is widespread so that comparison buying is possible.

In effect, the failure of IOFs to adopt open labeling of farm inputs imposed a negative externality on farmers, as there was no way in which farmers' preference for more accurate product descriptions could be articulated in a system composed entirely of investor-owned firms. By integrating backward into input manufacturing, farmers could introduce open formula labeling, not in order to benefit cooperative firms as such but to aid farmers as a whole.

Cooperatives themselves may impose negative externalities on nonmembers, which may induce these nonmembers to "vertically integrate" by joining the cooperative in order to overcome the externalities. For example, as marketing cooperatives vertically and horizontally integrate to a greater and greater extent, the reliability of the price information generated by residual markets declines and the risks of relying on those markets increase. Unaffiliated farmers become increasingly vulnerable to changes in agricultural markets, and their ability to obtain reasonable prices for their products may be eroded (Dunn, Ingalsbe, and Armstrong, p. 247). These farmers therefore have an incentive to join the cooperatives to escape these risks.¹

¹As alternative markets decline it also becomes increasingly difficult for multicommodity cooperatives to determine "realistic" prices for individual crops. The lack of a reliable external market price makes it difficult for members to judge the performance of the cooperative. For details see Chase-Lansdale (1980), Hayenga, and chapter 7.

The Hierarchical Decomposition Principle

Simply transferring a transaction from the market to the internal bureaucracy of a firm does not guarantee a reduction in transaction costs. Although internalization of the transaction eliminates previously-incurred selling costs, these are replaced by the costs of mediating the transaction within the firm. In order for vertical integration to result in a net savings, the firm must be organized internally in a way that allows it to handle the transaction efficiently. Simon and Williamson have argued that the internal efficiency of the firm is promoted by separating the activities of the firm, in both a vertical and horizontal sense, into relatively independent subsystems, "each one of which can be designed with only minimum concern for its interactions with the others" (Simon, cited in Williamson [1981], p. 1550). Vertical "slices" of the firm's activities correspond to different product lines, while horizontal "slices" correspond to operating versus strategic-planning activities.

Decomposing the firm's activities into relatively independent subunits helps prevent top management from being swamped with day-to-day operational duties, promotes an orderly flow of information within the firm, and helps managers with a division create an effective set of incentives for their subordinates by making division employees primarily responsible to their division manager, not a myriad of others, as might occur in a less hierarchical organization.

Williamson (1981, p. 1550) states the hierarchical decomposition principle for the efficient design of an organization as follows:

Internal organization should be designed in such a way as to effect quasi-independence between the parts, the high frequency dynamics (operating activities) and low frequency dynamics (strategic planning) should be clearly distinguished,

and incentives should be aligned within and between components so as to promote both local and global effectiveness.

With regard to the hierarchical decomposition principle, farmer cooperatives have two potential advantages over IOFs attempting to integrate backwards into farming through contracting or direct ownership: better information flows and decentralization of farm decision making. The desire to improve information flows within the marketing system may be an important motivation to found agricultural cooperatives.

Improved Market Information

The potential advantages of cooperatives over other forms of contracting in promoting the flow of truthful market information have already been discussed in chapter 2. Improved communication between customer and supplier regarding product specification is particularly valuable during periods of rapid technological change, when the development of products to address new problems is facilitated by close interaction between producer and user (Hirschman [1981], p. 220). It is also important when markets are poorly integrated and IOFs may as a result fail to perceive farmers' needs for new products.

Vertical integration into marketing or farm supply activities via a cooperative may also represent one of the few ways farmers can gain information on supply and demand conditions, including profit margins, in adjacent stages of the food system, particularly if these stages are dominated by privately held firms. (If publicly traded firms dominate the food system, stock prices and other public information may provide farmers a cheaper way of gaining insight into the profitability of adjacent stages of the food system.) Vertical integration is likely to be an expensive way to gain information about conditions in other parts of

the food system; inflated expectations of earnings may lead farmers to invest where it is unwarranted, leaving them poorer, albeit wiser. Nonetheless, in the early stages of cooperative development there may be advantages to farmers in collectively investing in market intelligence. This need not always involve heavy investment in physical facilities. For example, the organization that later became Sunkist Growers was initially founded to improve the flow of information and the supply-demand coordination between California citrus growers and the Eastern markets to which the farmers shipped their fruit. In its early years the cooperative devoted much of its effort to gathering information on existing and projected supplies in Eastern markets so that farmers could better coordinate shipments to avoid gluts or shortages. Smoothing out market supplies in the East was probably an important factor in building consumer acceptance of citrus, which at the time was a new product in the East and Midwest (Kirkman).

Decentralization of Farm Decision Making

Writers on transaction costs emphasize the advantages to a large firm of separating responsibility for day-to-day operating decisions from that for longer-range strategic planning. This division of responsibilities would be particularly important for a firm attempting to integrate vertically into farming, as many farm-level managerial decisions are highly time- and site-specific. Unless environmental conditions on the farm can be tightly controlled (as, for example, in poultry production), vertical integration into farming may require a higher degree of farm-manager autonomy than most firms are willing to delegate.

Farmer cooperatives, on the other hand, allow their members to capture many of the advantages of large-scale marketing, input production,

and strategic planning, while still permitting farmers to make most of their farm-level decisions themselves. By centralizing certain decisions at the cooperative level and retaining others at the farm level agricultural cooperatives may convey to their owners advantages similar to those of multidivisional firms in other branches of industry (see Williamson [1981], pp. 1555-56).

Federated versus Centralized Cooperatives

As farmer cooperatives vertically integrate further into marketing and input-supply activities, they must determine how best to structure themselves internally in order to meet their objectives. Two basic models have emerged: the federated cooperative and the centralized cooperative. A federated cooperative is a cooperative owned by other, smaller "local" cooperatives, whose members are farmers. The federated cooperative (often called a regional cooperative) sells goods and services to its locals and rebates net earnings to them. The board of directors of the federated cooperative is elected by the member co-ops. Federated cooperatives may themselves be members of even larger federated co-ops, called interregionals. These are primarily found in the farm-supply industry, where economies of size in manufacturing are large. Centralized cooperatives, on the other hand, may be as large as federated co-ops but have individual farmers as their members. Directors are typically elected through a delegate system, with individual members voting for district or regional delegates, who in turn elect the board. Whereas in a federated structure the local cooperatives own the regional, in a centralized cooperative the locals are simply branch outlets owned by the regional. A centralized cooperative therefore has much greater authority to dictate managerial behavior at the local level than does a federated cooperative.

Each structure has certain advantages; which type of cooperative is most effective in minimizing transaction costs depends on the environment.¹ Federated cooperatives allow greater farmer involvement in the governance of the locals and, as a result, may generate a greater awareness among farmers about the need to finance the cooperative adequately. This can be an important advantage in the early stages of the cooperative's development, when its access to loan capital is limited. Because of their greater grass-roots involvement, federated cooperatives may be more responsive to member requests for new products and services, and farmers may be more loyal to these organizations than they would be to centralized cooperatives.

Centralized cooperatives, on the other hand, can offer certain operational and managerial efficiencies. Because locals are obligated to obtain all their supplies from the central, it may be easier for the cooperative to project demand, minimize idle plant capacity, and capture economies of size in manufacturing and distribution. Because of their more hierarchical structure, centralized cooperatives can often respond more rapidly to changing market conditions than can their federated counterparts, in which decisions may require the approval of boards of directors at the local, regional, and interregional levels. In addition, centralized cooperatives may attract higher quality employees because of the greater possibilities for advancement within the organization. These advantages are likely to be most important in highly integrated and dynamic markets, where managerial flexibility and rapid decision making are critical to business success and where economies of size are substantial.

¹Some of the following points are taken from Ingraham.

At the same time, because of less direct farmer involvement in the decision making of the locals, centralized cooperatives may lead to member alienation, as farmers come to think of the cooperative as "those folks in Kansas City" rather than as the farmers' own firm.

As markets become more integrated and dynamic one would expect farmer cooperatives, particularly large ones with access to outside capital, to shift from federated to centralized structures in an attempt to reduce their transaction costs. Gold Kist and Southern States, two major agricultural cooperatives in the southeastern U.S., have recently undergone such a change, while others, such as Land O' Lakes, have developed hybrid structures. Such restructuring involves a redistribution of power in the organization, as evidenced by the ability of managers in the newly centralized cooperatives to close unprofitable but previously independent locals. Restructuring is therefore likely to be resisted by members of high-cost, low-margin locals.

Cooperatives as a Means of Redistributing Rights

The history of farmer cooperation shows that cooperatives were often formed in an attempt to redistribute property rights in society, not simply to reduce transaction costs within a given distribution of rights. Organizing collective action to redistribute rights often involves free-rider problems; therefore, an organization may attempt to finance its political activities through sales of appropriable goods to its members (Olson). Farmer cooperatives, which provide their members with goods such as farm supplies as well as lobbying, may therefore be an effective means of organizing for political action in those instances where farmers have a strong economic interest at stake (for example, in the design of

commodity policies), particularly where rules are lax concerning how cooperatives may spend their net earnings.

Political Activity of Cooperatives

A cooperative's attempt to exercise countervailing power represents an effort to redistribute rights. If effective, the countervailing power denies IOFs their previously held right to extract monopoly rents from farmers. Other pricing practices of cooperatives also have important distributional effects. For example, Schmid (p. 105) argued that in times of shortages, IOFs are most likely to use price to ration scarce supplies, and hence earn rents; while cooperatives tend to use other means to ration supplies among members.

Cooperatives also attempt to redistribute rights through more direct involvement in the political system. Particularly in those areas of agricultural production where public involvement is large (for example, because of public-health concerns) farmers may feel the need to organize politically to make their voice heard in public decision-making bodies. Once organized for this purpose, a cooperative can be used at low cost to lobby for other issues, such as improved terms of trade. (For example, consider U.S. dairy cooperatives.)

This suggests that public attempts to constrain farmers' latitude in making production decisions in order to deal with problems such as agricultural pollution and perceived labor exploitation will be met by increased lobbying by farmer cooperatives. Lobbying is also likely to grow as farm incomes are increasingly determined by decisions made in areas outside of farmers' traditional spheres of influence. In the U.S., for example, macroeconomic policy developed in the Treasury Department and

OMB may have a larger influence on farm incomes than USDA commodity policies (Dobson), and decisions made in the State Department regarding embargoes can negate years of effort by farmers to develop overseas markets. As direct government involvement in the agricultural economy increases, lobbying may become the most important function of many cooperatives. In the words of the manager of a large midwestern dairy cooperative:

We can increase returns to our members in two ways: through improving the efficiency of our distribution system for milk and through political action. Increasing efficiency adds pennies to our members' milk checks while political action adds dollars. We allocate our resources accordingly.

Cooperatives may also be used to channel resources to farmers after the rights to those resources have been won through political action. For instance, tobacco cooperatives in the U.S. serve largely as a mechanism to administer the tobacco price support program. Many dairy, fruit, and vegetable cooperatives implement the provisions of marketing orders, some of which permit price discrimination, which may raise grower returns above competitive levels (see Eisenstat and Masson). In Scandinavia, agricultural cooperatives take on many of the functions of a public agency, helping to coordinate government farm programs and equilibrate the supply and demand for agricultural products (Ollila).

One right won by U.S. cooperatives through the political process is single taxation of net earnings. Whereas the net earnings of IOFs are taxed twice, once at the corporate level and once when they are distributed to stockholders as dividends, cooperative net earnings are taxed only once, at the corporate level if they are "unallocated" and at the stockholder level if they are "allocated" (see appendix A). If farmers'

marginal tax rates are low, this tax advantage can be substantial and may in itself serve as an inducement to form farmer cooperatives (Helmberger, 1966, pp. 1432-33).¹

Cooperatives and the Democratic Ideal

Cooperatives, with their emphasis on member involvement and voting on a basis other than capital contribution, may serve to promote democratic ideals, particularly where other organizations in society are highly autocratic. Early cooperative organizers in the U.S. saw themselves as part of a larger social movement aimed at redistributing power in society. Neopopulist authors such as Kravitz continue to emphasize the importance of democratic cooperation not only as an end in itself but also as a way of combating the concentration of wealth and power they see as inherent in the growth of capitalism. Many cooperative supporters

¹This tax advantage is offset in part because the capital gains of an IOF are taxed at a lower rate than is dividend income, and, as explained in chapter 2, cooperative stockholders do not receive capital gains. Caves and Petersen (pp. 8-10) showed that the tax treatment of cooperatives confers an advantage on cooperative stockholders relative to IOF stockholders when:

$$(1-T_d) < (1-T_c)(1-T_g)$$

where

T_d = tax rate on dividends (which is also the rate at which cooperative savings distributed to members are taxed);

T_c = corporate income tax rate; and

T_g = capital gains tax rate.

Because the effective corporate income tax and capital gains tax rates are quite low, cooperative tax status does not always confer an advantage--it depends on the marginal tax rate of the stockholder. "Diverse personal tax rates are one reason why cooperatives and corporations may both be present in long-run equilibrium, with their market shares depending on the income distribution of farmers" (p. 10).

also stress the importance of cooperatives as "training grounds for democracy," in which members gain skills they later use in local governments and other organizations (see, for example, Wills, pp. 25, 28).

Although cooperation as a goal in itself may be an element in founding some agricultural cooperatives, it is unlikely by itself to sustain them, even when they have members with a strong ideological commitment to cooperatives. This is particularly true where there are alternative outlets for democratic participation, such as running for the school board. As discussed in chapter 6, ideological commitment to cooperatives may be important in sustaining them, but it is limited. As one co-op manager put it, "Cooperative loyalty is worth about two cents per bushel."

Incentives to Maintain a Farmer Cooperative

The chapter has thus far focused on possible incentives to establish a farmer cooperative. These may differ from the incentives to maintain or expand a cooperative once it is established (Shaffer, 1982; LeVay, pp. 26-31). Once a cooperative is in business, its assets generally become fixed, in the sense that the return to them in the cooperative exceeds the return they could earn in alternative uses. This is particularly true for the human capital of managers and board members, who often receive important pecuniary and psychological rewards from their involvement in the organization. Owners of these fixed assets therefore attempt to maintain the organization even though the conditions that initially gave rise to it may have changed, perhaps because of the activities of the cooperative itself.

Once established, the incentives for a cooperative to expand its operations are similar to those of other firms, including economies of

size and scope in manufacturing, administration, and selling.¹ Cooperatives may expand into activities seemingly unrelated to their original mission of serving farmers in a particular area in order to utilize by-products, gain fuller use of fixed resources, attempt to stabilize markets, spread risks, and strive for market power. Examples include:

1. CF Industries' involvement in the uranium industry. Uranium ore is an impurity in phosphate rock, which CF, an interregional supply cooperative, mines for fertilizer (CF Industries).
2. The common practice of most cooperatives of selling to nonmembers in order to spread overhead costs.
3. CF Industries' exporting of "excess" fertilizer in an attempt to stabilize the fertilizer market while keeping unit costs of production low by allowing plants to run at full capacity (CF Industries).
4. The purchase of the Joseph Pickett Brewery in Dubuque by AGRI Industries, a midwestern grain cooperative, in an attempt to spread risks in increasingly volatile commodity markets (AGRI).

In addition, conglomeration of a firm may serve as a substitute for a well-functioning capital market, allowing the firm to shift resources

¹Economies of scope occur when it is cheaper on a per-unit basis to produce or sell a broad range of products than a narrow range. Economies of scope are particularly important in selling, as they permit a fuller utilization of sales staff and offer customers the convenience of a full line of products, which may be important in gaining shelf space in food stores. The potential for substantial economies of scope in marketing was the major motivation for founding Sun-Diamond Growers of California, a federated cooperative owned by Sun-Maid (Raisin) Growers, Diamond Walnut Growers, Sunsweet (Prune) Growers and Valley Fig Growers, four cooperatives that prior to 1980 had marketed their products separately.

from low-return to high-return activities (Williamson [1981], pp. 1557-60). This may be particularly important for cooperatives because, as discussed in chapter 2, they may face greater difficulties than IOFs in obtaining loan capital.

At the same time, cooperatives face constraints on their diversification not faced by other firms. As cooperatives attempt to capture economies of scope, more of their costs become joint, and the allocation of joint costs can become a contentious issue among the membership (see chapter 2). Attempts to shift resources within the cooperative to take advantage of emerging profit opportunities may lead some members to charge that they are unfairly subsidizing others. These constraints on diversification are analyzed in the following chapter.

Conclusions

Many of the potential benefits farmer cooperatives offer their members derive from the fixity of assets, both physical and human, in farming and other types of agribusiness. Asset fixity in farming generates rents, which farmers' trading partners can potentially capture by acting opportunistically, provided that asset fixity in the trading partners' business creates barriers to entry or exit that permit the exercise of market power. Asset fixity therefore underlies the arguments that cooperatives are necessary to provide farmers with market power and to preserve their access to markets. This suggests that farmer cooperatives are more likely to arise and convey greater benefits to their members where: (a) assets on both sides of the market are highly specialized and/or (b) product and factor markets are fragmented, leading to a divergence between the value of the asset in its current use and its value in alternative

uses. It also suggests that cooperatives will tend to be more prominent in declining markets than in expanding markets because in declining markets the long-term consequences to farmers' trading partners of acting opportunistically are less severe than in expanding markets, in which a reputation as a reliable trading partner may be essential to continued success. In addition, in situations where technical change in agriculture imposes capital losses on farmers, cooperatives may provide a safety valve for farmers' frustrations, thereby permitting a smoother structural transformation of farming.

Because of asset fixity cooperatives may offer certain advantages over IOFs during the early stages of agricultural specialization. Farmer-stockholders have fewer incentives to act opportunistically towards their own cooperative than they do towards an IOF (provided that their return from the cooperative is contingent upon their continued patronage); therefore, the cooperative has more of an incentive than an IOF to invest in training farmers in new production techniques. Furthermore, in the early stages of development cooperatives may provide one of the few outlets for surplus entrepreneurial talent trapped in agriculture by poorly functioning capital and labor markets.

The potential for opportunistic appropriation of rents from farmers is accentuated by the riskiness inherent in agricultural markets. Cooperatives may offer farmers certain advantages in dealing with risk, primarily through the cooperatives' ability to practice contingency pricing via patronage refunds and to offer members some degree of revenue insurance through pooling. This suggests that cooperative pooling and the use of contingency pricing will be more prevalent in subsectors like fruit and vegetables, where production and prices are more volatile and other

risk-management tools such as the futures market are unavailable, than they will be in subsectors like grain, where risk may not be as great and there are alternative ways of managing it.

Farmers may also vertically integrate via cooperatives in order to internalize externalities imposed upon them by their trading partners. On the output side, farmers' trading partners may pay insufficient attention to maintaining the quality of farm products (particularly highly perishable ones) as they move through the marketing system, thereby depressing farm-level demand for these products. Farmers therefore have an incentive to integrate forward in order to preserve their "consumer franchise." On the input side, farmers may have an incentive to integrate backward when they have no simple way of ascertaining the quality of purchased inputs, such as by simple inspection or by relying on the seller's reputation. Particularly in the early stages of the industrialization of agriculture, when purchased inputs are just becoming important in farming and input suppliers' reputations are not well-established, farmers may therefore have an incentive to integrate vertically via cooperatives in order to assure input quality.

Farmers may also have an incentive to integrate vertically in order to provide themselves with goods and services that no investor-owned firm has an incentive to produce due to their public-good nature. This is particularly true of the "competitive yardstick" services of farmer cooperatives, the benefits of which accrue not to the cooperative firm as such but to the farmer-members. The public-good nature of some cooperative activities, however, can create free-rider problems, which are examined in chapters 5 and 6.

In their internal organization farmer cooperatives may offer certain efficiencies over IOFs that help offset cooperatives' possibly higher decision costs, which were discussed in chapter 2. Because of their more open structure, information flows between patrons and management may be greater than in IOFs. In addition, the cooperative structure allows farmer members to make certain location-specific farm-level decisions individually while allowing other decisions to be made collectively. Therefore, if there are incentives to vertically integrate farming with other stages of production (for the reasons outlined above), cooperatives may be a more flexible means of achieving that integration than IOFs, in which central management may be reluctant to decentralize a large number of farm-level decisions.

The degree of decentralization that exists in farmer cooperatives, however, varies widely, reflecting differences in cooperatives' environments. As markets become increasingly integrated and dynamic, farmer cooperatives will likely become more centralized in an effort to reduce their internal decision-making costs. In doing so they may have to sacrifice some of the advantages of decentralization outlined above, such as better information flows between customer and management.

Farmers do not form or join cooperatives simply to reduce transaction costs; an additional motivation may be to try to redistribute rights in the farmers' favor. Particularly where farmer-members have strong common interests (as in single-commodity organizations), farmer cooperatives may be an important means by which farmers can unite to take political action. Because a cooperative provides members with appropriable goods and services as well as a means of organizing political action, it may

represent a way of overcoming the free-rider problem inherent in many political organizations (Olson).

Many of the cost savings outlined in this chapter could accrue to any farmer-owned corporation, not just those having the cooperative characteristics of limited return on equity capital and democratic decision making (see chapter 2). The advantages, in other words, stem from farmers' vertically integrating into marketing and farm supply activities, not necessarily from their doing so via organizations based on the Rochdale Principles. In many societies, however, the ability of a farmer organization to attract an initial membership and win concessions from the political system may depend on its being perceived as a democratic instrument of self-help, aimed at tempering the rapaciousness of capitalism. In this sense, Kravitz may be correct in saying that the process of cooperation is inseparable from the results of cooperation.

Once a farmer cooperative is formed its human and physical assets tend to become fixed in the sense that the return to them in their current use exceeds their salvage value; therefore, the owners of those assets (farmer-members and management) have incentives to maintain the organization even if the conditions that gave rise to its formation no longer exist. The organization may also face incentives, similar to those of other businesses, to expand into new operations in order to utilize by-products, spread overhead costs and risks, and so on. Such expansion, however, can lead to tensions among the membership concerning cross-subsidies; these are examined in chapters 5-7.

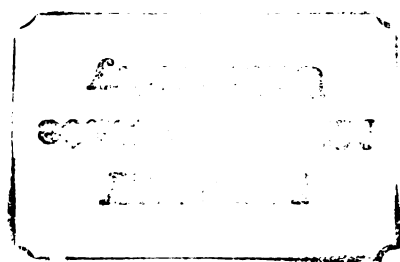
Just because there are potential advantages to agricultural cooperation in certain circumstances does not mean that farmers will always capture those advantages. Individual incentives may be structured in a way

that frustrates cooperative behavior. Understanding farmer cooperation therefore requires an understanding of the relationship between individual incentives and group behavior. Chapter 5 examines that relationship.



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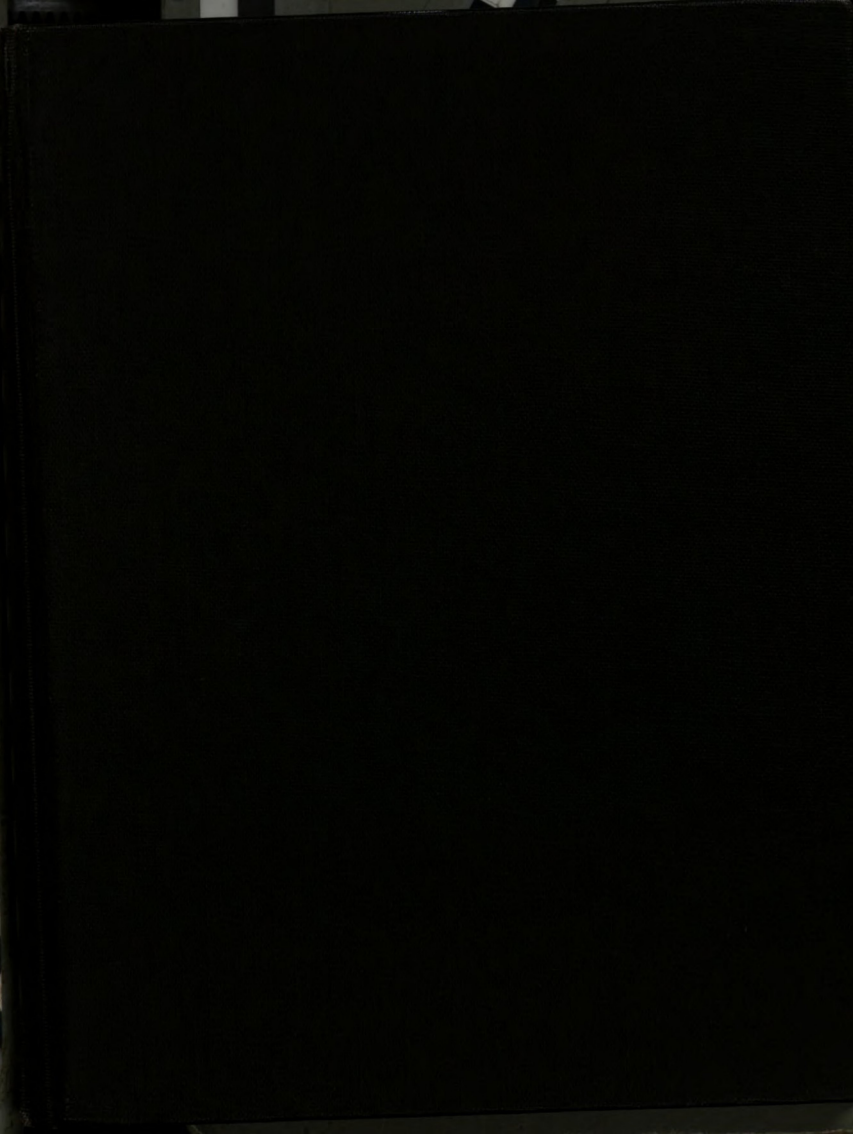
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CHAPTER 5
A GAME-THEORETIC ANALYSIS OF DECISION
MAKING IN FARMER COOPERATIVES

"It is in the design of institutions and their stability properties that game theory offers a natural tool for analysis " Schotter and Schwödiauer, p. 482.

This chapter uses concepts from game theory to develop further some aspects of the model of decision making in farmer cooperatives presented in chapter 3.¹ The basic game-theoretic concepts and set-theoretic notation used in this chapter are explained and formally defined in appendix C.

The chapter contains five sections. The first outlines why a game-theoretic approach is appropriate for analyzing many of the decisions made in farmer cooperatives and the types of issues to which game theory can lend insight. The second section discusses how elements of the model presented in chapter 3 can be expressed in game-theoretic terms. This section pays particular attention to the actors or "players" in various games played within the cooperative and to the objectives of those players. The third section examines several types of decisions within farmer cooperatives that can be viewed as involving bargaining between various participants and discusses how these decisions can be modeled as n-person

¹ Some of the material in this chapter appeared in John M. Staatz, "The Cooperative as a Coalition: A Game-Theoretic Approach," American Journal of Agricultural Economics 65, no. 5 (December, 1983):1084-89. It is included here by permission of the American Agricultural Economics Association.

cooperative games.¹ The fourth section discusses another set of decisions faced by participants in farmer cooperatives that resemble noncooperative games, particularly the prisoner's dilemma and the coordination problem (see appendix C for definitions of these terms). The fifth and final section summarizes the major conclusions and limitations of the game-theoretic analysis.

Reasons for a Game-Theoretic Approach

The Game-Theoretic Nature of Cooperative Decisions

As discussed in chapter 1, most formal models of the economic behavior of farmer cooperatives do not address the issue of group choice in cooperatives whose members have at least partially divergent goals and engage in strategic behavior. Cooperatives face many decisions, however, in which members' preferences cannot be assumed to be homogeneous. Examples include the pricing of different services to members, including the possibility of differential pricing based on members' patronage; the location of facilities; and the allocation of overhead costs and pool receipts. Furthermore, the preferences of management and the board of directors on many of these issues may differ from those of the rank-and-file membership. Although both the cooperative management literature and many cooperative theorists have informally discussed cooperative decision making in the context of heterogeneous preferences (see chapter 1), there is a need to develop models that address this issue explicitly and

¹In cooperative games players are free to communicate and make binding commitments with one another. In noncooperative games such communication and commitments are not permitted, or if they are, agreements are unenforceable. See appendix C for details.

in so doing suggest alternative ways of structuring cooperatives to deal with group choice.

As discussed in more detail in appendix C, game theory addresses the issue of group choice when the preferences of the members of a group are at least partially conflicting. Game theory involves, in the words of Luce and Raiffa, "the scientific study of interest conflict" (p. 1). A major area investigated by game theory is that of nonzero-sum games, that is, games in which the interests of the members of a group, while usually not entirely coincident, are not diametrically opposed (see appendix C). As will become evident below, most decisions in farmer cooperatives are nonzero-sum.

Two general types of group behavior are analyzable using the theory of nonzero-sum games. The first occurs when, because of high communication costs, unenforceability of contracts, lack of trust, or some other reason, members of the group eschew joint strategies and act independently of one another; this behavior involves a noncooperative game. The second arises when members of the group can communicate and make binding commitments with one another; these situations are analyzable using the theory of cooperative games. In cooperative games there are gains from joint action by a potential coalition of players, but the players must bargain among themselves about how the net benefits of the joint action are to be shared. Failure to agree on an allocation of net benefits among players prevents the coalition from forming (Roth). Many decisions in farmer cooperatives, such as how to allocate joint costs and pool receipts among producers of different products, can be modeled using cooperative games. Others, such as how to ensure member loyalty in a "competitive-yardstick" cooperative, more closely resemble noncooperative games.

A game-theoretic analysis of decision making in farmer cooperatives has affinities with the model of firm decision making outlined by Cyert and March in A Behavioral Theory of the Firm and with Simon's work on satisficing behavior. Although game theory assumes that individuals seek to maximize their utility, because of the mutual interdependence of the players in game theory the outcomes that emerge as solutions to games are those that satisfy some threshold level of payoff (the "security level") for each of the possible coalitions in the game (see appendix C). These security levels are analogous to the "satisfactory" or "target" levels of firm goals discussed by Cyert and March and Simon. Hoos (1982, p. 12) has argued that such a satisficing/game-theoretic model of behavior may be appropriate to farmer cooperatives.

Perhaps after all the objective of a cooperative is a variant of Simon's "satisficing theory." Seen in this way, the objective of a cooperative is to keep its farmer-members satisfied, or even happy, so that they will stay in the association and thus keep the cooperative alive.

A few game theorists, notably Schotter, have used the theory of non-cooperative games to explore the conditions under which institutional rules ("standard operating procedures" to use Cyert and March's term) arise to economize on decision-making costs. As detailed in the discussion of "supergames" in appendix C, Schotter (p. 109) defined institutional rules as equilibrium outcomes of a game that serve to "codify memory" for players regarding how others in the game are likely to behave. This is similar to Cyert and March's description of standard operating procedures as the "institutional memory" of an organization.¹

¹See Schotter, chapter 5, for a discussion of the similarities between his game-theoretic analysis and the work of Simon, Cyert and March, and Williamson.

Levels of Analysis

Churchman (1979) stressed that every system is embedded in a larger system. For example, a cooperative, a system in itself, is part of a larger national economy, which is part of the even larger system of laws, custom, habit, property rights, and instinct by which humans govern their affairs. Game theory can be used as a tool to understand cooperatives at any one of these levels; here, the emphasis will be primarily on farmer cooperatives as systems of organization in themselves, with some attention also given to the role of cooperatives in the larger economy.

Approaching the economy as a whole from a game-theoretic perspective involves viewing the economy as an n -person game in which individuals form coalitions (investor-owned firms, single proprietorships, cooperatives, and so on) in accordance with the payoffs they perceive from these different courses of action. In this framework cooperatives can be viewed as coalitions that formed in response to potential gains offered by this type of organization relative to other strategies open to the individuals involved. The nature of these potential gains were discussed in chapter 4.

The cooperative itself can be viewed in a game-theoretic context. The existing structure and practices of the co-op represent a strategy adopted by coalition members because this strategy is capable of holding the coalition together. Each different set of cooperative structures and practices represents a different strategy open to coalition members. Game theory views the final internal organization of the cooperative as resulting from a process of rational choice by coalition members among the

alternatives available to them. In this sense the game-theoretic approach is similar to the transaction-cost approach discussed in chapter 4.¹

Viewing cooperatives and their role in the economy from a game-theoretic perspective raises the question of the conditions under which a particular cooperative arrangement represents a stable outcome, that is, a means of organizing economic affairs that cannot be "overthrown" by some other strategy or coalition. Understanding the answer to this question should, in a broad sense, lead to a better understanding of the conditions under which cooperatives arise and how their internal structures evolve.

The simple answer to the above question is that a particular cooperative arrangement represents a stable solution when it lies within the core--the set of Pareto-better possible solutions that also exceed each possible coalition's security level.² This implies that: (1) there exist aggregate benefits to adopting the cooperative arrangement over alternative ways of organizing affairs, and (2) these aggregate benefits are distributed among the coalition participants in a way that prevents any other coalition or strategy from overthrowing the arrangement. These two conditions in turn raise a host of questions, which fall into two

¹Game theory deals with what constitutes rational choice among a finite set of alternatives. Although one might argue that there are an infinite number of ways of internally structuring a cooperative, in reality only a finite number of ways are actually considered by co-op participants. How alternative structures and practices come to be perceived and considered is thus a critical question, which is discussed in chapter 6.

²See appendix C for definitions of the core and of a coalition's security level. The core represents the most widely used solution concept for cooperative games. Appendix C discusses alternative solution concepts as well.

broad categories. The first, addressed in chapter 4, involves identifying the aggregate benefits that farmers may derive from cooperatives as opposed to other forms of economic organization. The second, addressed in the remainder of this chapter, deals with the strategies farmer cooperatives adopt to capture those advantages, the distributional consequences of those strategies, and their implications for stability of the cooperative.

Towards a Game-Theoretic Model

The general model of decision making in farmer cooperatives outlined in chapter 3 was game-theoretic in that each of the three groups of participants in the model, farmer-members, management, and members of the board, was assumed to pursue its own goals, yet the outcome of any one participant's actions depended on the actions of the other participants as well. Furthermore, even within a class of participants, such as farmer-members, not all actors were assumed to have identical interests or act in identical ways.

The model presented in chapter 3 pictured each actor as seeking to maximize a utility function having two arguments, pecuniary benefits and nonpecuniary benefits:

$$(5.1) \quad U = U(R_p, R_n), \quad \frac{\partial U}{\partial R_p} > 0, \quad \frac{\partial U}{\partial R_n} > 0$$

where

R_p = pecuniary benefits and

R_n = nonpecuniary benefits.

Actors were assumed to evaluate both pecuniary and nonpecuniary benefits in a discounted-present-value sense, where the discounting also took account of the actors' risk preferences.

As discussed in appendix C, game theory assumes that an actor evaluates the outcome of a given pattern of behavior in terms of the utility he derives from it. The above model, based on utility maximization, is therefore consistent with a game-theoretic approach. In order to simplify the analysis we will initially make some further restrictive assumptions about the nature of the participants' utility functions. These assumptions will be relaxed later in this chapter and in chapter 6.

Farmers' Goals

The analysis will initially assume that farmer-members of cooperatives are risk neutral and have utility functions that are linear in a single argument, pecuniary benefits (money). This assumption allows us to discuss payoffs to farmers from the cooperative's activities purely in terms of monetary outcomes.¹

The Goals of Management

The model presented in chapter 3 assumed that members of cooperative management, like all other actors in the model, derive utility from pecuniary and nonpecuniary benefits. Both the pecuniary benefits (salary) and nonpecuniary benefits (for example, the feeling of power from directing a large staff) are strongly correlated with the growth of the cooperative and the individual's position within the managerial hierarchy. Therefore, we will initially assume that the predominant instrumental goals of top management are the preservation and growth of the

¹This assumption is simply one way (the least complex way) of assuming transferable utility, which, as discussed in appendix C, greatly simplifies the analysis of cooperative games. More complex assumptions will be introduced later in this chapter and in chapter 6.

organization and the maintenance of their position within it. (For lower-level management, advancement up the managerial ladder is also a major goal.) Maintaining their positions in the organization in turn requires members of top management to return a "satisfactory" level of returns to farmer members.¹ Therefore, top management can be pictured as seeking to promote the growth of the cooperative subject to meeting minimum member demands for net returns from the organization.

Assuming that cooperative managers are interested primarily in preserving their own jobs and expanding the size of the cooperative does not necessarily imply that co-op managers work against the interests of the farmer-members. For example, the analysis of the horizon problem in chapter 2 suggested that these managerial goals may result in the manager's serving as the guardian of the cooperative when the farmer-members are tempted, because of short-run incentives, to liquidate it. The assumption made above regarding managerial behavior does suggest, however, that cooperative managers will not be the first to suggest that a farmer cooperative disband, even if the conditions that gave rise to its founding no longer exist.

Goals of the Board of Directors

Members of the board of directors in a farmer cooperative play a dual role: they are farmer-members of the cooperative and they are officers of the company. We can assume that as farmer-members they have the same motivation as other farmer-members, namely, the pursuit of

¹Where "satisfactory" is defined as giving each possible coalition in the cooperative at least its security level of net returns. See below and appendix C for details.

pecuniary gains. As elected officials of the company, however, they also have motivations akin to those of management. In particular, members of the board have access to certain nonpecuniary benefits of the cooperative (the prestige of being on the board, corporate perquisites, and so on) and power to shape corporate decisions that in turn influence the profitability of the member's own farm enterprise. A board member's ability to receive these pecuniary and nonpecuniary benefits of board membership depends on the size and financial health of the cooperative (and hence its ability to finance such benefits) and on the board member's retaining his seat on the board. Maintaining his seat, in turn, requires convincing his constituents (farmer-members, or delegates in a federated cooperative) that he has worked to guarantee them an "acceptable" level of returns from the cooperative.¹

In summary, board members are initially assumed to pursue both pecuniary benefits in their dealings with the cooperative (as do other farmer-members of the cooperative) and the nonpecuniary benefits of board membership. As suggested in chapter 3, because board members do not bear the full marginal cost of producing the nonpecuniary benefits

¹This suggests that board member behavior will depend critically on the rules of representation in the organization, particularly on whom the board members perceive their constituents to be. For example, if board members of a multicommodity marketing cooperative are elected on a commodity basis, each board member might take a very sectarian view of the cooperative's activities, supporting the cooperative's ventures only when his particular commodity group benefited from them. Changing the rules of representation to require election on a geographic rather than a commodity basis might lead to less factious board decision making, as each board member would become beholden to a constituency with a broader set of interests than before.

they receive, they may have an incentive to increase the proportion of the cooperative's resources devoted to the production of nonpecuniary benefits.¹

Cooperative Behavior as a Cooperative Game

Although the preferences of different participants are seldom strictly opposed, neither are they identical. Co-op participants, therefore, face two interrelated questions: (1) Can the participants identify and agree upon a set of objectives yielding benefits of joint action? And (2) Can an allocation of the benefits and costs of this action be found that maintains the incentives of each group to participate in the activity? "The mere existence of potential gains does not necessarily mean that they can be realized. There is a the problem of building an organization with sufficient cohesion to withstand the disintegrating forces arising out of conflicting interests" (Helmberger and Hoos[1965], p. 184).

The theory of cooperative games addresses the issue of group choice when the preferences of the members of a group are at least partially conflicting. Viewing the allocation of benefits and costs in a cooperative as a cooperative game focuses attention on the following questions: (1) How do the policies of a cooperative regarding the allocation of benefits and costs among the membership affect the payoffs (both pecuniary and nonpecuniary) to various potential coalitions within the

¹Crucial elements in determining board-member behavior are thus their marginal rates of substitution between pecuniary and nonpecuniary benefits and between different types of nonpecuniary benefits (for example, between the prestige of holding office and material perquisites). Chapter 6 discusses how farmer cooperatives attempt to influence these marginal rates of substitution through the inculcation of cooperative ideology.

cooperative? And (2) How do these payoffs affect the willingness of various coalitions to remain active in the cooperative as opposed to taking their business elsewhere?

Types of Bargaining Issues

In farmer cooperatives, many potential bargaining situations such as those portrayed in the theory of cooperative games arise. Table 5.1 lists some of these situations and the disputants involved. Table 5.1 is illustrative, not exhaustive. It includes only a partial listing of the bargaining issues that may arise between the three main actors in our model--farmer-members, management, and the board of directors. Broadening the list of participants to include all those shown in Table 3.1 would greatly expand the compilation. For example, lenders such as the Bank for Cooperatives may prefer a certain mix of debt and equity financing that differs from that preferred by management and the farmer-members of the cooperative, and thus bargaining between the lenders and the co-op's management might arise over the conditions under which loans should be extended to the organization.

The bargaining issues shown in Table 5.1 are grouped into four categories, three directly affecting the pecuniary returns farmer-members receive from the organization (allocation of revenues and pricing of services, joint cost allocation, and financing of the cooperative) and one (constitutional issues) influencing the distribution of power and decision-making authority within the cooperative. Each individual bargaining issue can be viewed as an n-person cooperative game involving the disputants listed in the table. For example, the pricing of goods and services to members (item 1(c) in the table) can be conceived of as a

TABLE 5.1

POTENTIAL BARGAINING SITUATIONS IN FARMER COOPERATIVES AND THE DISPUTANTS INVOLVED

Bargaining Issue	Parties Involved	Parties' Preferences
1. <u>Allocation of Revenues and Pricing of Services</u>		
a. Allocation of Pool Revenues	a. Producers of commodities participating in the pool	a. Producers of each commodity seek an allocation rule that will increase their relative share of the pool's returns.
b1. Design of Pools (profit centers)	b1. Producers of all products in the cooperative	b1. Each producer or producer group has an incentive to have its product be the least profitable one in the pool, or equivalently, to exclude less profitable products from its pool.
b2. Design of Pools (profit centers)	b2. i. Producers of highly profitable items ii. Management (and possibly the board)	b2. i. Seek separate (narrow) pools for their products to avoid cross-subsidizing less-profitable products. ii. Seek broad pools to allow managerial flexibility in pricing.
c. Pricing of Goods and Services to Members	c. i. Members whose per-unit cost of service is low (e.g., large farmers)	c. i. Prefer differential pricing of services to membership based on cost of service.

TABLE 5.1 (cont'd.)

Bargaining Issue	Parties Involved	Parties' Preferences
d. Netting ^a	c. ii. Members whose per-unit cost of service is high (e.g., small farmers) d. i. Participants in highly profitable co-op activities ii. Participants in unprofitable co-op activities. iii. Management	c. ii. Prefer uniform pricing of services to members. d. i. Oppose netting with less profitable activities. ii. Favor netting with more profitable activities. iii. Favor netting to reduce the cooperative's tax burden.
2. <u>Joint Cost Allocation</u>		
a. Classification of Costs as Joint or Attributable	a. i. Farmer members ii. Management	a. i. Each farmer member has an incentive to have as many of the costs of his own activities as possible classified as joint and as few of those of others as possible classified as joint. ii. May prefer classifying a large percentage of costs as joint to reduce accounting costs and increase pricing flexibility.

TABLE 5.1 (cont'd.)

Bargaining Issue	Parties Involved		Parties' Preferences
b. Allocation of Joint Costs	b. i.	Producers of high-value products or users of high-value services	b. i. Prefer a joint cost allocation rule with a basis other than value of product or service (e.g., a rule based on the physical volume of product handled).
	ii.	Producers of low-value products or users of low-value services	ii. Prefer a joint cost allocation rule based on value of product or service (e.g., dollar volume of product handled).
	iii.	Management	iii. May prefer to allocate a high proportion of joint costs to unprofitable products or services in order to discourage their production or use.
	iv.	Board of Directors	iv. May prefer to allocate a low proportion of joint costs to unprofitable products or services in order to "help out" and maintain political support from patrons producing those products or using those services. ^b

TABLE 5.1 (cont'd.)

Bargaining Issue	Parties Involved		Parties' Preferences
3. <u>Financing the Cooperative</u>			
a. Favorable Current Member Prices vs. Equity Retention	a. i. Current members, especially those nearing retirement	a. i.	Prefer favorable current prices (e.g., high "cash payout") over equity retention by cooperative to finance growth. ^c
	ii. Management and possibly the board	ii.	Favor equity retention (e.g., issuing a high proportion of the patronage refund in the form of stock) in order to promote the cooperative's growth.
b. Cash Patronage Refund vs. Equity Retirement (for a given level of firm growth) ^d	b. i. Younger, "underinvested" farmers	b. i.	Prefer high percentage of patronage refund paid as cash at the expense of slower equity retirement.
	ii. Older, "overinvested" farmers	ii.	Prefer low percentage of patronage refund paid as cash and faster equity retirement.
c. Dividend Rate Paid on Member Capital	c. i. Younger, "underinvested" farmers	c. i.	Prefer low dividend rate.
	ii. Older, "overinvested" farmers	ii.	Prefer high dividend rate.

TABLE 5.1 (cont'd.)

Bargaining Issue	Parties Involved		Parties' Preferences
d. Choice of Equity Financing Mechanism	d. i.	Patrons using services that are not capital-intensive	d. i. Prefer equity financing mechanism based on assets employed. ^e
	ii.	Patrons using capital-intensive services	ii. Prefer equity financing mechanism based on physical volume produced or handled (e.g., per-unit retains).
	iii.	Management	iii. May prefer less complicated equity finance mechanisms (e.g., per-unit retains) due to their lower cost of administration.
4. <u>Constitutional Issues</u>			
a. Voting	a. i.	Small-volume patrons	a. i. Favor one-member, one-vote.
	ii.	Large-volume patrons	ii. Favor voting based on patronage.
b. Centralized vs. Federated Structure	b. i.	Small-volume patrons	b. i. May prefer federated structure due to greater potential for grass-roots involvement. ^f

TABLE 5.1 (cont'd.)

Bargaining Issue	Parties Involved	Parties' Preferences
c. Other Institutional Issues Such as the Rules of Representation and the Allocation of Responsibility Between the Board and Management.	ii. High-volume patrons	ii. May prefer centralized structure due to its possibly greater ability to capture economies of size.
	iii. Management	iii. May prefer centralized structure due to its possibly lower internal decision-making costs and its greater potential for managerial advancement.
	iv. Potential board members	iv. Prefer federated structure due to greater opportunities for member involvement.
	c. All participants in the cooperative	c. Each group seeks arrangements that increase its relative influence in the organization.

^aNetting refers to the pooling of net returns from different accounting activities in a cooperative prior to the calculation and distribution of patronage refunds. See appendix A.

^bThe board's preference on this issue depends on whom the board members perceive to be their clientele. See text for details.

TABLE 5.1 (cont'd.)

^cOlder members might prefer a high level of equity retention if the retained funds were used to speed up the rate of equity retirement. See item 3(b).

^dIf retained earnings were used primarily to finance growth of the firm rather than retire member equities, overinvested members might prefer a high level of cash payout. See item 3(a).

^eFor an example of an asset-based equity financing arrangement see the description of CF Industries' modified base-capital plan in Cobia, et al., pp. 190-94.

^fNote that this conclusion assumes that farmer-members do derive nonpecuniary benefits from participating in cooperatives and that these benefits are relatively more important for low-patronage members than for high-patronage members.

bargaining game between two groups of members: those whom the cooperative can serve at relatively low per-unit costs or who have attractive market alternatives outside of the cooperative (for example, large farmers) and those whom it is more costly to serve or who have few attractive noncooperative alternatives (for example, small farmers). The low-cost patrons argue for differential pricing of goods and services based on the cost of service or on "meeting the competition," while the higher-cost patrons argue for uniform pricing.

Similarly, the issue of whether to devote more of the cooperative's cash flow to paying a high cash patronage refund at the expense of equity retirement (item 3(b) in the table) can be viewed as a bargaining game between younger, "underinvested" members interested in maximizing their current cash flow from the cooperative and older, "overinvested" members interested in getting back some of their accumulated investment in the cooperative.¹

Not all bargaining situations involve just farmer-members. For instance, the issue of what proportion of the cooperative's net earnings should be retained rather than rebated to members can be viewed as a bargaining game involving management and possibly the board on the one hand and farmer-members on the other. Management, and perhaps the board, interested in promoting growth of the cooperative, lobby for a high level of retained earnings to finance that growth, while farmer-members,

¹Royer (1982b) has documented the nature of the trade-off that exists in a cooperative between devoting cash flow to paying high cash patronage refunds and using it to retire member equities. This trade-off exists for a given level of firm growth. If retained earnings are used primarily to finance firm growth rather than to retire member equities, however, overinvested members may prefer a high level of cash patronage refund (see below).

particularly those nearing retirement and having only a limited ability to redeem their equity in the cooperative, argue that net earnings should be rebated to the members as cash.¹ Murray (1983a, 1983b, 1983c) examined this bargaining issue in detail in the context of British cooperatives, although not from a game-theoretic perspective. He argued that because the interests of both management and the board are generally strongly correlated with growth of the cooperative, these actors will push for the establishment of automatic capital accumulation mechanisms in the cooperative (such as per-unit retains and the creation of for-profit subsidiaries) to foster growth. They will also favor accumulation via unallocated reserves, which provide the cooperative with a permanent capital base that need not be returned to the members via equity retirement programs. Farmer-members, who have incentives to underfinance the cooperative for the reasons outlined in chapter 2, will resist such moves by management and the board, leading to conflict within the organization.

The constitutional issues listed in the table can be viewed as bargaining games that occur among various co-op participants at the time of the writing of the cooperative's bylaws. In deciding how to vote on constitutional issues the various participants have to project how their net

¹This particular "game" appeared prevalent among the cooperatives whose officials were interviewed by the author. As discussed above, if retained earnings are used to retire member equities rather than to finance growth of the co-op, older members may prefer a high level of retained earnings.

returns from the cooperative will be affected by the cooperative's adoption of different organizational structures.¹

Representing the Gains from Joint Action: The Characteristic Function

A basic assumption underlying the analysis in this chapter is that farmers engage in collective action via cooperatives because there are efficiencies in certain joint, as opposed to individual, actions. These efficiencies are represented in game-theoretic terms by a superadditive characteristic function. As discussed in more detail in appendix C, a characteristic function shows the minimum level of payoffs that any potential coalition of players can guarantee itself. Superadditivity of the characteristic function means that a single coalition of all the players ("the grand coalition") can always guarantee itself a higher level of payoff than can two or more disjoint subcoalitions which in total involve all the players. Mathematically, superadditivity of the characteristic function is expressed as follows:²

¹The best-known application of game theory to analyzing the choice of constitutional issues is Buchanan and Tullock's The Calculus of Consent, especially chapters 11 and 12. There is a fundamental difference, however, between the type of game analyzed by Buchanan and Tullock and those discussed here. Buchanan and Tullock analyzed constitutional choice in a democratic entity from which exit was essentially impossible; therefore, the criterion for group choice in their model was majority rule. Exit is possible from farmer cooperatives, however; farmer-members who strongly disagree with some collective action taken by the organization (for example, its pricing practices) are free to leave the organization. The criterion for group choice in these games, like that in all "classical" bargaining games (Roth), is therefore unanimity; if all members of a potential coalition are not at least as well off as they could be in some other arrangement, the coalition will not form. (See the discussion of solution concepts in appendix C.)

²See table C.1 in appendix C for an explanation of the set-theoretic notation used below.

For any two disjoint sets K and L in the set N ($K, L \subseteq N, K \cap L = \emptyset$), the characteristic function V is superadditive if

$$(5.2) \quad V(K) + V(L) \leq V(K \cup L),$$

that is, if the sum of the characteristic functions of K and L is a proper subset of the characteristic function of their union. This means that K and L can always gain at least as much in total by working together as they can by working separately. This does not, however, mean that K and L will work together. For joint action to occur not only must the total payoff to K and L be greater than the sum of the payoffs that would result from their individual actions, but both K 's and L 's individual shares of the joint "pie" must be greater than the payoffs each could achieve by acting independently (see the discussion of the core in appendix C).

In applying game theory to farmer cooperatives we can often equate superadditivity of the characteristic function with subadditivity of the cost function. In the context of farmer cooperatives, subadditivity of a cost function means that it is cheaper to provide some service to the members of a cooperative as whole than to provide it to them individually or in subgroups. Subadditivity of a cost function is expressed mathematically as follows:

For any $K, L \subseteq N, K \cap L = \emptyset$, the cost function is subadditive if

$$(5.3) \quad C(q^K) + C(q^L) \geq C(q^K + q^L)$$

where

$C(q)$ is the cost of producing quantity q of the service;

q^K is the quantity of the service demanded by K ; and

q^L is the quantity of the service demanded by L .

Equation (5.3) simply states that it is cheaper to provide the service to K and L jointly than to provide it to each of them individually. As above, whether the service actually is provided jointly depends on how K's and L's individual shares of the joint cost compare with what each would have to pay by acting individually.

For reasons that will become apparent below it is important to distinguish between a subadditive cost function and economies of scale. Economies of scale exist when the cost function is homogeneous of degree less than one, that is, when average cost declines monotonically throughout the range of production. The existence of economies of scale (declining average cost) is neither a necessary nor a sufficient condition for a cost function to be subadditive. In particular, a subadditive cost function can exhibit increasing average cost over a certain range of output. It is subadditivity of the cost function rather than economies of scale that makes joint provision of a service to a group more economical than providing the service to individual subunits of the group.¹

Subadditive Cost Functions and Cross-Subsidies

Faulhaber has used the concept of a subadditive cost function to define cross-subsidies in the context of the pricing of services from a public utility; a similar approach can be used to define cross-subsidies in multiproduct or multiservice farmer cooperatives. Faulhaber examined a situation in which the cost function for providing water services to a

¹For a detailed discussion of the relationship between subadditivity of a cost function and economies of scale see Baumol, Panzar, and Willig, chapter 7.

dispersed group of consumers was subadditive; it was always cheaper in terms of total cost to provide water to the consumers via a single large system than through a number of smaller systems. The question facing the administrator of the system was that of determining what price each consumer should be charged for water.

Faulhaber defined a set of prices as subsidy-free if they provided no consumer or group of consumers an incentive to "go it alone," that is, break away from the joint water system and establish its own system. In other words, prices were subsidy-free so long as for any subset $S \subseteq N$,

$$(5.4) \quad A(q^S) \leq C(q^S)$$

where

$A(q^S)$ is the price (cost allocation) charged S for its quantity q^S of water.

Cross-subsidies exist, according to Faulhaber, when a group of consumers are charged more for some jointly-provided service than it would cost the group to obtain that service independently.

If a firm, such as a cooperative, is constrained to break even, expression (5.4) implies that for prices to be subsidy-free:

$$(5.5) \quad A(q^S) \geq C(q^n) - C(q^{n-S}) \quad \forall S \subseteq N,$$

that is, the price (cost allocation) charged to any subset S in N must at least cover the incremental cost of providing the good or service to S .

According to this definition, cross-subsidies exist in a cooperative only if the users of a particular service pay more for it than their cost of providing the service to themselves through some alternative arrangement, such as their own independent cooperative. This notion of cross-subsidy differs from common usage, which tends to equate cross-subsidies

with the failure of goods or services to pay their "full pro-rata share of overhead costs." The problem with this latter definition is that there is no nonarbitrary way to determine the appropriate full pro-rata share of overhead costs that each good or service should bear (Clark; see also chapter 7); the definition is therefore nonoperational.

The alternative definition adopted here, however, would seem to imply that cross-subsidies would never persist because a nonsubsidy-free set of prices, by definition, lies outside the core of the bargaining game--the users of the "subsidizing" services can always do better by leaving the cooperative and providing the service themselves, either alone or with other disaffected members. This conclusion depends, however, on two assumptions. The first is perfect knowledge; given imperfect knowledge, members may be unaware of the costs of providing different services to themselves and therefore accept a noncore set of prices. Information costs thus play a key role in the stability of cooperatives' pricing and cost-allocation arrangements (see chapter 6). Second, the argument assumes that members evaluate the price of each cooperative service separately rather than as a bundle; this would occur if each member used only a single service (tomato growers used only tomato-processing services, peach growers used only peach-processing services, and so on) or if members were free to act as "cherry pickers," selecting the best deals available from the cooperative (presumably the subsidized services) and buying other services elsewhere. If, in contrast, members are each constrained to obtain an entire bundle of services from the cooperative (inputs, marketing services, and so on)¹ cross-subsidies in the prices of

¹This is common in many cooperatives in developing countries.

the individual items in the bundles may persist so long as the prices of the different bundles remain subsidy-free.¹

Examples of Cooperative Games

Two examples will illustrate how the theory of cooperative games can illuminate some of the trade-offs facing participants making decisions in farmer cooperatives. The first example, which relies on the core as a solution concept (see appendix C), examines cost allocation (pricing of services) in a farmer cooperative serving a heterogeneous membership and draws on the general analytic approach outlined by Faulhaber. The second example, which is based on the Nash-Zeuthen bargaining model discussed in appendix C, examines the decision regarding how much of the cooperative's net earnings should be retained and how much should be distributed to the members as cash.

Cost Allocation Among a Heterogeneous Membership

The Example

Consider a cooperative that provides a service to a heterogeneous set of members $N = \{1, 2, \dots, n\}$. For example, the members may differ in the crops they grow, their sizes of operations, or their time preference for money. Assume:

- (1) There are economies in the joint provision of the service to the membership, i.e., the cost function for producing the service is subadditive: for any disjoint subsets S and T in the

¹If members are each required to purchase a bundle of services from the cooperative, the prices of the bundles rather than the prices of the individual items in the bundles become the payoff vectors facing the players in the game.

set N ($S, T \subseteq N, S \cap T = \emptyset$):

$C(q^{S+T}) \leq C(q^S) + C(q^T)$, where $C(q^i)$ is the cost of providing the quantity of services q^i to group i . For example, $C(q^S)$ is the total cost S would incur providing q^S of the service to itself; $C(q^{S+T})$ is the total cost at which S and T could jointly provide $(q^S + q^T)$ of the service.

- (2) Farmers in group i have only the option of purchasing q^i from the cooperative or exiting the cooperative to obtain q^i in another way, either from an IOF or by forming another cooperative by themselves or with other disaffected members. (Allowing each group to vary its patronage with the cooperative would expand the number of strategies open to each player but would not change the basic results of the game-theoretic analysis.)
- (3) For $S, T \subseteq N, S \cap T = \emptyset$, the cross-elasticity of demand between q^S and q^T is zero.

The cost function for providing the service to each possible coalition in N , combined with the prices at which the service can be obtained outside the cooperative, can be used to define a characteristic function, $v(q^S)$, which shows the minimum payoff (i.e., the minimum cost of obtaining q^S) that each group S contained in N can guarantee itself, either by acting alone or by forming coalitions with other groups within or outside the cooperative.¹

¹ Payoffs are usually pictured in game-theoretic models as payments to players, while here they are payments by players. Formally, the correspondence to standard theory can be made by changing signs (i.e., payoffs become negative revenues) and thereby reversing the direction of all inequalities.

The board and management of the cooperative must decide how to allocate the cost of producing the services among the membership. Subadditivity of the cost function implies joint costs, and hence any allocation will be in some sense arbitrary (Clark). This does not mean, however, that management can allocate costs in any way it chooses; it must take into account the effect of its allocations on members' incentives to remain in the organization. If the cost allocated to group S , $A(q^S)$, is greater than $v(q^S)$, the minimum cost that S can guarantee itself, then S has an incentive to leave the cooperative. Hence, for a cost allocation to be stable (not induce defection), the following condition must be met:

$$(5.6) \quad A(q^S) \leq v(q^S) \quad \forall S \subseteq N.$$

If, in addition, the cooperative is constrained to break even, returning any surplus above cost to members,¹ the following condition must also be met:

$$(5.7) \quad \sum_{S \in N} A(q^S) = C(q^N).$$

Expressions (5.6) and (5.7) together define the core of the game, the set of feasible allocations that give all participants an incentive to remain within the organization.²

More than one set of cost allocations may lie within the core, and bargaining occurs within the cooperative over which set of cost

¹In farmer cooperatives the entire surplus above cost is not returned to the members as cash; some is kept as operating reserves. The decision on how much of the surplus to pay out as cash is itself a bargaining issue that is analyzed below using a game-theoretic model.

²Expressions (5.6) and (5.7) are called the "core constraints." To lie within the core an imputation must satisfy these expressions. See the discussion of solution concepts in appendix C for an analysis of how the core constraints change as the number of players increase.

allocations should be imposed. In reality, the characteristic function, $v(q^S)$, which embodies both the cooperative's cost function and the players' external market opportunities, is likely to be known only very imprecisely, so the bargaining will take place in an atmosphere of uncertainty. Co-op members may sometimes try to influence the cost allocation decisions of the board and management by issuing implicit threats and counterthreats, as each group tries to obtain the best possible allocation for itself while at the same time ensuring that other members still have an incentive to remain in the cooperative.

The ability of a member or group of members¹ to obtain concessions from other members of the cooperative depends on two factors: the costs the member could impose on other members if he were to exit the cooperative (this determines his bargaining threat to others in the organization) and the other players' perception of the costs he would impose on himself if he were to leave (this determines how seriously his threat is taken).

The potential harm, h_o , member S can impose on others in the cooperative can be measured by how much the remaining members' cost of obtaining the cooperatively produced service would increase if S were to leave the organization:

$$(5.8) \quad h_o = [C(q^{n-s})/q^{n-s} - C(q^n)/q^n] q^{n-s}.$$

With S in the organization, the remaining $n-s$ members can hope to obtain their q^{n-s} units of service at a unit cost of $C(q^n)/q^n$, the average cost of production for the grand coalition. (As will become apparent below,

¹In the following paragraphs the term "member" should be interpreted as signifying either a single member or a group of members acting as a coalition.

this hope is not always realized even if the grand coalition does form.) This unit cost would rise to $C(q^{n-s})/q^{n-s}$ if S were to leave the organization.

Similarly, the harm S would impose on himself by exiting, h_s , can be measured by how S 's cost of obtaining the service would increase if he left the organization:

$$(5.9) \quad h_s = v(q^s) - [C(q^n)/q^n] q^s.$$

Equation (5.8) states that, ceteris paribus, the more strongly subadditive the cooperative's cost function is with respect to a member's output, the stronger that member's bargaining position. Large members in co-ops with strongly subadditive cost functions would have substantial bargaining power; small members in co-ops with constant costs would have practically none.¹ This suggests that cooperatives comprised of a few large members may face more disruptive, threat-filled bargaining over allocation of costs and benefits than cooperatives with many small members. Co-ops with a few large members face an allocation problem similar to the problem of allocating costs and benefits in a cartel (Kuhn).

Equation (5.9) suggests that a member's threat of exit will be taken more seriously the smaller the perceived cost to him of leaving the cooperative. For example, a member's ability to extract concessions from his

¹This conclusion is strengthened even further if the assumption that all farmers are risk-neutral is replaced by the assumption that small farmers are more risk averse than large farmers. If large farmers are less risk averse, they would be more willing to gamble in the bargaining process than would small farmers and would therefore drive a harder bargain, particularly if (as game-theory assumes) the larger farmers were aware of the small farmers' risk preferences (see Harsanyi).

cooperative would be lower if he faced stiff penalties for defection (e.g., forfeiture of accrued retains) than if he did not.

In the bargaining process a member may argue that he should bear only the incremental cost of providing services to him, i.e., for $S \subseteq N$,

$$(5.10) \quad A(q^S) = C(q^N) - C(q^{N-S}) \quad \forall S \subseteq N.$$

Paying according to incremental costs may appear fair and is the rule that would result from a linear programming approach to pricing co-op services (see Hardie). Unfortunately, such an allocation scheme may not always be stable, as illustrated below.

Assume that the cooperative is comprised of four groups of members, B, S, G, and P. For example, the cooperative might provide processing and marketing services to producers of Beans, Spinach, Grapes, and Peaches. Assume that the cooperative has the following subadditive cost function (zeros can be added to the figures to lend more realism):

$$(5.11) \quad C(q^B) = C(q^S) = C(q^G) = C(q^P) = \$300$$

$$(5.12) \quad C(q^{B+S}) = C(q^{G+P}) = \$410$$

$$(5.13) \quad C(q^{B+G}) = C(q^{B+P}) = C(q^{S+G}) = C(q^{S+P}) = \$500$$

$$(5.14) \quad C(q^{B+S+G}) = \$600$$

$$(5.15) \quad C(q^{B+S+P}) = C(q^{B+G+P}) = C(q^{S+G+P}) = \$650$$

$$(5.16) \quad C(q^{B+S+G+P}) = \$810.$$

A cost function like this might arise in the following way. If each group of producers built its own processing plant, each could process its product at a cost of \$300. If the vegetable growers (B and S) jointly processed their products they could do so at a total cost of \$410, as could the fruit growers (G and P) if they processed jointly. There would

also be some savings if one group of vegetable growers (for example, B) combined with one group of fruit growers (for example, G) for joint processing. Their total cost of production, \$500, would be higher than that of the joint fruit or the joint vegetable operations, however, due to their inability to share certain costs that are joint in those operations (for example, the cost of syrup in an integrated fruit canning operation). Assume that if three products are processed jointly, the cooperative has to expand its warehouse. Suppose that this can be done on land immediately behind the current plant that would otherwise be used for burying or burning peach pits. If peaches are not processed by the cooperative, this poses no problem, and the combined cost of processing and marketing beans, spinach, and grapes becomes \$600. If, however, peaches are processed, the pits have to be hauled away, raising the price of processing any three-product combination including peaches to \$650. Finally, assume that even with hauling away the peach pits, all four products can be jointly processed in a single plant for \$810.

Because of the subadditivity of the cost function there are potential joint benefits from processing all four products in a single plant. The board and management are faced with determining a set of cost allocations, $A(q^1)$, that will cover the \$810 total cost of producing the service for all the members while still giving all members an incentive to remain in the organization. Note that charging all members the same cost for the service is infeasible; if each were charged the average cost of \$202.50, B, S, and G would have an incentive to form their own cooperative and produce the service for a total cost of \$600, or an average cost of \$200. Some sort of differential pricing is required to

hold the coalition together, in which P is forced to pay more than the average cost and B, S, and G pay less.¹

Will pricing according to incremental cost work? The incremental-cost pricing rule (5.10) and the break-even constraint (5.7) imply that:

$$(5.17) \quad A(q^b) + A(q^s) + A(q^g) + A(q^p) = \$810$$

$$(5.18) \quad A(q^i) \geq \$110 \quad \forall i$$

$$(5.19) \quad A(q^b) + A(q^s) \geq \$300$$

$$(5.20) \quad A(q^g) + A(q^p) \geq \$350.$$

Applying the incremental-cost rule $A(q^i) \geq \$110$ may not lead to a stable coalition. For example, the allocations $A(q^b) = A(q^s) = \$120$ and $A(q^g) = A(q^p) = \$285$ satisfy both (5.17) and (5.18), yet under this set of allocations G and P have a clear incentive to break away from the cooperative, since they could jointly produce the service for \$410, an average cost to them of \$205. The existence of costs that are joint among a proper subset of players (rather than being purely attributable or joint among all players) implies the need to test whether that subset, as well as the individual players, are paying their full incremental cost (Faulhaber).

In certain instances where the average cost of producing the service first decreases and then rises, there may be no stable allocation

¹ Here is where the distinction made earlier between economies of scale and a subadditive cost function becomes important. Because the cost function is subadditive, it is cheaper to process all four products in a single plant, but because the average cost of processing does not decline monotonically throughout the range of production, farmer-members cannot simply be charged the firm's average cost.

of costs (the core may be empty). For example, if equations (5.14) and (5.15) are replaced with

$$(5.14a) \quad C(q^{b+s+g}) = C(q^{b+s+p}) = C(q^{b+g+p}) = C(q^{s+g+p}) = \$600$$

(that is, if peach pits can be disposed of costlessly in the three-product plant), then the binding core constraints become:

$$(5.21) \quad A(q^b) + A(q^s) + A(q^g) \leq \$600$$

$$(5.22) \quad A(q^b) + A(q^s) + A(q^p) \leq \$600$$

$$(5.23) \quad A(q^b) + A(q^g) + A(q^p) \leq \$600$$

$$(5.24) \quad A(q^s) + A(q^g) + A(q^p) \leq \$600$$

and

$$(5.17) \quad A(q^b) + A(q^s) + A(q^g) + A(q^p) = \$810.$$

Adding (5.21) through (5.24) yields

$$3[A(q^b) + A(q^s) + A(q^g) + A(q^p)] \leq \$2,400,$$

or

$$(5.25) \quad A(q^b) + A(q^s) + A(q^g) + A(q^p) \leq \$800$$

which contradicts (5.17). Hence, even though there are economies in the joint provision of the service to all the participants, given this cost function the core constraints are such that there is no possible cost allocation that does not give someone the incentive to leave the cooperative.

Discussion

The simple game-theoretical model presented above illustrates the following points:

- (1) In certain circumstances differential pricing of services to members is necessary to preserve the stability of the cooperative. The differential pricing must reflect both how a member's patronage affects the cooperative's cost function (this is just an extension of the service at cost principle) and the member's strategic opportunities for obtaining the service outside the cooperative.¹ This suggests that large members in cooperatives with strongly subadditive cost functions may be particularly successful in extracting price concessions from the cooperative. Small members may oppose granting price concessions to larger members, however, for fear that the concessions will simply reinforce the competitive advantages of larger operations. In addition, income-tax provisions (for example, Section 521) may limit the degree to which cooperatives can price discriminate among their members.
- (2) Even if a cooperative does decide to price discriminate, if there are costs that are joint among a proper subset of members, the cooperative cannot simply adopt an incremental-cost rule for setting prices, as this can give some members incentives to leave the organization. Setting cost allocations can thus be a complex process, and it is problematic whether a feasible allocation could be determined on a simple one-member, one-vote basis.

¹In the above example, external market opportunities were not analyzed; the cooperative's cost function alone defined the characteristic function. Including external market opportunities in the analysis would have shrunk the core (reduced the scope for agreement within the cooperative).

(3) Although differential pricing of services to members may be necessary to preserve the stability of cooperatives that have highly heterogeneous memberships, instituting such pricing usually requires a vote of the board, which, if elected on a one-member, one-vote basis, may be controlled by smaller-volume patrons. If small patrons steadfastly oppose differential pricing, large members may exit the cooperative unless voting rules are changed to increase the political power of the larger patrons. Caves and Petersen (appendix A, p. 1) report some evidence that such a reallocation of political power has occurred in cooperatives with heterogeneous memberships, noting that the one-member, one-vote rule prevails in only 71 percent of large, predominantly federated cooperatives (whose members are likely to be diverse) compared with 92 percent of local cooperatives.¹

(4) In situations where a cooperative's average cost of providing a joint service first decreases then increases, there may be no allocation of costs that gives everyone an incentive to stay in the organization. This suggests that cooperatives need to be very careful in deciding when to expand their membership

¹Caves and Petersen explain this finding as follows. "We expect one-member, one-vote to prevail among relatively homogeneous and geographically centralized cooperatives, activity-weighted voting where members are more disparate economically, far-flung geographically, or enjoy better alternatives to the cooperative organization in question. These predictions are based on the expectation that members doing more business with the cooperative face absolutely larger (opportunity) losses when decisions are made contrary to their interest, but that lobbying and/or (implicit) side-payments to internalize such externalities are easier when members enjoy extensive interpersonal contact within a local community" (appendix A, p. 1).

and/or their activities, expanding only when there are clear synergisms that allow the organization to hold down its average costs. The impossibility of finding a stable allocation of costs among a heterogeneous membership may prevent cooperatives from "doing all things for all people."

- (5) If the core of the game is not empty, there may be more than one feasible allocation of costs, and the management and the board must somehow choose a fair allocation. The model presented above simply states that the final allocation must lie within the core; it does not specify where within the core the optimal allocation lies. Game theorists, however, have proposed several alternative solution concepts, each embodying a different concept of fairness (see appendix C). For instance, the Shapley-value approach, which allocates to each coalition its "average marginal cost" (see appendix C) would, in the above example, lead to the following cost allocation:

$$\begin{aligned} A(q^b) &= A(q^S) = A(q^G) = \$198.33, \text{ and} \\ A(q^P) &= \$215.00. \end{aligned}$$

Examination of these solution concepts may be useful in helping to determine equitable cost allocations.

- (6) Failure to choose an allocation that lies within the core can lead members simply to exit the cooperative. Game-theoretic analysis could help management predict which allocations would induce defection and which would not. In determining the cost functions facing cooperative participants (which in turn largely determine their characteristic functions), economic engineering approaches may be particularly useful (see French).

- (7) The model suggests that if dissatisfied members do not simply leave the cooperative, bargaining over allocations of costs and benefits can be intense and bruising. Reality, however, may not be so harsh. Participants are likely to know only very imprecisely the costs (payoffs) of the alternatives open to them, and the board and management may be able to influence their estimates of those costs (e.g., through member relations programs). In this sense, uncertainty about what is in one's best interest may reduce conflict in the cooperative. To the extent that members receive nonpecuniary benefits from remaining in the cooperative, bargaining over the allocation of monetary benefits and costs in the organization may also be muted. These possibilities are examined in chapter 6.
- (8) Another important way in which management and the board can facilitate agreement on allocation of costs and benefits is through devising ways to convert apparent zero-sum games among the membership into nonzero-sum games, thus expanding the potential core of the game. For example, allocation of receipts from a marketing pool among producers of different commodities (say, X, Y, and Z) may appear to be a zero-sum game if viewed in the context of a single year; whatever is gained by producers of X is lost to the producers of Y and Z. If, however, the producers can be convinced to take a multiyear perspective, the game becomes nonzero-sum. Allocating excessive returns to X may lead (via the supply response for X) to excessive inventories of X in coming years, reducing the net returns available for distribution among all producers in subsequent years. A

more "balanced" allocation in the current year may lead to improved profit possibilities for all producers in subsequent years, implying joint gains from a coordinated allocation strategy. Documenting the possible consequences of adopting extreme bargaining positions may be an important way in which management can facilitate agreement. Another way of converting zero-sum games to nonzero-sum games is by "logrolling"--tying the negotiation of one issue to another, so that the scope for tradeoffs, given divergent member preferences, is expanded (Raiffa; Buchanan and Tullock, chapters 10-11).

Bargaining Over the Cash Payout

A common problem faced by cooperatives is determining what proportion of net earnings to retain in order to finance the growth and operations of the organization and what proportion to rebate to the members as cash. Cooperative participants often refer to this problem as "determining the level of the cash payout." Given the assumptions outlined above, one would expect management to favor a low cash payout and farmer-members, particularly those nearing retirement, to favor a high one. This section outlines a simplified model of the bargaining between management and the farmer-members over the level of the cash payout, based on the Nash-Zeuthen model of bargaining (see Harsanyi and appendix C).¹

¹As discussed in appendix C, the Nash-Zeuthen theory of bargaining, unlike the theory of the core, predicts a unique bargaining outcome, not simply that the outcome will lie somewhere within the core. In particular, Nash and Zeuthen argued that the outcome that emerges from a two-person bargaining game is one which maximizes the product of the two parties' utilities above that which the players could obtain by acting independently (see appendix C for details).

An example of the trade-off between the cash payout and the rate of growth of retained equity is illustrated in Figure 5.1.¹ In this particular example, if the cooperative were content to have no growth in equity it could pay 43 percent of its patronage refund in cash; if, on the other hand, it paid its patronage refund entirely in stock it could grow at slightly over 16 percent per year. In the U.S., however, farmer cooperatives are legally obligated to pay a minimum of 20 percent of their "qualified" patronage refunds in cash (see appendix A); hence the "bargaining frontier" along which the management and members negotiate the level of the cash payout is the line segment AD in Figure 5.1 rather than the longer segment AB. The model presented in this section outlines the factors that determine which combination of cash payout and retained earnings along the segment AD will emerge as the bargained outcome.

The Nash-Zeuthen theory of bargaining assumes that in a bargaining situation such as the one portrayed here each player i develops his bargaining strategy by comparing three levels of utility: that he would obtain from his most preferred outcome, A_i ; that he would obtain if his opponent's most preferred outcome, A_j , were the result of the bargaining process; and that he would obtain if no agreement could be reached and open conflict, C , between the parties broke out. In the above example C is taken as representing a situation where, because of the lack of an agreement, the manager leaves (or is fired from) the cooperative.

¹For details see Cobia et al., chapter 5. Figure 5.1 assumes that the length of the cooperative's revolving fund is fixed at seven years. In reality, the length of the revolving period might simultaneously be a bargaining issue, leading to a game more complicated than that portrayed here, involving three groups: those favoring rapid growth of the cooperative, those favoring a high cash payout, and those favoring speedier redemption of member equities.

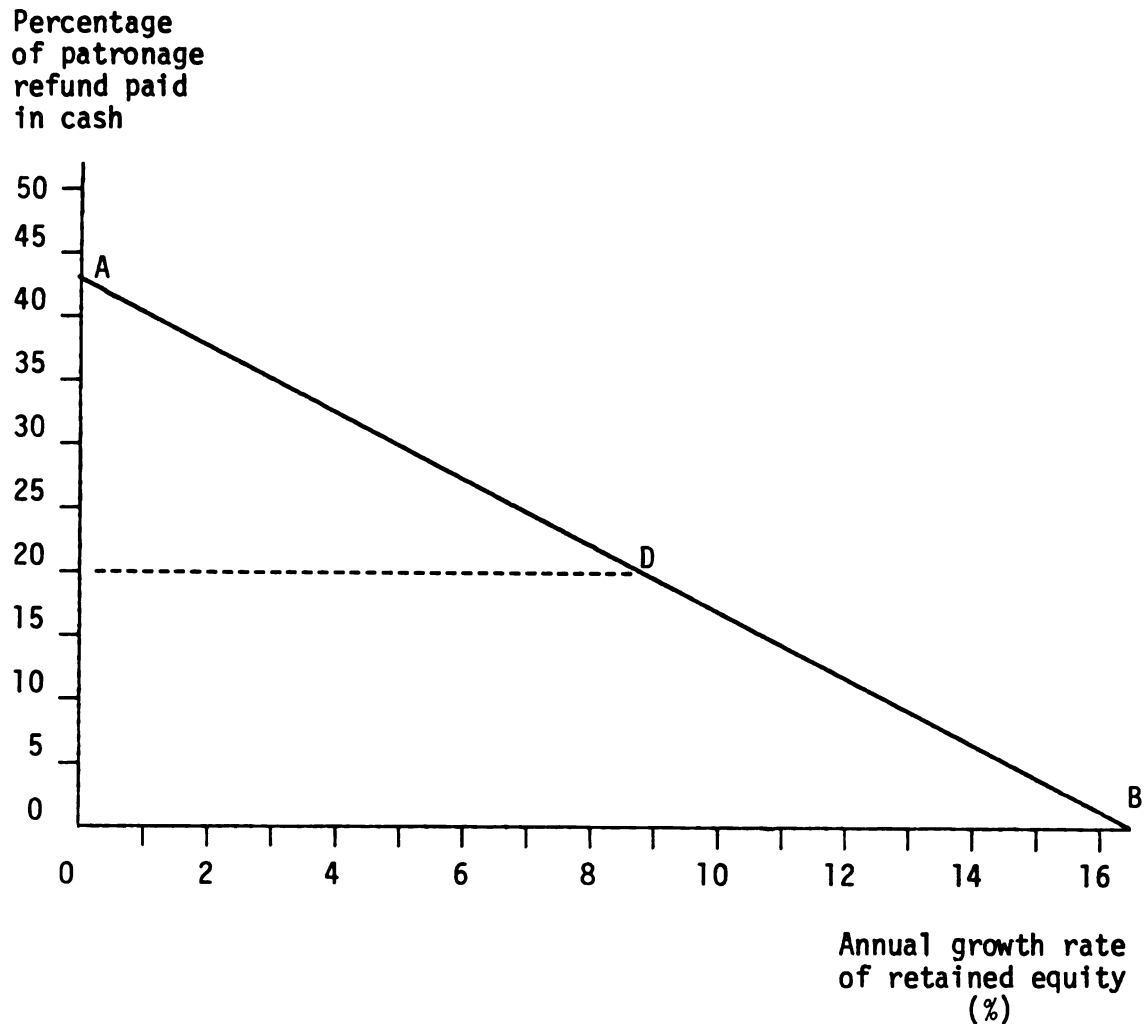


Figure 5.1 Trade-off between Growth Rate of Retained Equity and Percentage of Patronage Refund Paid in Cash

SOURCE: Calculated using the following formula from Cobia et al., p. 220:

$$c = 1 - 1/rt \quad \text{if } g = 0$$

$$= 1 - g/(1-(1+g)^{-t})r \quad \text{if } g > 0$$

where: c = percentage of patronage refund paid in cash;
 r = rate of return on retained equities;
 t = length of the revolving period (in years); and
 g = rate of growth in allocated equity.

This graph is drawn assuming $r = .25$ and $t = 7$.

Let $U_1(A_1)$ represent the net gain in utility above the conflict situation that player 1 would receive if he succeeded in obtaining his most preferred outcome, A_1 ; similarly, let $U_1(A_2)$ represent player 1's net gain in utility over the conflict situation if his opponent's most preferred outcome, A_2 , prevailed. $U_2(A_1)$ and $U_2(A_2)$ are defined analogously for player 2.

According to the Nash-Zeuthen theory of bargaining, in deciding whether to accept his opponent's offer of A_2 or continue to press for A_1 , player 1 reasons as follows. If the probability that player 2 will reject A_1 is p_2 , then player 1 can obtain $U_1(A_2)$ with certainty, $U_1(A_1)$ with probability $1-p_2$, and no net gain in utility (or zero) with probability p_2 .¹ Therefore, in attempting to maximize his expected utility, player 1 accepts A_2 only if $U_1(A_2) > (1-p_2) \cdot U_1(A_1)$, that is, if

$$(5.26) \quad [U_1(A_2) - U_1(A_1)]/U_1(A_1) < p_2.$$

If inequality (5.26) is reversed, player 1 rejects A_2 and insists on A_1 .

Nash and Zeuthen argued that "each party will make a concession to his opponent once he finds that the latter's determination is firmer (i.e., the latter's willingness to risk a conflict is greater) than is his own" (Harsanyi, p. 148).² In other words, player 1 will make a further concession if $p_1 < p_2$, that is, if

$$(5.27) \quad [U_1(A_1) - U_1(A_2)]/U_1(A_1) < [U_2(A_2) - U_2(A_1)]/U_2(A_2),$$

¹All utilities in this example are measured relative to the conflict situation, C. The utility derived from C is therefore arbitrarily defined as zero.

²For a justification for this assumption see Harsanyi, pp. 149-51.

while player 2 will make a concession in the opposite situation. "A concession need not be the complete acceptance of the other party's last offer, but it must be large enough to reverse the inequality sign... [in (5.27)]... if the utilities corresponding to the new offer are substituted." The process of concession-making will continue until the two parties meet somewhere in the middle of the bargaining frontier.

Expression (5.27) implies that player 1 will continue to make concessions so long as

$$(5.28) \quad U_1(A_1) \cdot U_2(A_1) < U_1(A_2) \cdot U_2(A_2)$$

If bargaining takes place as outlined above, the party whose last offer is associated with a utility product, $U_1 \cdot U_2$, that is lower than that of his opponent's last offer will make a further concession by putting forth a new offer (a new A_1) associated with a higher utility product, $U_1 \cdot U_2$, than his opponent's last offer. This process will continue until the product of the utilities $U_1 \cdot U_2$ is maximized, at which point neither party can gain by making further concessions. At this point, the product of the utilities of the two players is maximized (see appendix C).

In our example, let player 1 be the cooperative's manager, interested primarily in growth of the cooperative, and player 2 be the farmer-members, interested in their discounted present value of net returns from the cooperative. What does the above analysis suggest about the bargaining outcome that will emerge regarding the level of the cash payout?

According to the model, the proportion of the cooperative's net earnings that will be distributed as a cash payout as opposed to being retained to finance growth depends on the following factors:

$U_1(A_1)$ = the gain in utility (relative to the conflict situation) that the manager derives from obtaining a high level of retained

earnings (and, presumably, a high rate of growth). Note that the utilities discussed here are all measured relative to the utility associated with the conflict situation; hence, the value of $U_1(A_1)$ depends not only on how growth-oriented the manager is but also on his alternative opportunities should he be fired (or leave the cooperative). These in turn depend on the market for managerial talent, his particular skills, and on how highly he values his current position (a function, in part, of his risk preference).

$U_1(A_2)$ = the gain in utility (relative to the conflict situation) that the manager derives if the farmer-members prevail in having the cooperative disburse a high cash payout. By assumption $0 < U_1(A_2) < U_1(A_1)$, that is, the manager would most prefer that the cooperative have a high level of retained earnings, but failing that, he would prefer an amicable agreement to have a high cash payout over open conflict, which would result in his getting sacked.

The level of $U_1(A_2)$ relative to $U_1(A_1)$ can vary enormously depending on the design of managerial incentives. In the extreme case where managerial rewards, such as salary level, are tied to the level of the cash payout, the manager might even prefer a high cash payout to a high level of retained earnings, that is, $U_1(A_2) > U_1(A_1)$. In this situation there would be no bargaining at all between the management and the members; both would push for a high level of cash payout.¹ Although

¹How strongly members would push for a high current cash payout would depend in part on their discount rate (see below).

this structure of managerial incentives might lead to harmonious decision making within the cooperative, it might not be in the best long-term interest of the organization, as pointed out in the discussion of the horizon problem in chapter 2. In general, the more closely managerial incentives are tied to the level of the current cash payout, the smaller the gap between $U_1(A_1)$ and $U_1(A_2)$ will be, hence the more languid will be the manager's bargaining for a high level of retained earnings and the lower will be the final level of retained earnings that emerges from the bargaining process. On the other hand, the more closely the manager's reinforcers are associated with a high level of growth, the more vigorous will be his bargaining for a substantial level of retained earnings.

$U_2(A_2)$ = the gain in utility (relative to the conflict situation) that the farmer-members derive from the cooperative's having a high cash payout rather than a high level of retained earnings.

$U_2(A_1)$ = the gain in utility (relative to the conflict situation) that the farmer-members derive from having much of the cooperative's net earnings retained rather than distributed as a high cash payout.

Both $U_2(A_2)$ and $U_2(A_1)$ are measured relative to the utility that farmers would obtain in the conflict situation, in which the manager would be fired (or quit). The levels of $U_2(A_2)$ and $U_2(A_1)$ therefore depend on the cost to the members of replacing the skills that the manager brings to his job. In situations where the manager possesses much idiosyncratic knowledge about the functioning of the cooperative, the cost of replacing him may be high, implying that farmer-members have a strong incentive to

avoid the conflict situation. In this instance not only are both $U_2(A_1)$ and $U_2(A_2)$ relatively high, but the manager is likely to have a stronger bargaining position ($p_1 > p_2$, that is, the manager may be more willing than the farmer-members to risk the conflict situation), making it more likely that the cooperative will end up with a high level of retained earnings.

The difference between $U_2(A_2)$ and $U_2(A_1)$ measures the degree to which farmer-members prefer current cash flow to a high level of retained earnings. Because we have assumed that farmer-members evaluate the payoff from belonging to the cooperative in terms of the present value of net pecuniary returns, the difference between $U_2(A_2)$ and $U_2(A_1)$ therefore depends on the members' discount rate. If members have a high discount rate, they will strongly prefer current cash flow (outcome A_2); if they have a low discount rate, they may be more tolerant of a high level of retained earnings, as these presumably will engender a higher level of net returns to farmers in the future. This suggests that farmer cooperatives composed primarily of older members or members in cash-flow squeezes will tend to have higher levels of cash payouts than will cooperatives whose members are in business "for the long haul."¹

The difference between $U_2(A_2)$ and $U_2(A_1)$ also depends on the confidence that farmer-members have in the manager to use retained earnings in a way that will increase member returns in the future. Members who expect the manager to squander retained earnings on nonproductive

¹This conclusion is valid only for cooperatives with constant levels of equity redemption. It is possible that older members may lobby for a lower level of cash payout if the net earnings thus freed are used to retire member equities more quickly rather than being retained to finance growth.

investments and managerial perquisites will likely favor a high cash payout irrespective of their discount rate, as will members who believe that because of cross-subsidies within the cooperative retained earnings will end up benefiting members other than themselves.

In summary, the bargaining model suggests that, holding other uses of cash flow constant, the proportion of net earnings devoted to a high cash payout rather than being retained to finance firm growth will depend on five factors:

- (1) The market for managerial talent, which determines how willing both parties are to risk open conflict, in which the manager is forced (or chooses) to leave the cooperative. The greater the number of firm-specific skills the manager possesses, the greater are the costs of training a replacement; hence, the greater is the incumbent's bargaining power to push the cooperative to adopt the policies he favors. Similarly, if the manager has an employment contract with the cooperative that is costly for the firm to abrogate, if there is strong demand for the manager's skills from other employers, or if the manager is close to retirement (and hence does not fear being without a job) his bargaining power with his current employers may be high. On the other hand, the fewer the firm-specific skills of the current manager and the greater the ease of finding a replacement for him, the more willing farmer-members will be to drive a hard bargain, even if doing so risks an open rupture with the manager. This suggests that cooperatives engaged in relatively unsophisticated tasks, requiring a low level of managerial skills, will be characterized by a higher

level of cash payout than will cooperatives in which the manager possesses a large amount of human capital, particularly if it is firm-specific.

- (2) The risk preferences of the manager and of the farmer-members. The more risk preferring either managers or the farmer-members are, the more likely they are to try to drive a hard bargain, even if doing so risks a rupture in their relationship with the other party.
- (3) The design of managerial incentives. The analysis assumed that cooperative managers are interested primarily in growth of the organization. Managerial incentives may be structured, however, in a way that aligns the manager's material (and perhaps psychological) rewards with the level of the cash payout. Structuring managerial incentives in this way may reduce conflict within the organization over the level of the cash payout but may not always be in the best long-term interest of the cooperative.¹
- (4) The amount of confidence the members have in the manager to use retained earnings in a way that will increase the members' returns. This confidence likely varies among different factions of the membership, depending in part on how they believe the

¹For example, one fruit and vegetable processing cooperative visited by the author formerly paid its manager an annual bonus that was directly proportional to the amount by which members' cash returns exceeded the "established values" for their crops. (A crop's "established value" roughly corresponds to the prevailing "free-market" price for the crop in the area.) Partly as a consequence of this incentive system, for several years the cooperative retained a low proportion of its earnings for maintenance, leading to a deterioration of its facilities.

cooperative's cost-sharing, revenue pooling, and investment priorities redistribute income within the organization. It also depends on whether members perceive the manager as an "empire builder," interested primarily in assembling a large staff and executive perquisites; as an incompetent, unable to seize emerging market opportunities for the cooperative; or as an able trustee of the members' interests. If the members do not trust the manager to use retained earnings to increase member returns, the members will naturally lobby for a high cash payout (or replacement of the manager).

- (5) The discount rate of the members. Even if the members believe that the manager would use retained earnings to increase member returns in the future, they still may prefer a high cash payout if they have a high discount rate (for example if they are old or in a cash-flow squeeze). As discussed in chapter 6, one of the goals of management- and board-run member relations programs appears to be the lowering of members' discount rates, in part to encourage an increased level of retained earnings.

Cooperative Behavior as a Noncooperative Game

In certain circumstances participant behavior in a farmer cooperative more nearly resembles a noncooperative game, particularly a prisoner's dilemma or a coordination problem. In a prisoner's dilemma the "rational" pursuit of individual self-interest by players leads to a Pareto-inferior outcome. In a coordination problem there are benefits to coordinating the actions of individual players even though the individual pursuit of self-interest does not always lead to a mutually less-preferred outcome

(see appendix C for details and for formal definitions of these two types of noncooperative games). This section briefly discusses how models of prisoner's dilemmas and coordination problems can be used to analyze certain situations in farmer cooperatives.

Prisoner's Dilemmas in Farmer Cooperatives

Chapter 1 discussed how pricing and output decisions in farmer cooperatives may at times represent a prisoner's dilemma: given an inelastic demand for its product, a cooperative's revenues would increase if the cooperative restricted output; yet because the organization's net earnings are rebated to its members in proportion to their individual production, each member has an incentive to expand output, thereby undercutting the cooperative's attempt to restrict supply. Provision of certain public goods by cooperatives--more competitive input and output markets, lobbying, and so on (see chapter 4) may also resemble a prisoner's dilemma.¹ As with all public goods, a free-rider problem exists: an individual need not join or patronize the cooperative to enjoy all these benefits. Failure to patronize the cooperative, however, may lead to a long-term decline in the organization's ability to provide these goods. Rhodes (1978) has also suggested that farmer-members may often fail to oversee and discipline cooperative management adequately due to a free-rider problem:

Seldom does any cooperative member have an economic self-interest for trying to discipline management. His potential costs exceed his potential benefits. While all members together may have an economic incentive, the rational choice

¹For a review of the arguments that the provision of public goods represents a prisoner's dilemma see M. Taylor, chapter 1.

is for each individual to hope the others make the effort while he reaps the benefits (p. 223).

To what extent is the prisoner's dilemma an appropriate model of the output decisions, management discipline problems, and "competitive yardstick" and political activities of farmer cooperatives? As detailed in the discussion of noncooperative games in appendix C, the standard prisoner's dilemma is pictured as a one-time decision, in which players are given the choice of cooperating or defecting, and in which there are clear individual incentives to defect. Because they play the game only once, players are not concerned with maintaining their reputations as reliable partners; even if they defect they will not face retribution from their partners in subsequent periods.

The usefulness of this static prisoner's dilemma model to analyze cooperative loyalty is problematic because farmers do not face a one-time decision of whether to join and support a cooperative (or to support its decisions); that choice is continually before them. Reputations clearly do matter; cooperatives may expel habitually "noncooperative" members even if doing so imposes some short-term cost on the remaining members.

If a single-period game (called a constituent game) is infinitely iterated, a new game is defined (called a supergame), in which the payoffs are the net present values of the stream of payoffs from the constituent games. Several authors (for example, M. Taylor; Schotter; Axelrod and Hamilton) have shown that even if the constituent game is a prisoner's dilemma, the supergame need not be. This result is demonstrated in appendix C. The result depends critically on five elements:

- (1) the length of the supergame (the supergame must be of infinite duration or at least of a duration unknown in advance to the players);
- (2) the reaction of the players to a defection by one of their number;
- (3) the rates of time preference by the players;
- (4) the relative size of the payoffs for defection and cooperation in the constituent game; and
- (5) the number of players in the game.

A supergame of known duration comprised of constituent games that are prisoner's dilemmas is itself a prisoner's dilemma.¹ Similarly, the supergame will be a prisoner's dilemma if players who do not defect fail to punish (in subsequent iterations of the game) those who do; unconditional cooperation in a prisoner's dilemma supergame is never an equilibrium strategy (see appendix C).² In addition, even if there is punishment for defection the supergame may still be a prisoner's dilemma if players have sufficiently high discount rates; given a high discount rate, the gain to a player in the current period from defection may be greater than

¹If a player knew in advance that the n th iteration was the last, he would have a clear incentive to defect in that iteration, since in any single constituent game defection is the dominant strategy. The $(n-1)$ th iteration would then become in effect the last game, but here again the same argument for defection would apply, and so on, all the way back to the first iteration.

²Unconditional cooperation in a prisoner's dilemma supergame is defined as cooperating no matter how the other players have behaved in previous iterations of the game. Conditional cooperation is defined as cooperating only so long as the other players (or some critical number of them) continue to cooperate; if they defect, the other player defects (for some period) in subsequent iterations of the game.

the discounted value of the punishments subsequently inflicted. Related to this is the relative size of the payoffs for cooperation and defection in the constituent game. The higher the return to defection relative to cooperation in the constituent game, ceteris paribus, the more likely the supergame is to be a prisoner's dilemma. Lastly, the larger the number of players, the more likely it is that a supergame comprised of prisoner's dilemma constituent games will itself be a prisoner's dilemma. For conditional cooperation to be a rational behavior in an n-person prisoner's dilemma supergame each player must know how many other players cooperated in the previous iteration of the game and each cooperating player's discount rate must lie below a certain level (M. Taylor, chapter 3 and pp. 92-93). Both conditions are more likely to prevail in a small group than in a large one.

If the problem of maintaining loyalty to a farmer cooperative (or to its price and output decisions) is truly a prisoner's dilemma supergame, then the above analysis suggests the following hypotheses:

- (1) Cooperative loyalty is greater among those who will be farming for an indefinite period compared to those who are close to leaving farming, provided that there is no way for the individual leaving farming to continue to benefit from the existence of the cooperative (e.g., through capitalization of the value of the cooperative into the value of his land, through a "pension" provided by the retirement of his accrued equity in the organization, or through utility derived from passing on a viable farming operation to his heirs). If those leaving farming will have no further payoffs from the cooperative once they leave, they have no incentive to remain loyal to it

as they near their retirement; in the short-run, defection is always the dominant strategy.

- (2) Cooperative loyalty is greater the greater are the penalties for cooperative disloyalty. Although this is hardly a surprising hypothesis, it is sometimes ignored by cooperative practitioners. If cooperatives do indeed provide public goods, then theory suggests that it may be too easy for members to leave cooperatives. Although managers of cooperatives sometimes express astonishment that members who have substantial investments in a cooperative are not more loyal to the organization, in many instances the member's return on his investment is only weakly conditional on his continued patronage (see chapter 2). Co-op members may rationally regard their investment in the organization as a sunk cost and therefore not take it into account in making current decisions. This implies that cooperative loyalty might be increased by making the return on past investment more conditional on current patronage. Doing so might also increase the use of member voice relative to exit in disciplining management (Hirschman, 1970).
- (3) A farmer's cooperative loyalty decreases as he becomes more leveraged. Highly leveraged farmers are likely at times to face severe cash-flow difficulties and therefore have a high discount rate. As agriculture relies increasingly on purchased inputs and, as a consequence, farm borrowing increases, one would therefore expect a secular decline in cooperative loyalty. In addition, the widespread notion that young farmers

as a group display less cooperative loyalty than older farmers may in part be attributable to younger farmers being more highly leveraged than their older counterparts. In a cash-flow bind, many young farmers may not be able to afford cooperative loyalty if more favorable prices or credit terms are available elsewhere.¹

- (4) Cooperative loyalty is greater in small cooperatives than in large ones. As a corollary, loyalty is greater in federated cooperatives than in centralized cooperatives of equal size because actors in a federated cooperative (individual farmer-members at the local level and local cooperatives at the regional level) generally carry out their transactions in smaller groups than do actors in centralized cooperatives. Furthermore, it is more likely that members of a cooperative will develop concerns for the welfare of their co-members if the group is small and they get to know each other intimately. Developing a degree of altruism regarding the payoffs to the other players in a game can transform it from a prisoner's dilemma to a game that does not have a Pareto-inferior outcome (see chapter 6).

¹When the author suggested this hypothesis to a cooperative manager he replied, "But in the long run they can't afford cooperative disloyalty." His reply neatly illustrates the prisoner's dilemma.

Some evidence of the importance of cash-flow considerations in determining cooperative loyalty emerged from interviews with farmers. Several fruit and vegetable farmers reported selling crops produced on their own land to their co-op and crops produced on rented land to IOFs. In the presence of imperfect capital markets, the farmers needed the immediate payment for the crop provided by the IOFs in order to pay their land rent; for crops produced on their own land they could afford to accept the deferred payment typical of fruit and vegetable processing cooperatives.

Coordination Problems in Farmer Cooperatives

Some situations in farmer cooperatives resemble coordination problems, in which there is more than one Pareto-efficient equilibrium but in which the players must coordinate their actions in order to avoid recurrent nonequilibrium (Pareto-inferior) outcomes. If an individual knows how the other players plan to behave in a coordination problem his payoff is always higher if he coordinates his action with theirs, even if he prefers that they would behave differently. The critical short-run problem facing a player in a coordination problem is gaining some assurance of how the other players will act in the immediate future so that he can coordinate his actions with theirs. His long-run problem is influencing the others to behave in the way he most prefers, that is, in the way that yields him the highest payoff.¹

An example of the coordination problem in farmer cooperatives is the harmonization of farmers' production schedules to permit fuller use of processing plant capacity. It is in the farmer-members' interest that raw product shipments to the plant be coordinated to avoid gluts or shortages, yet all farmers may prefer certain delivery dates over others. If a farmer knows that half of his confreres will attempt to deliver tomatoes to the plant on August 10 it may be in his short-run interest to coordinate his actions with theirs by not delivering on that date. In the long term, however, he may favor the development of a rule that allows him to deliver on August 10.

¹See appendix C. The coordination problem has also been labeled "the assurance problem" (Sen) and "the battle of the sexes problem" (Bacharach, pp. 84-88).

The classical solution to a coordination problem suggested by game theorists is the development of a rule that specifies how various players must behave in different situations (for example, a production contract that specifies delivery dates). The rule provides all players with a stable set of expectations regarding how their colleagues will behave and therefore induces players, in pursuing their own self-interest, to coordinate their actions with others.

If the coordination problem is symmetrical, that is, if all players are indifferent to which equilibrium is the outcome, then the choice of a rule may be easy. For example, consider Figure 5.2, which illustrates the payoffs to two farmers trying to decide when to deliver their tomatoes to a cooperative processing plant. Two dates are possible: August 10 and August 20. Assume that farm production can be scheduled in a way that results in a farmer's expected production costs and yield being the same whether he harvests and delivers on August 10 or August 20. The only factor affecting his expected returns is how quickly the plant can handle his produce. If he is the only one delivering on a given day he will receive \$60/ton; if more than one farmer delivers on that day, delays in handling will lead to spoilage, and he will receive only \$45/ton. In this situation the establishment of a rule is simple: the farmers meet and simply agree to deliver on different dates.

In the more likely case where the game is nonsymmetric, for example, where there is an advantage to delivering on one date rather than on another (Figure 5.3), the establishment of a rule is more difficult. Although players still seek a stable set of expectations regarding others' behavior so as to avoid nonequilibrium outcomes, different rules imply different distributions of welfare (in this instance, income). Therefore,

		Grower 2	
		Deliver on August 10	Deliver on August 20
Grower 1	Deliver on August 10	(\$45, \$45)	(\$60, \$60)
	Deliver on August 20	(\$60, \$60)	(\$45, \$45)

Figure 5.2 Payoff Matrix for a Symmetric Coordination Problem

		Grower 2	
		Deliver on August 10	Deliver on August 20
Grower 1	Deliver on August 10	(\$45, \$45)	(\$65, \$58)
	Deliver on August 20	(\$58, \$65)	(\$42, \$42)

Figure 5.3 Payoff Matrix for a Nonsymmetric Coordination Problem

the rule that is established reflects the distribution of power among the players.

How are such rules established? Recent game-theoretic work has addressed this question, although not entirely satisfactorily. The following section examines rules and noncooperative games.

Noncooperative Games, Social Traps, and Social Institutions

In noncooperative games, both prisoners' dilemmas and coordination problems, the individual pursuit of self-interest can lead to collectively nonpreferred results. These games are a type of social trap, which is defined as a situation in which individual rewards (or reinforcers, to use the Skinnerian term) are inconsistent with group well-being or in which short-term reinforcers are inconsistent with long-term reinforcers (Cross and Guyer; Platt). The trap arises because of the inability of the players to make binding commitments with one another regarding mutually advantageous strategies. Platt has suggested that a generalized solution to social traps is the creation of a superordinate authority that in essence enforces a binding social contract obligating all members of the group to act cooperatively, thereby transforming the game from a noncooperative to a cooperative one. Indeed, the long-term societal gains from avoiding recurrent Pareto-inferior outcomes provides society with an incentive (or, if selective pressures are strong, an imperative) to develop such rules and institutions, which compel individuals to behave in socially desirable ways. These institutions lead to socially desirable behavior in two ways. First, they provide players with an improved set of expectations regarding how their cohorts will behave. For example, in a recurrent prisoner's dilemma situation, the

social institution specifies the sanctions that the group will impose on those who behave in an "antisocial" manner. In this way social institutions reduce the costs of individual and group actions by allowing individuals to make decisions without incurring the costs needed to develop reliable expectations in each idiosyncratic situation about how other actors will behave. In Schotter's words:

Institutions are established to help solve games that are iterated either a finite or an infinite number of times and become efficient by allowing agents to learn from the past and remember the societally agreed upon convention of behavior for these games. They avoid the suboptimal outcomes that might result if such institutions did not exist and agents were forced to repeatedly solve the same coordination problem (p. 134)....

Institutions tend to "codify memory" for the agents in the economy and thereby transform the game they are playing from a game of imperfect recall into one that has what we will call institution-assisted perfect recall. This transformation allows a considerable amount of informational efficiency (p. 109).

Second, many social institutions attempt to instill in individuals beliefs (ideology) that change the utility players attach to different outcomes of the game. By doing so, the institutions change the players' perceived payoff matrices and hence their behavior. The role of such ideology in overcoming recurrent prisoner's dilemmas and coordination problems is discussed in chapter 6.

Schotter argues that such institutions arise because they impart survival value to the groups that adopt them. Extending the arguments of Hayek, Schotter argues that nonmarket institutions as well as the market "emerge by human action but not by human design" (p. 139) through

the action of an invisible hand.¹ This argument appears counterfactual. Given a less than perfectly coercive environment, more than one social institution to deal with recurrent prisoner's dilemmas and coordination problems may have survival value. Which institution emerges depends not simply on chance or on the manipulations of an invisible hand, as Schotter suggests, but also on the distribution of power and the skill of those in society who grapple with ways to overcome these problems. In other words, certain types of recurrent noncooperative games create incentives to engage in cooperative games--bargaining over the design of social institutions to overcome the potential losses to society that would result from noncooperative behavior continuing unfettered. The following chapter elaborates on how such institutions emerge in farmer cooperatives and on the importance of bargaining in their creation.

Conclusions

Game theory, with its emphasis on decision making under conditions of mutual interdependence and on the allocation of costs and benefits from joint activity, is particularly suited to examining the behavior of participants in farmer cooperatives. Many decisions in these cooperatives resemble the bargaining situations analyzed by the theory of cooperative games, where joint action yields mutual benefits but where players must agree on how to share those benefits before the joint action

¹In game-theoretic terms, Schotter argues that such institutions represent Nash equilibria of noncooperative games played by people in society. (See the discussion of solution concepts in appendix C for the definition of a Nash equilibrium.) These institutions arise, Schotter believes, because people, acting independently, often spontaneously discover the gains from coordinating their actions with those of their cohorts and automatically develop social institutions to facilitate such coordination.

can be undertaken. Other decisions facing participants in farmer cooperatives, particularly those in which agreements among the participants are difficult to enforce, more closely resemble noncooperative games, especially the prisoner's dilemma and the coordination problem.

In developing the game-theoretic analysis in this chapter we initially assumed that farmer-members, in their dealings with their cooperatives, were risk neutral and were interested solely in pecuniary benefits. We assumed that cooperative managers were interested primarily in growth of the cooperative and preservation of their position within it; maintaining their position required them to return at least a "satisfactory" level of earnings to the farmer-members. In their role as farmers, members of the board were assumed to be interested in pecuniary returns from the cooperative; in their role as board members they were seen as also pursuing the nonpecuniary benefits of board membership.

A myriad of possible bargaining issues arise in farmer cooperatives. The above assumptions were incorporated into analyses, based on the theory of cooperative games, of two particularly important bargaining issues: the pricing of services in a cooperative having a heterogeneous membership and the determination of the level of cash patronage refunds. The analysis of the pricing issue demonstrated that in some instances differential pricing of services to members is necessary to preserve the stability of the cooperative; whether such pricing can always arise in one-member, one-vote cooperatives is problematic. Furthermore, when a cooperative's average cost of providing a joint service first declines and then increases, there may be no way of pricing the service that does not give some members of the organization an incentive to leave. This suggests that cooperatives need to pay close attention to how adding

additional activities or patrons affects their average costs of production. Game-theoretic analysis can potentially help cooperatives design pricing arrangements that reinforce cooperative stability.

Determining the level of the cash patronage refund, or cash payout, can be viewed as a bargaining game between the cooperative's manager (and possibly the board), interested mainly in growth of the organization, and the farmer-members, concerned primarily with their current pecuniary return from the cooperative. Analysis of this issue based on the Nash-Zeuthen model of bargaining reveals that the level of the cash payout is strongly influenced by five factors: the market for managerial talent, which determines the willingness of the manager and the farmer-members to risk open conflict in their bargaining; the risk preferences of the manager and the farmer-members; the design of managerial incentives, which determine how strongly the manager prefers growth to a high cash payout; the confidence the members have in the manager to use retained earnings in a way that will benefit the members in the future; and the members' discount rate. Several factors, in turn, can influence each of these.

Problems such as maintaining cooperative loyalty and harmonizing farmers' production schedules often resemble noncooperative games, specifically, the prisoner's dilemma and the coordination problem. These problems are not merely occasional, however; they are recurrent, and hence can be analyzed using the concept of a supergame, which is an infinitely-iterated one-period game. Analysis of cooperative loyalty based on the model of a prisoner's dilemma supergame suggests that cooperative loyalty will be greater: (a) among farmers who are not close to retirement, (b) in situations where a member's return on his past

investment in the cooperative is contingent upon his current patronage, (c) among farmers who are not highly leveraged, and (d) in smaller cooperatives and in federated cooperatives as compared with centralized cooperatives of equal size.

Recurrent coordination problems as well as recurrent prisoner's dilemmas create incentives for cooperatives to develop rules (such as contracts that specify delivery rates) aimed at avoiding nonequilibrium (Pareto-inferior) outcomes. As long as the payoffs facing farmer-members in these noncooperative games are not the same for all members, the rules that arise to deal with these problems will reflect the distribution of power within the cooperative. The arguments of Schotter notwithstanding, the rules will emerge both by human action and by human design. Chapter 6 discusses this issue in more detail.

Although game-theoretic analyses generate many intriguing hypotheses regarding farmer cooperatives, such analyses are built upon restrictive assumptions regarding the perfect knowledge of the players, their unlimited computational abilities, and the immutability of their preferences (see appendix C). Chapter 6 examines how relaxing these assumptions modifies the game-theoretic results.

CHAPTER 6

BROADENING THE ANALYSIS: TRANSACTION COSTS AND IDEOLOGY

"Game theorists--most applied mathematicians and mathematical economists--examine what ultrasmart, impecably rational, superpeople should do in competitive, interactive situations. They are not interested in the way erring folks like you and me actually behave." Raiffa, p. 21.

Game theory assumes that players have perfect knowledge of the payoffs available to them from alternative strategies, face no transaction costs, experience no difficulties in comparing alternatives, and have unchanging preferences. None of these assumptions reflects the reality of farmer cooperatives. This chapter examines how relaxing these assumptions modifies the results of the analysis from previous chapters.

The chapter has three main sections. The first examines the implications of costly information, other transaction costs, and bounded rationality for the game-theoretic results derived thus far. The topics discussed in this section include: (a) why costly information implies a need to delegate authority in the cooperative, in essence creating two simpler games in place of one more complex bargaining game; this delegation of authority implies inevitable bargaining over who should establish the rules and set the agenda for the cooperative; (b) how transaction costs affect who participates in the governance of the cooperative; (c) how costly information leads cooperatives to rely heavily on standard operating procedures (SOPs), and the problems cooperatives face in determining when to update their SOPs; (d) how costly information

affects the patterns of influence in farmer cooperatives; and (e) how access to information and the ability to change its price to others affect who actually controls decisions in farmer cooperatives. The second major section of the chapter examines how modifying the preferences of participants in farmer cooperatives through the inculcation of "cooperative ideology" can change their behavior from that predicted by game-theoretic models that assume immutable preferences. The discussion focuses on how cooperative ideology affects players' expectations regarding the payoffs from alternative strategies and players' rates of time preference. The third section summarizes the findings of the chapter.

Implications of Costly Information and Other Transaction Costs

Game theory rests upon a very important perfect-knowledge assumption: all players are assumed to know (a) the rules of the game, (b) all the other players' preferences, and (c) the relationship between all the players' actions and the outcomes of the game (or at least a probability distribution for those outcomes). Knowledge of the relationship between actions and consequences implies that players have perfect foresight (at least up to a probability distribution) and that in cooperative games players can instantly and effortlessly evaluate the payoffs from joining all possible coalitions and engaging in all possible strategies open to them. Game theory further assumes that players face no other transaction costs in carrying out their strategies, such as the costs of building coalitions and enforcing agreements. These assumptions are patently unrealistic. In this section we analyze how substituting more realistic assumptions regarding information costs, actors'

knowledge and computational abilities, and other transaction costs modifies the game-theoretic analysis presented in chapter 5.

Before analyzing how relaxing the perfect knowledge assumption alters the game-theoretic results, we note that much of the analysis prior to chapter 5 assumed less than perfect knowledge. For example, if knowledge were perfect, many of the rationales for forming or joining a farmer cooperative discussed in chapter 4 would not exist. Perfect knowledge would preclude opportunistic appropriation of rents, and hence there would be no need for cooperatives to arise to protect farmers from such opportunism. Farmers possessing perfect foresight would never invest in assets whose returns would fail to cover acquisition costs; farmers would foresee potential exploitation and avoid investing in assets whose rents others could appropriate. Similarly, there would be no need for many of the coordination functions of cooperatives. In short, many of the aggregate benefits from farmer cooperatives implicitly assumed in the game-theoretic models of chapter 5 were themselves a consequence of imperfect knowledge.

Limitations of the Perfect Knowledge Assumption

"The processes of obtaining, processing, and storing information and the processes of evaluating and negotiating coalitions cost money and take time.... These are not minor 'frictions,' as has been suggested sometimes, but are major economic limitational factors" (Shubik, 1952, p. 147). Shubik (1952) examined the implications of these costs for the outcome of cooperative games. The following paragraphs summarize his results.

Consider first the ability of a player to gather complete information on all the possible alternative payoffs available in an n-person cooperative game. If the i th player has σ_i strategies open to him (each strategy is a different course of action--for example, one strategy could involve selling all his product through the cooperative, another could involve selling half through the co-op and half to an IOF, and so on), then there are

$$S = n \prod_{i=1}^n \sigma_i$$

possible strategy combinations in the game, each corresponding to a different cell in the payoff matrix. If the upper bound on the player's ability to gather information is P_i (which could be a function of his budget, his time, his ability to conduct research, and so on), the proportion of the total information he can gather compared with the amount he would need in order to have complete information equals

$$\frac{P_i}{n \prod_{i=1}^n \sigma_i} = \frac{P_i}{S}$$

which approaches zero very rapidly as n increases. For example, if there are two players, each with 10 strategies, $S = 200$. If n increases to 10, $S = 100,000,000,000$. It is clear that in a game involving several players, each having several potential strategies, the cost of gathering enough information to become fully informed would be prohibitive.

Even if a player did gather all this information he would have to store it. If the cost of storing a piece of information is significant at all, information storage costs also will increase rapidly with n . If

the information storage capacity of player i is I_i then the proportion of the total information that he can store is

$$\frac{I_i}{\sum_{i=1}^n I_i} = \frac{I_i}{S}$$

This proportion also rapidly approaches zero as n increases.

Once the information was gathered and stored, the player would have to evaluate it, comparing the payoffs available from joining all possible coalitions open to him. If there are n players, this means that each player would have to make

$$\sum_{r=1}^n n C_r = (2^n - 1)$$

comparisons, a number that rapidly approaches infinity as n increases.

Even if the player succeeded in gathering, storing, and processing all the information needed to evaluate the game, he would still be faced with the costs of negotiating an agreement with the other players. Suppose that the final agreement was an imputation that assigned to each player a payoff between 1 and t . Then the probability of reaching an agreement in any one discussion is $1/t^n$ (Shubik, 1952, p. 148). Therefore, the number of imputations that would have to be discussed before an agreement was reached increases as a constant raised to the n th power.

In summary, the costs of gathering, storing, and processing information and negotiating an agreement in an n -person cooperative game all increase in proportion to a number raised to the n th power. This fact seriously draws into question whether bargaining situations involving more than two players really resemble the scenarios portrayed by the theory of cooperative games. In Shubik's words:

As soon as the number of players becomes fairly large, the amount of information at the disposal of a single firm becomes a miniscule segment of that required to play a von Neumann-Morgenstern type of game. By attaching even slight costs to the acts of storing, gathering, and processing information, any firm can compute that the cost of getting anything like complete information will be astronomical" (pp. 148-49).

Shubik concluded that because of these information costs players often act noncooperatively, eschewing negotiation with one another over joint strategies in favor of the informationally more efficient strategy of acting independently. Cooperative games, he argued, are thus replaced by the noncooperative games that underlie them (see appendix C). Because the costs of reaching a joint strategy exceed the benefits of collaboration, each player acts independently.

Whereas Shubik argued that information costs reduced the scope for agreement in cooperative games from that predicted by theory, Schotter and Schwödiauer (p. 509) held just the opposite view. Because of transaction costs, they argued, it was unlikely that all possible coalitions that might block an imputation would form; hence, the core (the zone of agreement) would be larger than theory suggests. Although Schotter and Schwödiauer discussed transaction costs only in terms of the costs of forming coalitions, the same argument could apply to the costs of gathering information and evaluating alternatives. Because of the prohibitive costs of considering all possible alternatives, players might limit their deliberations to only a few. Fewer alternatives implies fewer binding constraints on each proposed imputation, and hence a greater scope for agreement.

In farmer cooperatives both the outcome predicted by Shubik and that predicted by Schotter and Schwödiauer appear to occur depending on the

circumstances. In many instances (pricing of products, for example) members do not vote on every alternative open to them; rather, the cooperative establishes a rule that provides each member with a low-cost set of expectations regarding the outcome of the cooperative's actions. Given this set of expectations, the members can then each go ahead and act independently, as they would in a competitive market. For example, the cooperative may establish a rule that the price of fertilizer to members will be \$X/ton, subject to a possible price adjustment via a patronage refund. Members generally then go ahead and plan their production based on that expected price rather than exploring all alternative pricing schemes with all possible coalitions of members of the cooperative. They act, in other words, as they would in a noncooperative game in which the price of fertilizer was given exogenously.

In other circumstances, particularly those concerning major decisions for the cooperative, such as whether to merge with another cooperative, the members do negotiate with one another and vote. They do not consider all the alternatives open to the cooperative, however, only a select few. Although the game is still cooperative, it is a much simpler game than that predicted by theory.

Who establishes the rules in these noncooperative games and who selects the alternatives to be considered in the (simplified) cooperative games? Answering these questions is important to understanding the behavior of farmer cooperatives. The rules determine what the "independent" actors in a noncooperative game have to take into account in planning their behavior and hence how they interact with one another. Similarly, the agenda that is established in a bargaining (cooperative-game) situation largely conditions the outcome of that bargaining.

Because of information costs and other transaction costs, the highly elaborated bargaining game predicted by the theory discussed in chapter 5 is replaced by two interlinked games. The first, a cooperative (bargaining) game, can be called a constitutional game. In it, the rules of the cooperative are established, including pricing rules, rules that determine who sets the agenda for subsequent bargaining issues among the members (for example, the rules for electing the board of directors and the way in which resolutions can be put to the membership), and so on.¹ Even in the constitutional game not all alternatives are considered; limits imposed by the external environment (competition in the industry, laws governing the structure of farmer cooperatives, and so on) and the knowledge and imagination of the members determine the alternatives considered. The second, or consequent game, consists of the noncooperative game or the simplified cooperative game discussed above.

Stating that the fully elaborated game predicted by theory is replaced by a constitutional game and a consequent game is simply another way of saying that in the presence of transaction costs there are economies in moving from decision making based on direct democracy (the fully elaborated game) to a system of representative governance (the two subgames [see chapter 3]). In such a system the outcome of the constitutional game largely conditions the outcome of the consequent game. Therefore, understanding the behavior of a particular farmer cooperative requires an understanding of its rules for making rules and how these influence who participates in the governance of the cooperative.

¹These are the types of games investigated by Buchanan and Tullock.

Transaction Costs and Cooperative Governance

One implication of the model presented in chapter 3 was that members would decide whether to participate in a cooperative's governance based on their perceived costs and benefits of participation. The existence of transaction costs implies that participation will be concentrated among members having an intense interest in particular issues decided by the cooperative, while those having a more diffuse interest will abstain, even if in aggregate they could gain a great deal from participation. For example, consider a cooperative that is deciding among three options: to expand its current plant at site 1, to build a new plant at site 2, or to keep its current plant at site 1 with no expansion. One group, C, has a concentrated interest in keeping or expanding the plant at site 1, while a second group, D, has a slight (diffused) preference for building a new plant at site 2. Suppose that the board of directors will decide the plant location based on the input the board receives from the members. If it hears only from members of C, it will expand the plant at site 1, if it hears only from members of D, it will build a new plant at site 2, if it hears from neither group it will keep the current plant at site 1 unmodified, and if it hears from both groups it will decide on the plant location through a process that gives each group a 50-percent chance of getting its most-preferred alternative.

Members of C and D must decide whether to lobby for their preferred alternatives. Let the expected payoffs to individual members of C and D in the absence of transaction costs be those shown in Figure 6.1(a). In this situation the dominant strategy for each member is to lobby; no matter what his opponent does, the member's payoff is always higher if he

		Member D	
		Not Lobby	Lobby
Member C	Not Lobby	(10,5)	(3,7)
	Lobby	(15,5)	(9,6)

(a) Payoffs Without Transaction Costs

		Member D	
		Not Lobby	Lobby
Member C	Not Lobby	(10,5)	(3,4)
	Lobby	(12,5)	(6,3)

(b) Payoffs After Deducting Transaction Costs

Figure 6.1 Payoffs for Political Action in the Cooperative--
Concentrated and Diffused Interests

lobbies. The equilibrium outcome is therefore lobbying by both C and D, with C's expected payoff equal to 9 and D's expected payoff equal to 6.

Now suppose that the cost of lobbying for each group is 3. Deducting this cost from the payoffs involving lobbying yields the payoff matrix shown in Figure 6.1(b). In this situation lobbying is still the dominant strategy for C--no matter what D does, C's payoff is always higher if he lobbies. D's dominant strategy, however, now becomes not lobbying. As a result of transaction costs the equilibrium outcome now involves only C's lobbying; hence, C's most preferred outcome (expansion of the plant on site 1) occurs.¹ Hence, the existence of transaction costs reinforces the tendency of members with concentrated interests to dominate cooperative governance.

This tendency is further reinforced by the value of the information generated by the cooperative during its operations. Information about developments in a subsector is valuable to farmers in that subsector and is often costly to obtain. When such information is costly, one motivation to participate in the governance of a cooperative is the prospect of gaining access to information on the subsector generated by the cooperative's management during the course of its operations.² The value of this information to an individual is greater the larger is his investment

¹If the cost of lobbying for each group rose above 6, it would no longer even pay C to lobby, and a new equilibrium would occur, in which neither party would lobby and the old plant would remain at site 1. This illustrates a further point discussed below: high transaction costs, by reducing the likelihood that a cooperative will frequently change its existing policies, protect the utility of those favored by existing policies (in this case, members of C, who prefer that the plant remain at site 1).

²Several board members interviewed by the author cited access to such information as a major benefit of serving on the board.

in the subsector and the poorer are his alternative sources of information. Large farmers may therefore have a greater incentive to run for the board, to serve on cooperative committees, and so on, than do small farmers, particularly if information on developments in the subsector are not readily available from other sources.

Another consequence of transaction costs is a tendency for decisions in a cooperative, once made, to be relatively stable. Whereas game theory predicts that bargainers will recontract in an eyewink should any of them perceive the least advantage in some new course of action, in reality decisions are unlikely to be revised unless the gains from revising them clearly outweigh the transaction costs of organizing to do so. Therefore, as stressed in chapter 3, the existence of transactions costs protects the utility of those who have the initial right to decide an issue in the organization.

One of the most important transaction costs facing co-op participants is the cost of developing reliable estimates of the likely outcomes of different courses of action. Uncertainty concerning alternative outcomes has two important consequences. First, it imparts a conservatism to decision making in the organization; once participants settle upon a way of handling a problem that "works," they are reluctant to give it up. Because of uncertainty, the potential payoffs of untested alternatives are discounted, and the greater the uncertainty the larger the discount factor. Hence, decisions often tend to be guided by standard operating procedures rather than a constant search for a global optimum (Cyert and March). Second, a major way that an actor can influence others in the organization is by providing them with low-cost information regarding the outcomes that he favors. By reducing others' costs of evaluating these

alternatives, he can often induce them to act in a way that he prefers, even if they do not accept the subsidized information at face value. Both of these consequences of uncertainty are discussed in more detail below.

Information Costs and Standard Operating Procedures

Chapter 3 stressed the logic of relying upon simple rules of thumb (standard operating procedures, or SOPs) in making decisions in situations in which information is costly to obtain, process, and incorporate into decisions. SOPs represent a rational attempt to economize on these information costs (Cyert and March).

Recently Heiner has argued that regularities in behavior, such as SOPs, arise not from rational economizing behavior as posited here but from the inability of economic agents to distinguish preferred from less-preferred behavior in an uncertain environment. If an agent cannot reliably judge when his decisions will be improved by taking into account additional information, it may be in his interest to ignore that information. Given uncertainty, *u*, about whether actions based upon the additional information would actually be preferred, the agent may mistakenly incorporate the additional information into his decisions when it is not appropriate to do so, leading to less-preferred outcomes than if he had ignored the information. For example, consider a farmer who is trying to select a pesticide. Should the farmer read all the technical literature available on the alternative products? This depends on whether the additional information will lead to a more-preferred outcome for the farmer. If the farmer has little training in organic chemistry, studying information on the molecular structure of the pesticides may

lead him to focus erroneously on some irrelevant characteristic of the products, resulting in a worse outcome than if he had ignored these data.

Heiner (p. 566) argued that behavior will be rule-governed (that is, actors will ignore the additional information available to them and not engage in new actions based on that information) so long as the following condition holds:

$$(6.1) \quad \frac{r(u)}{w(u)} < \frac{l(e)}{g(e)} \cdot \frac{1 - \pi(e)}{\pi(e)}$$

where

$r(u)$ = the probability that the agent selects a new action (based on the additional information) when that action would actually be preferred over the previous rule-governed behavior. That is, $r(u)$ is the conditional probability of selecting the new action at the "right" time. This probability is a decreasing function of u : the greater the uncertainty the more difficult it is to tell whether a new action will actually be preferred.

$w(u)$ = the probability that the agent selects the new action at the "wrong" time, that is, when it would be less-preferred to the previous rule-governed behavior. $w(u)$ is an increasing function of u .

$l(e)$ = the loss the agent suffers when he selects the new action at the "wrong" time. This loss is a function of the environment, e , in which the agent finds himself.

$g(e)$ = the gain the agent receives when he selects the new action at the "right" time.

$\pi(e)$ = the probability of the "right" time to select the new action occurring.

$1 - \pi(e)$ = the probability of the "wrong" time to select the new action occurring.

Heiner called the ratio $\frac{r(u)}{w(u)}$ the reliability ratio, "which measures the probability of 'correctly' responding under the right circumstances relative to the probability of 'mistakenly' responding under the wrong circumstances" (p. 566). The right-hand side of (6.1) he called the tolerance limit, which "determines how likely the chance of selecting an action under the right conditions must be compared to the chance of selecting it under the wrong conditions before allowing greater flexibility to select that action will improve performance." Expression (6.1), which Heiner labeled the reliability criterion, yields the following rule for determining when to adopt a new action over previously rule-governed behavior (for example, when to change SOPs): "do so if the actual reliability in selecting the action exceeds the minimum required reliability necessary to improve performance" (p. 566).

Heiner's analysis, which implies that agents will forgo actions that are actually preferred under certain circumstances, is sharply at odds with the model of economic behavior based on utility maximization under conditions of certainty. Heiner's approach is, however, consistent with the maximizing model presented in this study, in which there is a cost to gathering, storing, and processing information. The correspondence of the two approaches can be seen by rearranging the terms of (6.1). Rule-governed behavior will remain unchanged so long as:

$$(6.2) \quad g(e) \cdot r(u) \cdot \pi(e) < l(e) \cdot w(u) \cdot [1 - \pi(e)]$$

The left-hand side of (6.2) represents the expected gain from adopting a new action (changing SOPs) while the right-hand side represents the expected cost. As long as the expected cost of gathering, processing, and incorporating additional information into a decision is greater than the expected gain from doing so, that information should be ignored. This is exactly the criterion for information gathering and processing mentioned in chapter 3.

Expressing this criterion in the form of (6.2) focuses attention on conditions that might make it worthwhile for an agent to change his SOPs. In particular, changes in the environment can change the gains from adopting new behaviors in the "right" conditions as well as the probability of the "right" conditions occurring. If a sufficient number of individual agents in an organization like a farmers' cooperative believe that it is in their interest to change an SOP of the organization and if the other transaction costs (such as the cost of coalition-building) are not too high, the SOP will be modified.

Consider, for example, the common SOP among fruit and vegetable processing cooperatives of providing a "home" for however much raw product their members produce. As discussed in chapter 4, creating a "home" for their raw-product has been a major motivation for farmers to form processing cooperatives. In certain states of the environment the SOP of accepting however much raw product members produced may have been in the best interest of both the farmers and their cooperatives. In the 1960s, when demand for canned fruit and vegetables was expanding, this SOP helped assure cooperatives adequate supplies both to serve the expanding market and perhaps to increase their market share. Furthermore,

the promise of a secure "home" may have attracted additional members, allowing the cooperatives to exploit economies of size.

In the 1970s the environment in which these processing cooperatives operated began to change. Per capita consumption of many canned fruits and vegetables stagnated or declined, the size and market share of cooperatives grew, farmer bargaining with IOF processors increased, and real interest rates rose. Each of these changes affected the profitability of the SOP of providing a "home" for the members' product. The stagnant demand eliminated the advantage to the cooperative of increased raw-product supplies, while the increasing size of most cooperative processors meant that they had already captured most of the available economies of size in processing, so expanded volume did not lower their per-unit costs of production. As the market share of the cooperative processors increased, they could no longer act as price takers in the processed-product markets; cooperatives that processed and tried to sell all that their members produced during bumper-crop years depressed market prices. This tendency of cooperatives to "break the market" was reinforced by the increasing importance of farmer bargaining during the 1970s. Bargaining obligated IOF processors (but not cooperatives) to pay farmers specified raw-product prices. Because IOFs were obligated to meet these prices, they would purchase only the amount of product they could profitably process and market given those prices. The rest of the raw product flowed to the cooperatives, which lacking the discipline imposed by the bargained price, tended to "wrap a can around" whatever their members produced, leading to increased inventories and further depressed

processed-product prices.¹ As interest rates rose in the late 1970s the cost of carrying these unsold inventories soared.

Heiner's model would predict that because of these environmental changes cooperatives would change their SOP of providing a "home" for their members' products. Such a change, however, would not occur immediately. In an uncertain environment, participants in a cooperative might have difficulty determining whether it was the "right" time to adopt a new action (contracting on the basis of tonnage rather than acreage). Given the cyclical nature of many agricultural markets, it may have been difficult to determine whether the stagnating consumption of canned fruits and vegetables in the mid 1970s was simply a short-term cyclical event (and hence the SOP of providing a "home" was still adaptive) or part of a long-term trend (and hence the SOP was maladaptive and ought to be changed). Heiner's model would predict that eventually, however, if market pressures were strong enough, the SOP would be changed.

The discussion of transaction costs earlier in this chapter suggests that such a change would occur first where the transaction costs of imposing it were lowest, and this prediction seems to have been borne out. One of the first processing cooperatives to contract on a tonnage rather than on an acreage basis was Pro-Fac, a cooperative established in 1961 as part of a joint venture with an IOF marketing firm, Curtice-Burns. The agreement with Curtice-Burns allows the management of Curtice-Burns, rather than Pro-Fac's board, to establish limits on the amount of product processed. Because the Curtice-Burns management is relatively insulated

¹This dynamic probably contributed to the exit of some IOF processors from the industry in the late 1970s.

from pressures of the farmer-members and does not have to build coalitions among them, Pro-Fac/Curtice-Burns could move relatively easily to tonnage contracts, where the total tonnage contracted is based on what Curtice-Burns management estimates that it can profitably sell.¹

In the cooperatives where the choice of tonnage or acreage contracts is decided by the board of directors, tonnage restrictions have tended to be imposed first on minor crops, where the cost of assembling a coalition of board members opposed to continuing to provide a "home" for a minor crop that was a money-loser was relatively low. It has been harder to build coalitions to limit the tonnage of major crops, which many of the board members and their constituents produce. For example, one processing cooperative, which eventually did impose tonnage limits on all its products, first imposed them on pears because, in the words of the manager, "There were eight guys on the board [out of ten] who were not pear producers and would therefore vote against pears." In another processing cooperative that handled seventeen different commodities, tonnage limits had been imposed on all crops except sweet corn and green beans. Not surprisingly, sweet corn and green beans were the only crops grown by a majority of the members. For producers of minor crops to assemble coalitions to defend their "homes" would have involved possibly complex vote-swapping arrangements having high enforcement costs. These costs of coalition building proved so high that the coalitions did not materialize. In contrast, due to the large number of corn and bean

¹Pro-Fac does have acreage contracts on a few crops in a few areas where members lack alternative markets.

producers, the cost of assembling a coalition to defend their right to unlimited production was low, and they prevailed.

Cooperatives face many similar situations of deciding when their SOPs are outdated and need to be modified. These decisions depend critically on the patterns of influence within the cooperative, which are discussed in the following section.

Information Costs and Influence

Chapter 3 stressed that if information is costly to collect, process and incorporate into decisions, a rational person will accumulate additional information about an issue only as long as the expected cost of that information is less than its expected benefit.¹ It therefore becomes possible to influence others by providing them with free or highly subsidized information favorable to one's cause. Even though the recipients of this low-cost information may discount it because they perceive it to be biased, as long as they do not totally discount it they will rationally use some subsidized information in making their decisions, which will therefore be swayed in the direction sought by the provider of the low-cost information (Bartlett). This explains the ubiquity of advertising and lobbying in a world of costly information.

Because participants in farmer cooperatives do not always have congruent interests there are often incentives to try to influence the

¹Hirschman (1981, pp. 214-19) has argued that at times it is difficult to separate the rewards that individuals receive from striving for a goal (especially their sense of personal satisfaction) from the rewards they receive from achieving it. For example, participation in the governance of a cooperative and the analysis of information related to it may be fun for some individuals and become goals in and of themselves, thereby fostering greater participation in the cooperative's activities. In terms of the model presented in chapter 3, such rewards would be included in the nonpecuniary returns generated by the cooperative.

cooperative's decisions by influencing others in the organization. If, as posited in chapter 3, participants in farmer cooperatives make decisions based on expected pecuniary and nonpecuniary returns, then attempts to influence others will focus on changing their expectations regarding the payoffs to different courses of action. For example, in the debate over whether fruit and vegetable processing cooperatives should continue to provide a "home" for their members' products, cooperative managers, whose continued employment and level of pecuniary and nonpecuniary rewards are closely tied to the financial performance of their cooperatives, have played a key role. The impetus to impose tonnage restrictions has come largely from management, which has provided the board and farmer-members with low-cost information regarding the long-term demand prospects for canned fruits and vegetables, the financial cost of carrying large inventories of unsold product, and the effect such inventories have on market prices. Initially, some of this information focused on the implicit cross-subsidies inherent in the cooperative's providing a "home" for products whose markets were particularly weak. This information helped to influence members who were not producers of those crops to push for tonnage limits.

Member relations programs are another example of the use of subsidized information by management (and the board). Among the goals of these programs are convincing farmer-members that the current policies of the cooperative are appropriate and that the benefits of cooperative membership are high. Member relations programs also attempt to change members expectations regarding what market conditions would be like if the cooperative did not exist, thereby inducing greater cooperative

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loyalty. Member relations programs also play an important role in the inculcation of cooperative ideology, which is discussed later in this chapter.

According to the model outlined in chapter 3, farmer members devote resources to the production of influence so long as the marginal benefit of doing so exceeds its marginal cost and the farmer does not encounter a resource constraint (see also Bartlett, pp. 143-49). Because larger-patronage members have the most at stake financially in how the cooperative sets its policies, because they generally have more resources to devote to the production of influence, and because the withdrawal of their patronage may harm the organization, one would expect these members to have influence in the organization greater than that implied by their formal voting power. A cooperative, like any other business, finds it difficult to ignore the wishes of its largest customers. Furthermore, as demonstrated earlier in this chapter, the existence of transactions costs reduces the ability of smaller-volume patrons, who may have a more diffuse interest in the cooperative's policies, to offset the influence of their larger counterparts.

The nonvoting influence of the larger patrons does not necessarily impair the performance of the cooperative. Whereas in a world of perfect knowledge rational co-op members would never vote for policies that give the larger members incentives to leave the cooperative (that is, policies that lie outside the core of the game), leaving the remaining members in the cooperative worse off than before if substantial economies of size exist. Therefore, the influence of the larger members, perhaps in the form of a threat to exit if policy X is enacted, may in some instances lead to better cooperative decisions. In other instances, however, the

larger members may have no intention of leaving the organization if their demands are not met and may simply use their influence to promote policies that increase their share of the cooperative surplus.¹

Given divergent member interests and the relatively low cost of exercising voice in many farmer cooperatives, one would expect member attempts to influence the board and management to be widespread. These attempts might range from a member arguing with his fieldman about the quality of his products to concerted lobbying by a group of members to have a manager fired. Members may not always confine their lobbying to management and the board; at times, they may find it more effective to try to influence other cooperative participants (actors 4-8 in Table 3.1), who in turn may exert pressure on management and the board. For example, in one cooperative visited by the author, dissident members who were seeking to have the manager fired telephoned local banks and the regional office of the Bank for Cooperatives, arguing that the banks should not loan to the cooperative or to its members as long as the current manager was in office; they contended that his policies made the cooperative and its members poor credit risks. These dissidents hoped that pressure from the banks would mobilize board and farmer-member support to oust the manager.

Given the widespread attempts to influence them, the board and management must determine how much to discount the subsidized information they receive, that is, how representative this information is of the views of the membership as a whole. There is, as in all political

¹The influence of these members can be great. One manager told the author that four large members of his cooperative were in effect non-elected members of the board. The manager would check with these four members as well as with the board before proposing major changes in the cooperative's policies.

systems based on voice, the danger of decisions being dominated by the vociferous. Furthermore, as stressed in chapter 3, member voice, even if representative, may be based on a very weak understanding of the problem, and responding to that voice can lead to poor decisions. There is some evidence that cooperative boards often tend to focus their attention more on short-term politically expedient issues than on crucial long-term planning issues (Garoian and Haseley, pp. 74-75; Caves and Petersen, appendix A, p. 3). Such a focus, which is the logical consequence of responding primarily to members' concerns (which are often short-term--see chapter 2), leaves long-term planning by default mainly to managers.

Information and the Control of the Cooperative

As farmer cooperatives become larger and more complex, information costs may hinder the ability of farmer-members to monitor the activities of the board and the ability of the board to monitor the activities of management. This problem has at least two aspects. First, the agents being monitored (the board, management, or both) often control access to the information needed to evaluate their performance, and they can release it selectively (or perhaps not at all), in a way that influences how they are evaluated. For example, Brown (1979) found that during the mid-1970s, 9 percent of a sample of 154 large farmer cooperatives failed to provide their members with any sort of annual report and an additional 34 percent did not provide a complete set of financial statements.¹ Lacking internally-generated information on their cooperative's performance, members of these co-ops may have found it very difficult and expensive to

¹At the time of the study these 154 cooperatives accounted for 57 percent of all sales by farmer cooperatives in the U.S.

evaluate the actions of their board and management. Examples of farmer-members' and board members' being kept in the dark regarding managerial decisions are common enough to indicate that access to information poses a serious problem in some farmer cooperatives.¹ In such circumstances, if exit from the cooperative is not expensive, members may rely on exit (or the threat of exit) to discipline management rather than relying on member voice, as exercised through the board. One danger of relying purely on exit, however, is that by the time managerial malfeasance becomes apparent and patrons begin to leave, much of the stockholder-members' equity in the organization may have already been eroded.

Perhaps a more serious problem is that even when information on the cooperative's operations is provided, it may be difficult for those charged with overseeing the cooperative's activities to interpret. As cooperatives become larger and more complex, their operations become increasingly removed from the experiences of farmer-members and farmer directors. Complex technical and accounting information may overwhelm the capacity of part-time directors to evaluate it, and management may have few incentives to develop simplified performance indicators that would facilitate the board's scrutiny of management. In such circumstances there is a danger of Parkinson's Law operating, with the board focusing attention on relatively minor items that lie within its ken and leaving important but complex proposals by management practically unscrutinized.²

¹See, for example, Roy Rowan's account of the experience of Farmers' Export Company ("A Farm Co-op in the Hands of High Rollers." Fortune 103 (April 20, 1981): 148-60).

²One manager in a very large cooperative described how the board spent 1-1/2 hours discussing the cooperative's coffee-fund expenses (\$14,000 per year) but routinely approved multimillion-dollar investments after only a few minutes' discussion.

As mentioned in chapter 3, the problem of an information imbalance between the board and management is inherent in an organization with part-time directors. Management, which daily uses information on the cooperative, has a greater incentive to invest in the skills and knowledge to understand this information than does the board, which meets perhaps two days per month to oversee the cooperative's operations. Board members and farmer-members may attempt to offset this imbalance by developing indicators of managerial performance that are not entirely dependent on the information provided by management. For example, Chase-Lansdale (1980, pp. 96-97) argued that one reason why members of fruit and vegetable processing cooperatives generally favor collective bargaining between farmers and IOF processors is that the bargained raw-product price gives co-op members an independent benchmark against which to measure the returns from their cooperative. Boards of directors, in an attempt to improve their ability to evaluate management's proposals, have sometimes relied on ad hoc committees of external experts and studies by consulting firms; some bylaws also permit outside members on the board, who bring additional expertise to the board. Other alternatives, which have not been used, might involve moving to a full-time board (or at least full-time chairman) and the board hiring a full-time staff of analysts independent of management to evaluate management's proposals.

These alternatives ultimately run into two constraints. First, overly zealous monitoring of management could negate the economies of delegation that gave rise to management in the first place (see chapter 3). Second, one is eventually faced with the question, Who will watch

the watchman? In answering this question, the inculcation of cooperative ideology plays a large role, and it is to ideology that we now turn.

Ideology and Control

Game theory assumes that each player has an unchanging set of preferences. Much of the activity in farmer cooperatives, however, is aimed precisely at changing the preferences of the participants in the organization in order to modify their behavior. One of the main ways in which this is done is through attempting to inculcate a "cooperative ideology" into farmer-members, members of the board, and members of management. This section examines how such an ideology may affect the behavior of co-op participants.

Throughout this study instances have been noted where the incentives facing individual participants in farmer cooperatives may induce them to behave in a way that is inconsistent with the welfare of the cooperative as a whole. Individual farmers may expand production when farmer-members as a group would benefit if output were restricted; farmers may act as free riders with respect to the cooperative's competitive-yardstick activities, leading to a long-term decline in the cooperative's ability to carry out those activities; managers may attempt to conceal their activities from the board through manipulation of information; and individual board members may attempt to use their positions to feather their own nests rather than to improve the welfare of the members. Such a divergence between individual and group incentives is not unique to cooperatives; it is faced to some degree by all organizations. As an adaptive response to this problem, most organizations attempt to inculcate an organizational ideology--a set of shared norms and beliefs--that tend to reduce the divergence between individual and group goals (Roberts).

In the game-theoretic terms of chapter 5 the function of cooperative ideology is twofold. First, it aims at altering players' perceptions of the payoff matrices of the constituent games that they play. (Recall that players evaluate these payoffs in terms of utility, not just money.) Specifically, cooperative ideology, which is fostered both through formal programs involving subsidized information (member-relations activities, board and management training sessions, and so on) and informal socialization processes, attempts to:

- (1) Change farmer-members' expectations regarding the pecuniary payoffs that would be available to them with and without the cooperative. As mentioned earlier, member-relations programs often stress the importance of cooperatives in enforcing competition and suggest that if they are not supported farmers will be much worse off in the future.
- (2) Influence participants' marginal rates of substitution between pecuniary and nonpecuniary benefits. Cooperative ideology often stresses cooperation as a goal in and of itself, being as worthy of a person's efforts as striving for material advantage. This ideology at the same time tries to reduce the marginal utility that members of the organization receive from pecuniary benefits they receive "unethically"--for example, from using their position of authority in the cooperative to benefit themselves financially at the expense of others in the organization. For instance, nearly every cooperative manager and board member interviewed by the author reported that when new members join the board, a socialization process takes place in which the new members are urged to look beyond the interests

of just their particular commodity or region and take a broader view of the cooperative's interests. Many participants stressed the importance of this socialization process in reducing sectarian conflict among the board members. Similar socialization processes are also important for management. Partly as a result of such socialization, most managers and board members seem to serve their cooperatives out of a genuine concern for their members and attach considerable weight to the nonmonetary rewards of their position (prestige, a sense of helping farmers, and so on).

- (3) Induce a degree of altruism in players' evaluation of the payoffs from the constituent games, that is, broaden a player's evaluation of the outcome of a game to include not only how well he fares personally but also how well his cohorts make out. At several points in this study we have stressed that cultivating concern for others in the cooperative may help overcome potential prisoner's dilemmas, such as that represented by the horizon problem. This can perhaps best be seen through an extreme example. Suppose that initially the payoff matrix facing two typical co-op members is that shown in Figure 6.2 (a), which represents a prisoner's dilemma. Both player 1 and player 2 can choose between cooperating (C) and defecting (D), and each has a clear incentive to defect. When both do defect, however, the outcome (1,1) is mutually less preferred than the outcome (5,4), which would have obtained had they both cooperated. Now suppose that through the inculcation of a new ideology the players are miraculously transformed

		Player 2	
		C	D
Player 1	C	(5,4)	(0,7)
	D	(7,0)	(1,1)

(a) Original Game

		Player 2	
		C	D
Player 2	C	(4,5)	(7,0)
	D	(0,7)	(1,1)

(b) Transformed Game

Figure 6.2 Transformation of a Prisoner's Dilemma
through Complete Altruism

into complete altruists: each player is concerned only with how well the other player does. This can be represented by making 1's payoffs equal to the levels of utility that 2 derived from the different outcomes in the original game and vice versa. This results in a transformed game, shown in Figure 6.2 (b), in which mutual cooperation is the equilibrium outcome. That is, through the introduction of complete altruism the game is transformed from a prisoner's dilemma into a game in which cooperation spontaneously occurs. Although complete altruism is admittedly unlikely, in general the greater the degree of altruism that can be inculcated in players, the more likely are prisoner's dilemmas to be transformed into games with less insidious payoff structures. For example, if each player in Figure 6.2 became only "half altruistic," viewing his payoffs as the average payoff to both himself and his cohort in Figure 6.2 (a), then the game would be transformed into that shown in Figure 6.3, in which mutual cooperation is again the equilibrium outcome. (For a more detailed analysis see M. Taylor, chapter 4).

		Player 2	
		C	D
Player 1	C	(4.5, 4.5)	(3.5, 3.5)
	D	(3.5, 3.5)	(1, 1)

Figure 6.3 Transformed Prisoner's Dilemma through "Half Altruism"

The second major aim of cooperative ideology is to decrease the discount rate which members use to compare the payoffs from sequential constituent games in supergames. As demonstrated in appendix C, the higher the discount rate the more likely it is that a supergame comprised of constituent games that are prisoner's dilemmas will itself be a prisoner's dilemma. For example, members with high discount rates are often "unable to afford cooperative loyalty;" therefore much of the socialization process in cooperatives aims at trying to get farmer-members and board members to take a long view of the cooperative's activities. By reducing the members' discount rates, cooperative ideology discourages short-term opportunistic behavior in favor of long-term support for mutual cooperation.

If ideology is an adaptive response by an organization to the problems it faces, then that ideology needs to evolve as the problems change. An ideology that is incongruent with the problems faced by an organization is ultimately maladaptive. The problem of updating ideologies is similar to the problem of updating SOPs discussed earlier in this chapter. But because ideology that has been incorporated into an individual's set of values seems so "natural" and self-apparent, the need for its change will be perceived only gradually and therefore it is likely to change only slowly. Attempts to change elements of an organization's ideology rapidly may meet bitter resistance from certain participants, as has occurred in some cooperatives when differential pricing of services to members was proposed, even though, as demonstrated in chapter 5, such pricing is sometimes necessary to preserve the viability of the cooperative.

Conclusions

The existence of transaction costs, especially the costs of gathering, storing, and processing information and incorporating it into decisions, modifies the game-theoretic analysis of chapter 5 in several important ways. Highly detailed bargaining games over the allocation of costs and benefits from joint action are likely to be replaced with simpler games: constitutional games, in which the rules of the cooperative are established and its agenda is set, and consequent games, which are simplified noncooperative or cooperative games whose outcomes are determined in large measure by the outcome of the constitutional games. Understanding the behavior of farmer cooperatives therefore requires an understanding of the constitutional games, that is, the games involving the governance of the cooperative. The existence of transaction costs affects these games of governance; in particular, they reinforce the tendency for cooperative governance to be dominated by those having a concentrated as opposed to a diffused interest in the issues being decided by the cooperative. This tendency is further reinforced by the fact that participating in the cooperative's governance may give individuals access to important information on the subsector, which is generally more valuable to those having large investments in the subsector.

The existence of transaction costs also tends to protect the utility of those who are granted the initial right to decide an issue in the cooperative, since those who want to reverse that decision must first overcome the transaction costs involved in doing so. Therefore, the allocation of these initial rights (often determined during the drafting of

the cooperative's bylaws) will importantly affect the cooperative's subsequent behavior.

The existence of information costs also imparts a greater conservatism in decision making by cooperative participants than one would predict from standard game theory. Because of uncertainty, the payoffs to untested alternatives are discounted, leading cooperative participants to rely on standard operating procedures that have proven workable in the past. Nonetheless, participants are still faced with the problem of deciding when it would be advantageous to modify their SOPs. Changes in the environment and in the information available to cooperative participants (some of it provided by parties trying to influence the cooperative) lead to changes in SOPs, but the process is also dependent on the costs of building and maintaining coalitions within the cooperative, as was demonstrated in the analysis of processing cooperatives' modification of their SOPs of providing a "home" for their members' products.

Because information is costly it becomes possible to influence decisions in the cooperative by providing decision makers with low-cost information regarding the likely outcomes from certain courses of action. This information can lead to changes in the decision makers' perception of the payoff matrix and hence their behavior. Large-patronage members may be particularly adept at exercising nonvoting influence because producing such influence through subsidizing information requires resources and because these members have the potential to harm the cooperative if they withdraw their patronage. Although the production of influence may be concentrated among the larger-volume patrons, given the relatively low costs of exercising voice in many cooperatives other participants will also attempt to influence decisions. The board and management are

continually faced with the problems of determining the representativeness of the views that they hear and of resisting the pressure to accede to vocal but poorly thought-out demands.

Limited access to information, limited ability to interpret information provided, or both can hinder the ability of farmer-members and the board to monitor the activities of their cooperative, particularly when the cooperative becomes large and complex. This raises the question of whether a part-time board comprised of farmers, many of whom face the responsibility of running a full-time farm business as well, has the time and the training necessary to monitor effectively the activities of a multimillion- or billion-dollar corporation. One would expect boards to evolve mechanisms to help overcome the informational imbalance between management and the board, and some have done so, providing, for example, a limited number of positions on the board for outside directors. Other mechanisms may also be needed.

The inculcation of a cooperative ideology may help to overcome some of these problems. The fostering of such an ideology represents an attempt by the cooperative to instill standards of behavior among its participants that restrain them from acting in a way that is destructive for the organization even though it may be individually profitable in the short run. Cooperative ideology attempts to change members' expectations regarding the payoffs they will receive from supporting their cooperative, influence participants' marginal rates of substitution between the pecuniary and nonpecuniary returns they receive from the cooperative (this is particularly important in inducing "ethical" behavior by members of the board and management), induce a degree of altruism among participants regarding the welfare of the other participants in the cooperative,

and lower members' discount rates, thereby inducing them to take a longer-run view of their relationship with the cooperative.

Although the introduction of transaction costs and ideology modifies some of the game-theoretic analysis of chapter 5 it does not negate many of the main conclusions of that analysis. The concept of the core remains particularly important: to prevent a proposed allocation of costs and benefits in a farmer cooperative from inducing defection, careful attention has to be given to the payoffs facing individual members. Chapter 7 examines this principle through a case study of the pooling and joint-cost allocation arrangements in some fruit and vegetable processing cooperatives.

CHAPTER 7

A CASE STUDY OF POOLING AND JOINT COST ALLOCATION IN FRUIT AND VEGETABLE PROCESSING COOPERATIVES

"Given a multi-department, multi-commodity supply or marketing cooperative operation, the achievement of absolute, finite equity in the treatment of each individual patron would be a literal impossibility." Touche-Ross (1978), p. 46.

"Discrimination is the secret of efficiency...[but] one must know where to stop." Clark, p. 416.

This chapter uses ideas developed in the preceding chapters to analyze the choice of pooling arrangements and the associated allocation of joint costs in fruit and vegetable processing cooperatives. Pooling arrangements in these cooperatives are a central determinant of how the net benefits from cooperative activity are shared among the membership; therefore, the choice of pooling arrangements can be viewed as a bargaining issue, analyzable using the theory of cooperative games discussed in chapter 5. The search for a pooling arrangement that is acceptable to the members and management is thus equivalent to a search for a solution to a cooperative game. All participants in the cooperative do not have equal access to information regarding the consequences of alternative pooling practices, hence the selection of a particular solution (that is, the choice of a particular pooling arrangement) will reflect the patterns of influence in the cooperative and the participants' bounded rationality, as discussed in chapter 6.

This chapter is divided into three parts. The first part defines pooling, describes alternative ways in which marketing cooperatives pool their products, analyzes how the design of pools can affect the distribution of income among members of a cooperative, and examines the advantages and disadvantages of pooling from the standpoints of various co-op participants. Particular attention is focused on how decisions regarding the number and diversity of commodities included in a pool affect member returns. The second part of the chapter analyzes the decision of three major West Coast fruit and vegetable processing cooperatives to change their pooling practices in 1983. Because of changes in the environment in which these cooperatives operated, participants in these organizations perceived that their previous pooling rules no longer provided "stable" solutions; therefore they sought new pooling arrangements. This section examines their search for new pooling arrangements, using analytic tools developed in previous chapters. A final section summarizes the findings of the chapter.

The Concepts of Pooling and Joint Cost Allocation

Definition of Pooling

The bylaws of a marketing cooperative usually specify two separate sums owed to farmer members: the initial value of their crops sold through the cooperative and the patronage refund. The initial valuation represents the payment to the farmer for his crop, while the patronage refund apportions to the members any net income of the cooperative that remains after deducting its costs (including the initial valuation of raw-products) and unallocated additions to the firm's capital (Sosnick, 1963, p. 48).

There are three ways in which cooperatives can set initial crop values.¹ The first is called "selling by individual results." In this method, the cooperative sells each member's deliveries separately, returning to the member the amount realized for the sale minus the direct costs of handling the member's product and a share of the cooperative's overhead costs. A major disadvantage of selling by individual results is that the cooperative has to keep track of the identity of each member's product throughout the marketing process so that the returns received for it can be properly attributed back to the member. Because selling by individual results prevents members' products from being commingled during processing, it is not a feasible way of valuing members' products in most processing cooperatives that operate plants having substantial economies of size or that produce products such as fruit cocktail that are a blend of more than one raw-product.²

A second method of setting raw-product value is called "immediate fixation," in which the cooperative, much like an IOF, commits itself to pay the member a specific price for his raw-product. Any net earnings accruing to the cooperative after members have been paid and all other costs have been covered are then rebated to members as a patronage refund.

The third method is called "pooling." In this method a member's product is grouped together with "similar" products and members are paid

¹The following paragraphs draw heavily on Sosnick (1963), pp. 48-49.

²Some cotton and rice cooperatives use a form of selling by individual results called a "contract pool," a "call pool" or a "purchase pool." (See Hammond for details.) The pools referred to below exclude this type of arrangement.

the average net return earned by the group, or pool, in which their product participates. Payments to members are usually spread out over the period (often a year or more) during which the crops in the pool are sold by the cooperative. Members receive an advance covering some portion of the estimated value of the crop shortly before or soon after delivering their products to the cooperative (often the advance is used to finance harvesting costs) and periodic "progress payments" as long as some of the pool products remain unsold.¹ A final "equalization payment," which aims at bringing pool participants' total payments in line with what their products actually earned, is issued when the pool is closed.²

Pooling, unlike selling by individual results, allows member products to be commingled in processing, thereby facilitating the handling of large lots. Unlike valuing by immediate fixation, pooling does not require the cooperative to commit itself to a specific price for a member's product before it is known how much revenue that product will generate for the cooperative.

Although one might argue that whenever two or more products share joint costs they are "pooled," the term pooling, as used here, is confined to instances where net revenues are apportioned among farmer members in the manner described above. As will become apparent, however,

¹In some cooperatives, products remaining unsold at the end of the cooperative's fiscal year are transferred or "sold" to the following year's pool.

²Pooling is also used in many supply cooperatives, where revenues from the sales of "similar" items (such as farm supplies) are pooled and uniform patronage refund rates (per dollar of patronage) are extended to all members who bought products from the pool.

pooling does raise important questions of joint cost allocation, which are discussed below.

Examples of Pooling Arrangements

The concept of pooling is best illustrated through examples.¹ Table 7.1 illustrates the accounts of a processing cooperative handling a single raw-product through a single pool. The cooperative processes and sells 100 tons of its members' raw product, for which it receives a gross revenue of \$10,000. After deducting both direct costs and overhead costs \$1,000 remains, which yields a grower return of \$10 per ton of raw product. From this a certain proportion, in this case 15 percent, is retained as operating reserves (see the discussion of the "cash payout " in chapter 5), which leaves a net cash payment to growers of \$8.50 per ton.

One disadvantage of the pooling arrangement illustrated in Table 7.1 is that members may have to wait several months after they have delivered their crops before they know with some certainty what their returns will be. This hinders comparison of the cooperative's performance with that of other market alternatives and increases the difficulty of budgeting farm operations.

Partly to overcome these problems many cooperatives that practice pooling, including almost all fruit and vegetable processing cooperatives, have adopted the practice of declaring, at the time of acquisition, a value for the member's raw product, even though the member may not receive full payment for his product until later in the pooling year. This

¹The following examples are taken from Touche-Ross (1982).

TABLE 7.1
COSTS AND RETURNS OF A PROCESSING COOPERATIVE HANDLING
A SINGLE PRODUCT THROUGH A SINGLE POOL

Units of Raw Product Handled	100 tons
Sales of Finished Product	\$10,000
Direct Costs of Labor, Material and Services (excluding raw product)	<u>5,000</u>
Gross Margin	\$ 5,000
Overhead, Sales, General and Administrative Costs	<u>4,000</u>
Proceeds from Operations (Net Margin)	\$ 1,000
Return to Growers for Raw Product	\$10 per ton
Retainage from Members @ 15%	\$1.50 per ton
Cash Distribution to Growers	\$8.50 per ton

SOURCE: Adapted from Touche-Ross (1982), p. 2.

declared value, often called the "commercial market value" (CMV), "economic value," or "established value" (EV), may be the prevailing "free-market" price, the price negotiated between a bargaining association and IOF processors, or a figure determined by the cooperative in some other way. In declaring an EV the cooperative in essence adopts a form of "immediate fixation," although the cooperative is not obligated to pay members the full declared value if the pool generates insufficient returns to do so. Nonetheless, in the cooperative's accounts (Table 7.2) the declared value of the raw product is deducted as a cost (albeit a cost that has a subordinated claim on cash flow compared with the other costs) in calculating the member's net returns. As will be seen below, the way in which EV is established in multicommodity cooperatives has important implications for income distribution within those organizations.

In the example illustrated in Table 7.2 the total return to members for their raw product equals \$10 per ton, while the EV is \$9 per ton. The pool is therefore said to have returned 111 percent ($10/9 \times 100$) of EV.

When a cooperative handles more than one commodity, the design of its pooling arrangements is a critical determinant of how the benefits from the cooperative's activities are shared among the membership.¹ Two

¹In this chapter raw products are considered to be separate commodities if they yield the cooperative different net revenues. Hence, depending on the circumstances, a commodity might be defined as a specific species (e.g., peaches); a specific variety (e.g., Elbertas); a particular grade or yield of a variety; or a specific species, variety, or grade of product delivered to the cooperative at a particular date. Commodities may also be defined by their intended end use, for example, milk destined for the fluid market as opposed to milk destined for manufacturing use.

TABLE 7.2

COSTS AND RETURNS OF A PROCESSING COOPERATIVE HANDLING
A SINGLE PRODUCT THROUGH A SINGLE POOL USING
A DECLARED RAW-PRODUCT VALUE

Units of Raw Product Handled	100 tons
Sales of Finished Product	\$10,000
Direct Costs of Raw Product, Based on Established Value (100 tons @ \$9/ton) =	\$ 900
Direct Cost of Labor, Materials, and Services	<u>5,000</u>
Gross Margin	\$ 4,100
Overhead, Selling, General and Administrative Costs	<u>4,000</u>
Proceeds from Operations (Net Margin)	\$ 100
Add Back Raw-Product Value	900
Return to Growers	\$ 1,000 or \$10 per ton
Retainage from Members @ 15%	\$1.50 per ton
Cash Distribution to Growers	\$8.50 per ton

SOURCE: Adapted from Touche-Ross (1982), p. 3.

characteristics of a pool are particularly important: its breadth, that is, the number of commodities included in the pool; and the formula used to determine the share of the pool's net returns allocated to producers of different commodities (Buccola and Subaei, 1983a, pp. 1-2).

The number of products included in a pool can range from one up to the total number of commodities handled by the cooperative. If all products handled by the cooperative are placed in one pool the cooperative is said to operate a single pool; if more than one pool is used the cooperative is said to operate multiple pools.

The operation of a single pool for a three-commodity cooperative is illustrated in Table 7.3. In this pool sales of finished products from the three commodities, X, Y, and Z, total \$30,000. From this figure the cooperative deducts its direct cost of the raw-product (which is calculated by valuing the members' deliveries at the established values) and its direct costs for other inputs in order to arrive at its gross margin. Although the direct costs of labor, materials, and services are shown separately for each commodity in Table 7.3, these costs need not be separated by commodity in order to calculate member returns; in a single pool all costs are shared.¹

Overhead costs, which do not have to be allocated among products in a single pool, are subtracted from the pool's gross margin to yield the net proceeds to the pool, in this instance, \$2,000. This is added to the \$10,000 total value of raw product (based on the EVs) to give a total return to the growers of \$12,000. This total return is 120% of

¹Most single-pool cooperatives do, however, try to keep track of their direct costs by commodity, as this provides useful managerial information.

TABLE 7.3
COSTS AND RETURNS FOR A SINGLE POOL IN A THREE-COMMODITY COOPERATIVE

Cost or Revenue Item	Commodities			Total
	X	Y	Z	
Tons of Raw Product Handled	5	10	15	30
Sales of Finished Product	\$15,000	\$10,000	\$ 5,000	\$30,000
Direct Cost of Raw Product (at Established Value)	6,000	3,000	1,000	10,000
Direct Costs for Labor, Materials, and Services (excluding Raw Product)	<u>5,000</u>	<u>5,000</u>	<u>2,000</u>	<u>12,000</u>
Gross Margin	\$ 4,000	\$ 2,000	\$ 2,000	\$ 8,000
Overhead, Sales, and General Administration				<u>6,000</u>
Proceeds of Single Pool (Net Margin)				<u>\$ 2,000</u>
Return to Growers	\$ 7,200	\$ 3,600	\$ 1,200	\$12,000
Grower Return as a Percentage of EV	120%	120%	120%	120%

SOURCE: Adapted from Touche-Ross (1982), p. 6.

the total cost of the raw products valued at EV. The allocation rule in a single-pool cooperative is that producers of each commodity in the pool receive the same percentage of EV as earned by the total pool, which in Table 7.3 is 120%. Producers of X therefore receive \$7,200 ($1.2 \times \$6,000$), producers of Y receive \$3,600 ($1.2 \times \$3,000$), and producers of Z receive \$1,200 ($1.2 \times \$1,000$).

A multiple-pool cooperative may operate a separate pool for each commodity it handles or it may group commodities into only a few pools--for example, one for fruits, one for vegetables, and one for nuts. Table 7.4 illustrates what the accounts of the cooperative just discussed would look like if it operated a separate pool for each of its three commodities.

In Table 7.4, like Table 7.3, sales of processed products total \$30,000, and deliveries of each raw product are valued at their respective EVs. The raw-product cost and the direct costs of processing are deducted from the sales revenue of each processed product to yield a gross margin for each commodity. In a multiple-pool cooperative overhead costs have to be allocated among the pools in order to determine the net returns to each pool. In Table 7.4 the \$6,000 overhead is evenly split among the three pools; as discussed below, other allocation schemes are possible. Deducting each pool's share of overhead costs from its gross margin yields the return to growers from that pool. Unlike in a single pool, returns to different commodities measured as a percentage of EV typically vary in a multiple-pool cooperative. Costs and revenues are not totally shared in such a cooperative; each commodity is said to "stand on its own feet." For example, given the accounting rules of the cooperative shown in Table 7.4, commodity X appears more

TABLE 7.4
COSTS AND RETURNS FOR A MULTIPLE-POOL COOPERATIVE

Cost or Revenue Item	Commodities			Total
	X	Y	Z	
Tons of Raw Product Handled	5	10	15	30
Sales of Finished Product	\$15,000	\$10,000	\$ 5,000	\$30,000
Direct Cost of Raw Product (at Established Value)	6,000	3,000	1,000	10,000
Direct Costs for Labor, Materials, and Services (excluding Raw Product)	<u>5,000</u>	<u>5,000</u>	<u>2,000</u>	<u>12,000</u>
Gross Margin	\$ 4,000	\$ 2,000	\$ 2,000	\$ 8,000
Overhead, Sales, General, and Administration	<u>2,000</u>	<u>2,000</u>	<u>2,000</u>	<u>6,000</u>
Proceeds of Pools	<u>\$ 2,000</u>	<u>\$ 0</u>	<u>\$ 0</u>	<u>\$ 2,000</u>
Return to Growers	\$ 8,000	\$ 3,000	\$ 1,000	\$12,000
Grower Returns as a Percentage of EV	133%	100%	100%	120%

SOURCE: Adapted from Touche-Ross (1982), p. 5.

profitable to the cooperative than either Y or Z. In the multiple-pool system the producers of X capture this higher return for themselves: they receive 133 percent of EV compared with 100 percent for the producers of Y and Z. In the single-pool (Table 7.3) the high return to X was shared among producers of all three commodities, each of whom received 120 percent of EV. As will become apparent below, the "profitability" to a cooperative of a particular crop in a multiple-pool arrangement is a function of the accounting rules of the organization.

Determinants of Pool Returns

The Established Value

Several decisions made by a cooperative's management and board of directors affect how the earnings of a pool are distributed among pool participants. One of the most important of these decisions, in both single-pool and multiple-pool cooperatives, is the setting of established values for individual crops. In a multicommodity pool, such as that shown in Table 7.3, the established value of a particular crop determines the cost of that crop to the pool; the pool is obligated to pay this cost to the producers of that crop before the pool's net margin, which is distributed among producers of all crops participating in the pool, is calculated. Therefore, the return to an individual commodity in a pool is greater the larger is its EV and the smaller is the EV of all the other commodities in the pool. As a result, producers have a strong interest in influencing the relative levels of EV of different commodities in a multicommodity pool. For example, if a processing cooperative that operates a multicommodity pool adopts as its EVs the raw-product prices negotiated between farmer bargaining associations and IOF

processors, then each commodity group within the processing cooperative has a strong incentive to support vigorous collective bargaining for its particular crop. Tomato growers, even if they do not sell to IOFs, will push the tomato bargaining association to try to negotiate a high price with IOFs, as this will increase the tomato EV paid by the processing cooperative. Producers of other crops will behave in a similar manner. If some crops in the pool have collective bargaining while others do not, this process can skew the returns of the pool towards producers of the bargained crops (see Chase-Lansdale, 1980). In multiple-pool cooperatives (including cooperatives that run a separate pool for each commodity) the setting of EV may also affect how joint costs are allocated among pools. This is discussed below.

The Breadth of the Pool

The breadth of a pool refers to the number of commodities included in the pool. The breadth of a pool affects the profitability of producing the various commodities in the pool and the variability of returns to the producers of those commodities. A broad pool, that is, one containing a large number of products, may involve substantial income transfers and redistribution of risk among pool participants.

Because net returns are shared in a pool, producers of each commodity have an incentive to have their crop be included in a pool where all the other crops are more profitable to the co-op than is their own, as this will maximize the transfer of income to these producers from producers of other crops. Similarly, it is in the interest of a group of producers to have their product be included in a pool with crops whose net return to the cooperative is less variable than that of their

own crop, as this transfers some of the income risk to producers of the more stable crops. Because producers of a commodity have an incentive, at least in the short run, to have their commodity be the least individually profitable (to the cooperative) and the most risky of any crop in its pool, farmer-members have a keen interest in how pool boundaries are drawn.

Allocation of Shared Costs

The way in which shared costs (overhead costs) are allocated among commodities strongly influences member returns.¹ Within a pool (for example, in a single-pool cooperative) overhead costs are essentially allocated through a process of averaging, as all costs are shared. If a cooperative operates more than one pool, costs that are shared among the pools (for example, the cooperative's general administrative costs) must be explicitly apportioned among the pools. The rules for apportioning shared costs affect the profitability of each pool. For example, in Table 7.4 shared costs were split evenly among the three pools, each of which paid \$2,000. If, instead, these costs had been allocated in proportion to the final sales revenue of each pool, X would have paid \$3,000, Y would have paid \$2,000, and Z would have paid \$1,000. X's pool would have then returned 117% of EV, Y's pool would have returned 100% of EV, and Z's pool would have returned 200% of EV.

If costs are truly joint among products there is no nonarbitrary way of allocating them. These shared costs may arise in several ways (Clark, pp. 57-58). A piece of equipment or particular type of work

¹The following discussion draws heavily on Chase-Lansdale (n.d.) and Braeutigam.

(for example, legal services) may render simultaneous service to different types of output or to the firm as a whole, but its relative contribution to specific lines of activity may be unclear. A type of work may be conducted for a particular unit of business but have important "spill-over effects" on other lines of the business. This is particularly true in the advertising of branded products, where advertising one particular item may also increase demand for other items in the same product line.¹ It is also important where economies of scope exist (for example, in selling) because expenditures on one particular item may make it cheaper to produce and sell other items as well.² Finally, costs may be potentially attributable to separate lines of activity but the effort required to determine the proper attributions may be so large that it is more economical to treat these costs as shared.

The problem of allocating shared or overhead costs can be visualized as follows (Braeutigam). Consider a cooperative handling n products in a given pool. The cost of handling the products can be written as:

$$(7.1) \quad C(\underline{X}) = S + \sum_{i=1}^n C_i(X_i)$$

where

$C(\underline{X})$ = the cost function for the pool;

¹For example, the advertising that accompanied the introduction of Land O'Lakes margarine between 1972 and 1982 reportedly also increased sales of Land O'Lakes butter (Hofstad).

²Again, Land O'Lakes is an example. The introduction of margarine broadened the cooperative's product line in the "spreads" category, making it economical for the company to serve smaller accounts that it previously could not afford to carry when the cooperative sold only butter. The costs involved in introducing the margarine, in other words, allowed the cooperative to sell butter in more markets than before (ibid.).

$\tilde{X}$ = an $n \times 1$ vector, $(X_1, X_2, \dots, X_n)$, where each X_i represents a different product in the pool;

S = shared costs of the pool; and

$C_i(X_i)$ = the attributable cost of handling the i th commodity in the pool.

The problem facing the board and management of the cooperative is determining what fraction of the shared cost, S , each of the n commodities should bear. If the fraction of shared costs borne by the i th commodity is s_i , the board and management must determine a set of s_i such that:

$$(7.2) \quad \sum_{i=1}^n s_i = 1.$$

Cooperatives typically use one of four methods to determine the proportion of shared costs that each commodity in a pool should bear. The first method, known as the relative output method or volume basis, allocates shared costs among commodities on the basis of the physical volume of raw or processed product accounted for by each commodity. The fraction of shared costs allocated to the i th commodity by the relative output method equals

$$(7.3) \quad s_i^0 = \frac{X_i}{\sum_{i=1}^n X_i}$$

where

s_i^0 = commodity i 's allocated fraction of shared costs under the relative output method; and

X_i = the physical volume of the i th commodity, either in raw or processed form.

For example, total shared costs for a vegetable pool might be divided by the total number of cases packed, leading to a constant per-case charge for shared costs. The relative output method creates a linear relationship between the volume of a commodity handled and that commodity's proportion of shared costs. If nonlinear economies of size exist, this method does not accurately reflect how additional volume contributes to cost (Chase-Lansdale, n.d., p. 6).

A second way of allocating shared costs is the attributable cost method. This method allocates to each commodity a fraction of shared costs equal to that commodity's share of the pool's total attributable costs. For example, if processing tomatoes account for 30 percent of the pool's total direct costs for labor, materials, and services (excluding raw-product expenditures), then tomatoes are also charged 30 percent of the pool's shared costs. In other words, the fraction of shared costs allocated to the i th commodity by the attributable cost method equals

$$(7.4) \quad s_i^a = \frac{C_i(X_i)}{\sum_{i=1}^n C_i(X_i)}$$

where

s_i^a = commodity i 's allocated fraction of shared costs under the attributable cost method; and

$C_i(X_i)$ = the attributable cost of handling the i th commodity in the pool.

The third common way of allocating shared costs is the relative dollar value method, which is also known as the percentage ratio basis or the gross revenue method. Unlike the relative output method, which

allocates shared costs on the basis of the physical volume of each of the products in the pool, the relative dollar value method allocates these costs on the basis of the dollar value of each of the commodities in the pool. This dollar value may refer to the raw product (that is, it may be the EV) or it may refer to the finished product, in which case it is the anticipated revenue from sales of the processed product. The fraction of shared costs allocated to the ith commodity by the relative dollar value method equals

$$(7.5) \quad s_i^d = \frac{d_i(X_i)}{\sum_{i=1}^n d_i(X_i)}$$

where

s_i^d = commodity i's allocated fraction of shared costs under the relative dollar value method; and

$d_i(X_i)$ = the dollar value of the ith commodity, calculated with respect to either the raw product or the processed product.

For example, a processing cooperative might allocate shared costs on the basis of sales of processed products. If commodity X accounted for 20 percent of final sales it would bear 20 percent of the shared costs. As with the relative output method, the relative dollar value method establishes a linear relationship between shared costs and output, in this case the dollar value of output.

The fourth way of allocating shared costs is known as the discretionary basis. In this method the board and management allocate shared costs on an ad hoc basis, usually in proportion to a commodity's perceived ability to bear these costs. A certain amount of discretion is sometimes also used to adjust the allocations derived from the other

methods discussed above, although the board and management must continue to make sure that equation (7.2) holds, that is, the cost allocations to the individual commodities are sufficient to cover the total shared costs.¹

The rule adopted for allocating shared costs can dramatically affect the returns to different groups of members. For example, consider a multipool cooperative that produces several goods and/or services for its members, each corresponding to a separate pool. These products or services could be processing services, as in a marketing cooperative, or farm inputs, as in a supply cooperative. Assume:

- (1) the cooperative provides the goods and services at cost, rebating all profits to the members;
- (2) the revenue obtained from selling each good or service just covers the cost of producing it, where "cost" includes the good's allocation of shared costs (that is, each product or service is required to "stand on its own feet"); and
- (3) the cross elasticity of demand between any two goods and/or services produced by the cooperative is zero.

¹The importance of discretionary allocations is illustrated in the comments of a board member of a Michigan processing cooperative quoted by Chase-Lansdale (1980, p. 154 n.):

Say you have \$500,000 worth of overhead to spread on cherries, prunes, apples, and juice. You start out in the spring with \$350,000 allocated to cherries, \$100,000 to apples, and \$50,000 to something else. You get to the end of the year and find that doesn't work. You find your apple deal could take \$150,000 and prunes cost you \$50,000 so you switch over. You have a bottom figure at the end of the year. You make it come out right by making the necessary changes...99% of the growers had no idea what was going on inside the cooperative.

Under these conditions Braeutigam has shown that the relative output method of allocating shared costs will lead to the following relationship between the price charged for the various goods and services and the attributable costs of producing them.¹

$$(7.6) \quad P_i - \frac{C_i(X_i)}{X_i} = P_j - \frac{C_j(X_j)}{X_j} \quad \forall i, j$$

where

P_i = the price of the i th good or service produced by the cooperative;

$\frac{C_i(X_i)}{X_i}$ = the average attributable cost of producing the i th good or service; and

P_j and $\frac{C_j(X_j)}{X_j}$ are defined analogously for the j th good or service.

Equation (7.6) states that, given the above assumptions, using the relative output method to allocate shared costs results in the difference between the price of a good or service and the average attributable cost of producing it being equal for all goods and services produced by the cooperative.

In contrast, both the attributable cost method and the relative dollar value method imply that:

$$(7.7) \quad \frac{P_i}{C_i(X_i)/X_i} = \frac{P_j}{C_j(X_j)/X_j} \quad \forall i, j,$$

that is, the ratio of the price of a service to its average attributable cost is the same for all services.

¹Braeutigam's analysis was of public-utility pricing; it is adapted here to the analogous problem of cost allocation among cooperative pools.

Consider a cooperative that cans and markets both tomatoes and pears. The board and management must decide what price to charge members for the cooperative's services.¹ The cooperative packs 100 cases each of tomatoes and pears. Assume that

$$C_i/X_i = \text{attributable cost of canning and selling pears} = \\ \$1.50/\text{case};$$

$$C_j/X_j = \text{attributable cost of canning and selling tomatoes} = \\ \$2.50/\text{case}; \text{ and}$$

$$S = \text{shared costs} = \$600.$$

Therefore the cost function for the cooperative equals $C(X) = S + C_i + C_j = \$600 + \$150 + \$250 = \$1,000$. The break-even constraint for the cooperative is

$$(7.8) \quad 100 P_i + 100 P_j = \$1,000.$$

If the cooperative allocates its shared costs using the relative output method equation (7.6) implies that

$$(7.9) \quad P_i - \$1.50 = P_j - \$2.50.$$

Solving (7.8) and (7.9) simultaneously yields the following prices for the processing and selling services:

$$P_i = \$4.50 \text{ and}$$

$$P_j = \$5.50,$$

that is, pear growers are charged \$4.50 per case for the services and tomato growers are charged \$5.50 per case.

¹In reality, the charge for these services would be incorporated in the net return the members received for their products from the cooperative rather than being calculated explicitly. Nonetheless, the impact on income distribution within the cooperative would be the same as if members were explicitly charged for the cooperative's services.

If, in contrast, the cooperative allocated shared costs based on the attributable cost or the relative dollar value method, equation (7.7) implies that

$$(7.10) \quad P_i/1.50 = P_j/2.50.$$

Solving (7.8) and (7.10) simultaneously yields:

$$P_i = \$3.75 \text{ and}$$

$$P_j = \$6.25.$$

In other words, adopting the attributable cost method or relative dollar value method results in tomatoes, which have the higher attributable cost, paying a higher proportion of the cost of maintaining the cooperative than under relative output method, while pears pay a smaller proportion.

Advantages and Disadvantages of Alternative Pooling Arrangements

Because pooling arrangements affect the distribution of income within the cooperative, there is typically no single arrangement that is universally preferred by all co-op participants. This section outlines possible advantages and disadvantages of broad versus narrow pools, pointing out how various groups within the cooperative may evaluate these pools differently.¹

¹This section is based upon Sosnick (1963); Buccola (1982); Buccola and Subaei (1983a, 1983b); Touche-Ross (1978); and the author's interviews with cooperative managers and board members.

Advantages of Broad Pools

Commonly perceived advantages to pooling or to reducing the number of pools in a cooperative (for example, moving from multiple pools to a single pool) include:

- (1) Pooling allows the commingling of members' products, which can reduce marketing and processing costs (since the identity of individual lots do not have to be preserved) and the development of blended products. For example, one cooperative visited by the author had recently moved from multiple pools to a single pool because the board and management had concluded that there was no equitable way in which to allocate returns from blended products among individual product pools. By moving to a single pool the board essentially allowed the allocation of returns from blended products to be made through the averaging process of a single pool and through the setting of EV's rather than through more explicit board and management decisions. Although returns were still being allocated to producers of different crops, they were being done so in a way that was perhaps less visible to the membership and less politically divisive for the board. By obscuring allocational decisions (and hence individual participants' objections to those decisions) pooling may thus facilitate agreement in the cooperative regarding the sharing of returns from joint undertakings, such as the sale of blended products.
- (2) Reducing the number of pools in a cooperative reduces accounting costs; detailed records on the costs incurred in handling individual commodities are not necessary, as all costs within

a pool are shared. This advantage of pooling appears to be declining as the cost of computerized information handling falls.

- (3) Pooling may lead to some reduction in risk for individual farmers, as fluctuations in the returns for their commodities are counterbalanced by offsetting fluctuations in the returns for other commodities in the pool (see chapter 4). This may in turn enhance the ability of co-op members to budget and borrow to finance farm operations (Sosnick, 1963, p. 60). Whether pooling does reduce risk depends, however, on the crops involved (producers of "stable" crops may find their returns destabilized by pooling) and on whether fluctuations in the returns for different crops in the pool offset or reinforce each other.¹
- (4) Pooling increases the production and marketing flexibility of a cooperative; therefore, co-op managers tend to prefer fewer and broader pools. If a cooperative runs a separate pool for every commodity it handles and requires each to "stand on its own feet" the cooperative cannot handle any product that generates insufficient revenue to cover both its attributable costs and its full pro-rata share of overhead costs as determined by the co-op's rules for allocation of shared costs. As long as a product generates enough revenue to cover its attributable costs and make some contribution to overhead costs,

¹For details on how alternative pooling practices could affect the stability of returns to producers of different crops in a multicommodity cooperative, see Buccola and Sabaei (1983b).

however, the cooperative firm and the members who produce other commodities are better off handling that product than not, even if it does not "stand on its own feet."¹ By making some contribution to overhead the product reduces the overhead burden that producers of other commodities must bear. If cooperative members insist that this product cover its full share of the overhead, the product's pool will show a loss every year, and IOFs and single-pool cooperatives will be able and willing to bid the product away from the multiple-pool cooperative, leaving the remaining members of that cooperative worse off than before.

Broad pools promote marketing flexibility by allowing a cooperative to promote its entire line of products by using individual products as loss leaders without forcing the producers of those particular products to bear the entire cost of the promotion. In this sense broad pools promote fairness among the members (Buccola, pp. 27-28). In interviews with the author, several board members and managers argued that without broad pools it would be politically impossible for a manager to follow this practice of "using one product to sell another." This type of marketing flexibility is needed to meet the competition of IOFs, which can allocate costs among products and set relative product prices in whatever way they find most profitable.

¹ Provided that no expansion of "overhead" has occurred just to handle this product. Any such expansion of overhead should be considered an attributable cost of the product.

Similarly, broad pools permit a cooperative to enter new, potentially profitable markets even though doing so may involve losses for the first few years. These losses are "carried" by the other products in the pool, which in turn will share in some of the future profits of the new products. Several of the managers and board members interviewed by the author stated that it was much easier in a single-pool cooperative than in a multiple-pool cooperative to get board agreement to make investments in potentially profitable new products or processes, even if these did not directly involve all members of the cooperative. The single-pool gave all members a share of the new profits, whereas in a multiple-pool cooperative members might oppose investing in a highly profitable venture that did not directly benefit their particular commodity. Broad pools, in other words, may permit a cooperative to be more flexible in seizing emerging market opportunities by making it easier to build coalitions within the board. The sharing of profits through the single pool involves side payments to producers of less profitable crops to gain their support for investments involving more profitable crops.

- (5) A single-pool relieves management and the board from having to make arbitrary allocations of overhead costs among pools. Although most cooperatives use a specific rule for initially allocating overhead, the results of these allocations are often modified in an ad hoc manner through "pool equalization

accounts" or "kitty accounting" so that each pool manages to "stand on its own feet" (Touche-Ross, 1978, p. 45).

Disadvantages of Broad Pools

There are three major disadvantages of broad pools:

- (1) There are potential inequities among members because commodities that are highly profitable for the cooperative may subsidize less profitable commodities. Tensions over cross-subsidies may lead producers of the more profitable commodities to threaten to leave the cooperative unless pooling rules are changed to give these producers a larger share of the revenues generated by their products.
- (2) Pooling, by averaging the returns to all products in the pool, creates disincentives to produce high quality products; a member who produces a high-quality product does not receive 100 percent of the additional net revenue his product generates for the association. If the cost of producing a product is proportional to its quality then a member has a short-run incentive to have his product be the lowest quality of any in the pool, as this minimizes his cost while he still receives the uniform pool price. Such an incentive can lead in the long run to the cooperative's having lower product quality and lower returns than if it had operated narrower pools.
- (3) The allocation of returns from a broad pool is critically dependent on the setting of EVs. As cash markets for many products have eroded in recent years (see below) the setting

of EV has been left more to the discretion of management and the board, and hence is potentially subject to arbitrary decisions.

The considerations outlined in this section all played important roles in the decision of three major California cooperatives to change their pooling practices in 1983. This decision is examined in the following section.

Changes in Pooling Practices of California Fruit and Vegetable Processing Cooperatives in 1983

Most of the canned fruits and tomato products sold in the U.S. originate in California, with farmer cooperatives accounting for much of that volume. Industry sources estimated that in the early 1980s the three major California fruit and vegetable processing cooperatives, Tri/Valley Growers (TVG), California Cannery and Growers (Cal Can), and Pacific Coast Producers (PCP), processed approximately 25 percent of the processing tomatoes grown in California and, along with one IOF processor (DeL Monte), accounted for about 80 percent of the state's canned fruit production.¹

Up through 1983 all three of the cooperatives handled both fruits and vegetables in a single-pool; the major commodities were peaches, pears, tomatoes, and, in the case of TVG, olives.² Beginning in the mid 1970s a number of changes occurred in the environment in which these

¹In June 1983 Cal Can filed for reorganization under Chapter 11 of the federal bankruptcy laws. Therefore, the following discussion will focus mainly on TVG and PCP.

²The return to members who grew olives, a particularly profitable commodity for TVG, was enhanced through a special "equalization program" that raised the EV of olives in order to ensure the cooperative an adequate supply.

cooperatives operated that made single pooling less acceptable to certain participants in the cooperatives. In other words, the stability of single pooling as a solution to the cooperative game of how to allocate the returns from joint action was increasingly drawn into question. This section outlines how these changes led the cooperative participants to seek a new solution to their cooperative game, one that would ensure stability of their organizations.

Forces Precipitating a Change in Pooling Practices

By the end of the 1970s a number of technological and market changes had occurred that created tensions between fruit growers and tomato growers participating in the cooperatives' single pools. These changes included:

- (1) A weakening market for California canned fruits, due primarily to declining per capita consumption but also the result of shrinking export markets (because of EEC policies aimed at self-sufficiency) and increased competition from processed pears produced in the Pacific Northwest.
- (2) A strengthening market for tomato products, due in part to the increasing popularity of Italian food.
- (3) The development of two-stage processing of tomatoes. In two-stage processing, instead of converting tomatoes at harvest into finished products such as catsup, the tomatoes are initially concentrated into paste, a storable commodity which is reprocessed later (either in the same plant or elsewhere) into products such as sauce, puree, juice, and catsup. Two-stage processing allows a firm to spread tomato processing

throughout the year, thereby reducing the need for multicommodity plants. One of the major advantages of a multicommodity plant is that it allows overhead to be shared among several commodities that are harvested and processed throughout the year. Because of two-stage processing, tomatoes became, in the words of one tomato grower, "the only crop that could support a co-op all by itself."

- (4) The increasing use of single-product plants, in part the result of two-stage processing of tomatoes.
- (5) The reduction in accounting costs due to the computer revolution.

The increase in the profitability to the cooperative of processing tomatoes relative to fruit led many tomato growers to feel that the single-pool resulted in their subsidizing the returns to fruit growers.¹ Increasing demand for tomatoes from IOF processors, including some single-commodity firms that specialized in two-stage processing, increased the market options of tomato growers and reduced their dependence on the cooperatives. In the game-theoretic terms of chapter 5, the security level of tomato growers had increased, leading them to demand a higher payoff from the cooperative coalition. One way of getting these higher payoffs would be to move to separate pools so that the earnings from the tomato products would not be "diluted" by losses from the processed fruits. The possibility of moving to separate pools was

¹In one cooperative this feeling was exacerbated by the cooperative's practice of having the pool as a whole contribute to the fruit bargaining associations (which indirectly led to higher EVs for the fruit growers) while assessing only the tomato growers for contributions to the tomato bargaining association.

enhanced by the increasing use of single-product plants and by the computer revolution. The increased reliance on single-product plants reduced the number of shared costs that would have to be allocated in a multiple-pool cooperative as well as reducing the number of ways in which shared costs could be allocated in the remaining multicommodity plants.

In game-theoretic terms the creation of single-product processing plants created new core constraints that restricted how costs could be allocated in the remaining multiproduct plants. Producers of a particular crop who were charged more for the use of a multicommodity plant than they would have had to pay in a single-commodity plant had an incentive to leave the cooperative and establish their own single-commodity cooperative. (See the example of cost allocation in a multicommodity cooperative in chapter 5.)

The ratio of shared costs to attributable costs was further reduced by the reduction in accounting costs made possible by the computer revolution. It now became economical to keep track of certain costs that were in fact attributable but which in the past had been included in overhead due to high accounting costs. Chase-Lansdale (n.d.) reports that in the mid-1970s shared costs represented between 25 percent and 95 percent of the total cost of processing and marketing different canned fruits and vegetables in California. By 1979/80 shared costs represented 32 percent of total costs in the industry (Touche-Ross, 1982, appendix A), and by 1983 shared costs accounted for 20 percent or less of total costs for most multicommodity canners in the state (Brown, personal communication).

As a result of these changes not only were there pressures from tomato growers to move away from single pooling, but such a move seemed increasingly feasible to management from an accounting standpoint. At the same time managers of these cooperatives, faced with large unsold inventories of canned fruit that threatened the organization's financial viability, became concerned that single pools had failed to signal fruit growers how badly the demand for their products had fallen. Managers therefore also became interested in modifying the single-pool in order to send less distorted economic messages to the farmer-members.

The Influence of Subsidized Information

The analysis in chapter 6 indicated that subsidized information can often play an important role in influencing whether and how cooperatives change their standard operating procedures, such as their pooling rules. In the discussions that took place in the California cooperatives about whether to move away from single pooling, a study by the accounting firm of Touche-Ross (1982), commissioned by the Agricultural Cooperative Service of USDA, was extremely influential in shaping the debate, even though that was not its primary intended purpose.

The report, which built upon previous research by George Kuznets, Sidney Hoos, and Eric Thor of the University of California-Berkeley, addressed the increasingly difficult problem of setting EVs when there are few market outlets other than cooperatives. The California cooperatives had historically used the prices paid by IOF processors to calculate member EVs, but as the market share of IOF processors declined, it became increasingly problematic that the remaining IOF prices accurately reflected the market supply and demand situation. As an alternative way

of setting EVs the report advocated working backwards from the price of the finished products. Using forecasting models for finished products developed by Kuznets and Hoos, a cooperative could estimate its projected returns from selling a given processed product, such as canned pears. It could then deduct the attributable costs of processing the product and the product's allocation of shared costs to arrive at an estimate of what the raw-product would actually earn for the cooperative. The procedure is illustrated in Table 7.5, using the historical price (rather than the forecast price) for processed Bartlett pears in 1972/72.

The cost figures used in the Touche-Ross report were based on an annual survey conducted by the company of the costs for all California fruit and vegetable processors. Hence, the allocations of overhead costs shown in the report represented industry averages, based on different allocation rules used by different processors. The estimated "true" economic worth of the various products calculated in the report therefore also represented industry averages rather than estimates of how much each commodity contributed to any particular cooperative.

After outlining this procedure for estimating more "realistic" economic values for raw products, the report used historical data on the prices of processed products and the cooperatives' costs to calculate the raw-product prices this procedure would have generated over the period 1960/61 through 1979/80 (assuming no forecast errors) and compared them with the actual prices farmers received for their raw products. The analysis covered pears, peaches, apricots, fruit cocktail, spinach, and a variety of tomato products. The results, in the words of one cooperative manager, "really stirred up the industry. They showed that for whatever period you picked--four of the last five years, eighteen

TABLE 7.5
CALCULATION OF RAW-PRODUCT VALUE OF BARTLETT PEARS
BASED ON FINISHED-PRODUCT PRICE, 1971/72

Average F.O.B. Price per Case Realized by California Cooperatives (No. 2-1/2 Choice)	\$ 7.80
Variable Costs of Processing	- 3.85
Contribution to Gross Margin	\$ 3.95
Allocation of Shared Costs	- 1.43
Gross Income	\$ 2.52
Cost of Capital	- .39
Net Revenue per Case	<u>\$ 2.14</u>
Case Yield (cases per ton)	<u>x 45.38</u>
Grade Yield (percentage undamaged)	<u>x .9598</u>
Economic Value per Ton of Raw Product	\$93.07

SOURCE: Adapted from Touche-Ross (1982), p. 18.

out of the last twenty, or whatever--tomato growers had supported the fruit growers." For example, the figures indicated that over the 1960-79 period payments to tomato growers represented only 74 percent of what their raw product actually earned for the cooperatives, while pear growers received 152 percent of the "true" value of their raw product and peach growers received 223 percent (Touche-Ross, 1982, appendix A). Although the report noted that each product covered its attributable costs and made some contribution to overhead, it is possible that some of that "overhead" had been created simply to handle the unprofitable items (Brown, personal communication).

The report greatly strengthened the hands of those seeking changes in the pooling rules. Tomato growers cited it as proof that they were being forced to subsidize the fruit growers, and some in management saw it as evidence that the single pool did indeed distort economic signals to producers.¹ According to participants interviewed by the author, the report was extensively discussed in board and grower meetings, and fruit growers, faced with implicit (and occasionally explicit) threats of exit by tomato growers if the pooling rules were not modified, conceded that some changes were needed.

The Search for a New Solution

Once fruit growers conceded the need for change, management, which had been allied with tomato growers in advocating new pooling arrangements, began working with fruit growers (and some of the tomato growers) to prevent those changes from being too extreme. While some tomato

¹Some management officials, however, expressed doubt to the author about the accuracy of the cost figures upon which the study was based.

growers advocated totally separate pools for tomatoes and fruits, management (and even some board members who were tomato growers) wanted to retain some elements of a single pool in order to preserve the managerial flexibility discussed above. There was also a concern, as mentioned earlier in the chapter, that moving to totally separate pools would destroy the ability of the board to agree on undertaking potentially profitable investments in the processing of individual commodities, as the profits from those investments would accrue only to producers of the commodities directly involved rather than being shared among all members through a single pool. In other words, totally separate pools might destroy the commonality of interest of the board. A further concern was that in moving to separate pools the insurance aspects of a single pool would be lost. For these reasons, management lobbied tomato growers for a solution that would preserve some aspects of the single pool, stressing particularly to growers that cross-subsidies ran both ways--that in years of poor tomato prices (such as 1979/80) fruit growers had helped "carry" the tomatoes. In urging tomato growers to "take a long view" of the cooperative's enterprise, management was essentially trying to get them to reduce their discount rate by convincing them to give more weight to the possible future costs of separate pools compared with their present benefits (see chapter 6).

The solutions that emerged from board and grower discussions were compromises. TVG adopted what was called a "50/50 pool." The co-op established six separate pools: mixed fruits, which included all cling peaches, all pears used for mixed fruit packs, grapes, and cherries; grade pack pears, which included all pears in excess of those needed for the mixed fruit packs; apricots; Elberta peaches; tomatoes; and olives.

The co-op also retained a single multicommodity pool that included all the crops handled by the co-op. Each grower's deliveries of raw product were divided equally between this multicommodity pool and the appropriate single-commodity pools. The return to a grower therefore was a blend of the earnings from the multicommodity pool and from the separate pools in which he participated. Although EV continued to be set as before, the bylaws were amended to allow the board "to establish or adjust established value by reference to contributions to margin in the affected pool or pools...when available data as to commercial transactions is deemed inadequate to fairly fix the value" (Tri/Valley Growers). Cal Can was reportedly considering a plan similar to TVG's before it went bankrupt.

PCP adopted a plan similar to that advocated in the Touche-Ross report. The co-op now calculates a three-year moving average of the prices received for each of its processed products (based on the past two years' prices and an estimate of the current years' prices) and then works backwards to calculate the "true" EV of each raw product in the manner outlined above. These EVs are then used to establish the initial valuation of the members' raw-products, which continue to be sold through a single-pool. The use of a three-year moving average rather than a forecast of only the current year's prices and the continued reliance on a single-pool (albeit with new EVs) preserves some of the smoothing of member returns and the managerial flexibility present in the old single-pool method of pricing. By preserving at least the image of operating on a single pool it also helps maintain the cohesiveness of the board.

One might expect that the move to these new systems of raw-product pricing would have simply replaced controversies over cross-subsidization within a pool with new controversies over how joint costs should be allocated among pools. This does not appear to have occurred, apparently because of the bounded rationality of the members. Discussions with managers and board members revealed that while most farmer-members are sensitive to the issue of potential cross-subsidies in a single pool, they tend to regard the allocation of shared costs as a technical matter to be settled by accountants. This attitude may change as members become more familiar with the new pricing arrangements.¹

Conclusions

The choice of pooling practices in a cooperative represents the solution to a cooperative game, that of deciding how to allocate the costs and benefits of joint action by farmers. Several factors determine how pooling arrangements affect co-op participants, including the number and breadth of pools, the rules for allocating pool receipts (including the setting of EVs), and, in multiple-pool cooperatives, the rules for allocating shared costs. Broad pools tend to increase managerial flexibility, may provide some degree of income stabilization for members, and contribute to more harmonious board decision making. They may, however, distort economic signals to members and lead to income transfers among producers of different commodities, raising serious

¹One would expect managers to foster the belief among members that the rules for allocating shared costs are purely technical matters, as this belief would reduce conflict among the members and increase managerial flexibility in allocating costs and setting prices.

equity issues and the potential threat of exit by members who feel they are being forced to subsidize their less profitable brethren.

The change in the pooling practices of the major California fruit and vegetable processing cooperatives in 1983 illustrates many of the concepts discussed in chapters 5 and 6. Technological and market changes in late 1970s changed the core constraints facing these cooperatives; as a result, the single-pool solution was no longer stable, as tomato growers threatened to leave the organizations. The debate over whether to change the pooling rules was strongly influenced by subsidized information in the form of an outside report that documented the degree of income transfers engendered by the old pooling system.

Coalition building was important in bringing about the change in pooling rules. Management, concerned that the single pool was generating distorted economic signals to growers that threatened the viability of the cooperative (and hence managers' employment), initially allied itself with tomato growers in pushing for a change in the pooling system. Once fruit growers had conceded the need for change, however, management allied itself with them to prevent the change from being so drastic as to deny management some of the flexibility offered by single pools.

The outcome of this process, as the theory of bargaining would suggest, was a compromise--a new solution that for the time, at least, appears stable. The cooperative coalition was preserved due to the participants' ability to agree on a reallocation of the benefits from cooperative activity.

CHAPTER 8

CONCLUSIONS AND IMPLICATIONS

"You can see a lot just by looking." Yogi Berra

This study has attempted to take a hard look at farmer cooperatives in order to understand better what they are, how they differ structurally and behaviorally from other types of businesses, and how those structural and behavioral differences affect the distribution of the costs and benefits generated by these organizations. This chapter summarizes the major conclusions of the study, draws implications regarding how farmer cooperatives and public policies towards them might be modified to improve performance, and suggests ways in which the analytical approach outlined in this study can be extended and further applied empirically.

The chapter contains five sections. The first section summarizes the analytical approach adopted in this study, relates it to the approaches used in other theoretical studies of farmer cooperatives, and outlines its unique contributions to the understanding of many of the issues facing these organizations. The second section outlines the major behavioral differences between farmer cooperatives and investor-owned firms that have been highlighted in this study and discusses how the standard operating procedures of cooperatives can affect those differences. The third section examines cooperatives' behavior in a dynamic context, discussing how changes in the economy are likely to affect

cooperatives' role and behavior in the future. The fourth section draws implications from the analysis for the design of cooperatives' structures and practices and for needed changes in public policies towards farmer cooperatives. The final section discusses how the research presented here could be further extended both theoretically and empirically.

Towards an Integrated View of Farmer Cooperatives

Theorists have historically viewed the farmer cooperative as either a form of vertical integration by otherwise independent farmers, a firm which happens to be owned by its customers, or a coalition of previously competing firms that banded together to capture gains from joint action. Elements of all three approaches are useful in understanding how the benefits and costs generated by farmer cooperatives are distributed among the participants in these organizations. Many of the benefits that farmers derive from cooperatives are a result of the vertically integrated nature of these organizations (see chapter 4), which creates pressure on management of the cooperative to consider how the firm's actions affect the welfare of its customers. The separate legal identity of the cooperative from its member firms, on the other hand, may allow management scope to pursue actions (such as rapid growth of the organization) that favor the firm's employees at the expense of its stockholder-customers, and behavioral theories of the investor-owned firm can lend insight into this process. Such behavior may be held in check by two mechanisms: stockholders' actions, taken through the board of directors, to discipline management directly (as might occur in an IOF); and members' exiting the cooperative, thereby breaking up the cooperative coalition to pursue more attractive individual opportunities elsewhere.

A crucial element in understanding the behavior of farmer cooperatives therefore involves analyzing how actions of the collective (the cooperative firm) affect the incentives of the individual participants and hence their willingness to continue to participate in the organization; such an analysis involves viewing the cooperative as a coalition.

Although elements of all three of the approaches outlined above are needed to understand the behavior of farmer cooperatives, this study has especially stressed the coalitional approach for two reasons. First, many of the most contentious issues currently facing farmer cooperatives are coalitional, involving how the benefits of joint action should be shared among an increasingly diverse set of participants in the cooperatives and how the incentives facing individual participants can be structured so as to foster the well-being of the group as a whole. Examples include the issues of equal versus equitable treatment of members in the pricing of a cooperative's services and in the financing of the organization and that of designing managerial incentives so that managers act in the best interests of the farmer-members. The second reason for focusing on the coalitional approach is that this area of cooperative theory has received the least attention from previous theorists. The dearth of previous theoretical research on the cooperative as a coalition, the importance of coalitional issues facing cooperatives, and the existence of analytical techniques such as game theory that are designed to investigate the interrelationships between individual and group behavior suggested that the payoffs might be highest from concentrating on this area of cooperative theory.

Although the coalitional approach has been stressed, particularly in the game-theoretic analysis of chapters 5-7, the view of the

cooperative as a form of vertical integration and the view of the cooperative as a firm are necessary complements to this approach. The coalitional approach stresses the importance of understanding the distribution of the net gains from joint action, but many of these net gains are a result of the cooperative's vertically integrated nature. Similarly, the coalitional approach examines how behavior of individual participants in the cooperative affects the behavior of the organization as a whole, yet many of the conflicts between what is good for the individual and what is good for the group stem from the separate legal identity of the cooperative firm from its member firms.

Viewing the cooperative as a coalition emphasizes the relationship between individual incentives and collective behavior. The game-theoretic analysis of chapters 5 and 6, for example, demonstrated that attempts by a cooperative to treat a highly diverse set of members equally or to expand a single pool to include a broad variety of services may create incentives for individual members (typically those who have the greatest opportunities outside the cooperative) to withdraw from the organization, leaving the remaining members worse off than before. Similarly, farmer members, board members, and members of management often face individual incentives to behave in a way that is inconsistent with the welfare of the cooperative as a whole. Although the inculcation of an organizational ideology may modify these incentives and induce more group-oriented behavior, the design of the system for distributing material rewards within a cooperative is clearly important in aligning individual and group behavior. In designing systems for distributing individual rewards in cooperatives (for example, the pricing system) analysis like that presented here may prove particularly helpful.

The coalitional approach stresses that farmer cooperatives cannot always singlemindedly pursue the simple objectives posited in earlier models of cooperative behavior, such as maximization of total member profits or maximization of per-unit cooperative surplus, because doing so may result in a distribution of member benefits that creates incentives for certain members to leave the organization. For a similar reason a cooperative may not be able to serve everyone; tensions over cross-subsidies among a highly diverse membership may prove too disruptive. Rules such as "equal treatment for all" may in certain circumstances result in no service for anyone, as they precipitate the disintegration of the organization. This suggests that farmer cooperatives have to give very serious consideration to what services they will provide, to whom, and on what terms.

The coalitional approach also emphasizes that apparently irrational behavior by cooperatives may result from individual participants rationally pursuing their own self-interest. Consider intercooperative competition. Farmer cooperatives often fiercely compete with one another, even when they are owned by the same farmers (Ratchford, Swank). Although greater collaboration would seem to be in the long-term interest of the farmer stockholders, competition persists because individual incentives push managers, board members, and stockholders to encourage it. Although managers and board members may desire some reduction in intercooperative competition, they are likely to oppose taking collaboration to its logical extreme, merger, unless they are assured that they will retain positions of authority in the new organization. Farmer-members may prefer intercooperative competition for several reasons. If competing cooperatives cross-subsidize certain services (particularly if

different cooperatives subsidize different services), then members can act as "cherry pickers," buying from each cooperative its subsidized services and purchasing the other services (those that provide the subsidies) somewhere else. Second, if the cooperatives' equities are not freely redeemable due to the absence of a secondary market, then the horizon problem discussed in chapter 2 arises, in which members, particularly those nearing retirement, have an incentive to liquidate the cooperative in an attempt to get back their accrued investment. One way of liquidating a cooperative is to push it into ruinous price wars, which generate short-term gains to the members (in the form of more favorable prices) at the expense of the long-term viability of the organization. Third, members who feel distant from the board and management, particularly in large cooperatives, may feel that intercooperative competition is the only way in which the board and management can be effectively disciplined. These members might prefer better direct member control of the board and management in order to ensure the firm's efficiency (but then, again, they might not, given the individual costs of monitoring the organization), but lacking direct member control, intercooperative competition may be seen as the only way to keep the people at the top on their toes. The coalitional approach stresses that if "wasteful" intercooperative competition is to be reduced, individual incentives must first be changed.

Farmer Cooperatives and Investor-Owned Firms: A Comparison

It is often alleged that farmer cooperatives increasingly resemble investor-owned firms. (See, for example, Kravitz.) As cooperatives grow, the costs to the member of participating in the governance of the

association increase, so direct democracy gives way to delegated decision making, often by hired management. Management goals, it is argued, do not correspond with those of the farmer-members; like their IOF counterparts, cooperative managers seek mainly growth of the organization, managerial perks, and job security. Because of the high transaction costs involved, few farmer-members have incentives to become involved politically in the cooperative to check this sort of managerial behavior.

The analysis presented in this study suggests that such a scenario is certainly possible. But the study has also highlighted basic structural differences between farmer cooperatives and IOFs that lead to behavioral differences between the two types of organizations. The magnitude of these behavioral differences depend, however, on the standard operating procedures of individual cooperatives and IOFs.

The vertically integrated nature of farmer cooperatives lead to several behavioral differences. Because the customers of a cooperative are also its stockholders, the cooperative is likely to give greater weight in its pricing and output decisions to how those decisions affect the rate of return to fixed farm assets. Indeed, one of the major motivations for forming farmer cooperatives may be a desire to overcome the capital losses imposed on farmers by IOFs' opportunistically appropriating the rents generated by fixed farm assets (see chapter 4). Because cooperatives tend to take account of how their actions will affect the return to their members' assets, cooperatives' capital tends to be less mobile than that of IOFs. For example, cooperative firms are more likely than IOFs to continue to provide a "home" for their customers' products and supply those customers' input needs even when

new, more profitable outlets for the firms' capital arise. Pressures from members to avoid using cross-subsidies in order to finance the development of new products or services restrict even further the range of cooperatives' investments. (To some extent cooperative managers may try to overcome these restrictions by building up unallocated reserves, which represent a source of capital over which management has considerable discretion.)

Because cooperatives' capital is less mobile than that of IOFs, cooperatives may develop a larger systems interest in how the agricultural economy works. Because it is more difficult for cooperatives to "cut and run" should agriculture turn unprofitable, they have a stronger interest in making the system work. This, combined with their integrated nature, explains why cooperatives often take the lead in providing public goods (open formula feeds, grades, and so on) in the food system.

The immobility of cooperative capital may also make cooperatives more risk averse than IOFs, as cooperatives' portfolios tend to be less diversified than those of their IOF competitors. This risk aversion is reinforced by the difficulty of raising equity in a cooperative to replace that lost in risky ventures and by the requirement that stock be held only by members. This requirement prevents the stockholding function in a cooperative from being undertaken either by those who are more risk preferring than the cooperatives' customers or by those who are able, as IOF investors are, to diversify their portfolios.

As a result of this risk aversion, cooperatives, particularly supply cooperatives, may refrain from aggressive price cutting for fear of touching off a mutually destructive price war and may shy away from undertakings that are potentially very profitable but risky.

Cooperative managers may prefer to use net earnings to provide members with subsidized services (such as cut-rate insurance) rather than rebate earnings in proportion to patronage and risk being perceived by competitors as initiating a price war. As long as these subsidized services are widely consumed by the membership such a strategy may prove viable, but as the membership becomes more heterogeneous, tensions over the implicit income transfers involved may arise.

One of the most marked differences between farmer cooperatives and IOFs results from cooperative members' receiving their ownership benefits primarily through their patronage with the cooperative rather than through payments to capital. How returns gained through patronage are distributed depends on how the cooperative prices its products, allocates its costs, and finances its operations. Cooperative stockholders, unlike their IOF counterparts, are therefore vitally interested in the income-distribution consequences of their firms' pricing, cost allocation, and equity-finance decisions. They are therefore much more likely than IOF stockholders to demand a role in these decisions, which implies that a cooperative's board of directors will play a much more active role in determining these policies than will its IOF counterparts.

Both the theory outlined above and interviews with cooperative participants indicate that because the income that cooperative stockholders derive from their association depends more on the prices of the individual goods and services they purchase from the cooperative than on the firm's overall profitability, cooperative stockholders tend to be much more concerned about the cross-subsidies implied by their organization's pricing and cost-allocation practices than are IOF stockholders. This is particularly true during hard times, when cooperative members

facing financial difficulties feel they cannot afford the luxury of supporting their cohorts through such cross-subsidies. Consequently, cooperative managers generally have less flexibility than their IOF counterparts to use cross-subsidies to gain strategic market advantage or expand into new areas that might require initial subsidies. Furthermore, to the extent that concerns over cross-subsidies lead cooperatives to adopt single-commodity pools that require each product or service to pay its "full pro-rata share" of overhead costs, the cooperative may refuse to take on activities that could pay their marginal costs and make some contribution to the firm's overhead costs, albeit not the activities' "full pro-rata share." Refusing such activities leaves the members of the cooperative worse off, as the overhead burden of each of the remaining activities is higher than it would otherwise be.

Because of member concerns about cost allocations, cooperatives may allocate their joint costs differently than do IOFs. Although standard accounting practices may often lead to uniform cost allocation procedures by IOFs, these firms are free, in principle, to allocate costs in the manner they find most profitable. On the other hand, the theory developed here suggests that in cooperatives where members perceive joint cost allocation to be an important income-distribution issue joint costs will be spread more evenly across products than in IOFs in order to give the impression that each member is supporting his fair share of the burden. Cooperatives might also change their allocations more frequently than do IOFs in order to respond to vocal members who feel they are carrying an unfair share of the costs.

In addition to restricting the marketing flexibility and range of activities of farmer cooperatives, the members' concerns about the

income-distribution consequences of their firms' pricing and cost-allocation decisions raise the cost of making those decisions in cooperatives. Because the members are unlikely to be of one mind concerning what decisions should be taken, top managers may have to spend much of their time lobbying and conducting member-relations work in order to reach a consensus on those issues. There is a danger that as a result cooperative managers may devote too little time to other aspects of their jobs, particularly strategic planning.

Although the identity of the stockholder with the customer may complicate some aspects of the cooperative manager's life, it may simplify others. Because of their integrated nature cooperatives may be able to establish better flows of information between the firm and its farmer customers, which can be particularly helpful in anticipating changes in the demand for goods and services provided by the cooperative and in developing new products to meet farmers' changing needs. Cooperatives' customers may also be more loyal to their firm than are the customers of IOFs (particularly if the cooperative makes the return on equity invested in the organization contingent upon continued patronage), and this greater loyalty can facilitate the planning of future production. As stressed throughout this study, however, member loyalty can vary widely depending on the characteristics of the members and on the policies adopted by the cooperative (see especially chapters 5 and 6).

The differences between the financial structures of cooperatives and IOFs have several behavioral consequences. Two aspects of cooperatives' financial structure are particularly important: restrictions on who may own stock in the organization and the lack of a secondary market for the cooperative's equity securities. As mentioned above, the

restriction on stock ownership limits the pool of equity capital available to the organization and may lead to more risk averse behavior by the cooperative through preventing the stockholding function from being undertaken by those with more diversified portfolios. Not only does tying stockholding to patronage restrict the number of investors in the cooperative, but those investors may be reluctant to invest because doing so means forgoing the use of that capital in their own farm businesses. The tendency to underfinance the cooperative is reinforced by the cooperative practice of distributing net returns according to patronage rather than according to capital contribution. As long as patronage is profitable, members have an incentive to maximize their patronage relative to their capital contribution. To overcome this problem most cooperatives, usually at the behest of management, have developed automatic capital accumulation mechanisms, such as per-unit retains.

The lack of a secondary market for cooperative securities leads to the horizon problem discussed in chapter 2, which is essentially a problem of assuring the smooth intergenerational transfer of ownership of the cooperative. Because stockholders have no way to gain access to their investment in the cooperative except through patronage, they may be reluctant to have the cooperative undertake investments that have gestation periods longer than the period over which the current members expect to remain patrons. Older members, particularly those who are not concerned about bequeathing a viable farm operation to their heirs, may push for partial or complete liquidation of the cooperative in order to gain access to their accumulated capital investment. Ironically, the manager, pursuing his personal goal of cooperative growth, may end up as the guardian of the organization, pushing for the creation of automatic

capital retention mechanisms in order to protect the cooperative from the predation of its members.

The lack of a competitively determined price for cooperative stock denies cooperatives the ability to use fluctuations in the stock's value to influence managerial behavior. In contrast, fluctuations in the value of the stock of investor-owned firms, through their influence on stockholders' earnings and the value of managers' stock options, serve as an important mechanism to discipline managerial behavior. The business press, which arises as a consequence of the stock market, reinforces this discipline by disseminating information on the managerial abilities of different IOFs. Because cooperatives lack these automatic means of evaluating and disciplining managerial behavior, cooperatives have had to rely on other mechanisms, including having the board take a more active role in guiding the affairs of the firm.

The lack of a secondary market for cooperative stock also means that increases in the earning capacity of a cooperative are not capitalized into a form (such as a stock price) that is easily appropriable by an entrepreneur. Consequently, it is harder to get rich forming a cooperative than forming an IOF, in which increases in stock prices may handsomely reward entrepreneurial activity. Even though there might be ample social returns to justify forming a cooperative in certain circumstances, because the returns are widely diffused, no single individual may have sufficient incentive to launch the organization.

Cooperatives and investor-owned firms also differ in their formal governance structures, with cooperatives placing restrictions on voting one's stock and on who can serve on the board of directors. In addition,

cooperative boards are typically much more activist than their IOF counterparts.

The diffusion of nominal political control in farmer cooperatives, as typified by the one-member, one-vote rule, makes coalition building and decision making by consensus more important in cooperatives than in IOFs, where a few large stockholders may dictate the outcome of an issue. This suggests that decisions requiring stockholder approval may take longer and be more costly to achieve in cooperatives than in investor-owned firms. Certain decisions, however, are made unilaterally by management, and the diffusion of stockholder power in farmer cooperatives may also diffuse opposition to such decisions.

The more active role of cooperative boards of directors in the affairs of the firm as compared with that of IOF boards is not simply a consequence of cooperatives' democratic tradition. Because cooperative board members are both stockholders and customers of the firm they have a strong financial interest in the firm's decisions, which may not be true for IOF board members, particularly "outside" members. Furthermore, unlike "inside" members of IOF boards, the interests of cooperative board members are not necessarily coincident with the interests of management. For example, management may be primarily interested in growth of the cooperative while board members, in part because of the horizon problem, may be more interested in current member returns; hence, some confrontation between the board and management may arise.

Moreover, because cooperative benefits can accrue to members in forms that are difficult to measure (for example, as consumer surplus in transactions involving subsidized consumer goods) and because it is more difficult in cooperatives to create automatic mechanisms for disciplining

management, such as stock options, the board needs to be more directly involved in evaluating managerial performance. Cooperative boards are more active because they have to be if they are to assure responsible management. But this raises a serious challenge for cooperative boards in the future. As farmer cooperatives become larger and more complex it may become increasingly difficult for a part-time board of farmers to oversee and evaluate the performance of management adequately, in part because of the high information costs involved. There is a need to consider developing automatic indicators of managerial performance and changes in the board structure to meet this challenge. Some changes along these lines are discussed later in this chapter.

Although there are many potential behavioral differences between farmer cooperatives and IOFs, how strong these differences will be in a particular situation depends very much on the individual practices of the cooperative and the IOF involved. A cooperative that fails to develop its field staff or conduct surveys of its members may possess much poorer information about its customers' demands than does a competing IOF, while a cooperative that rapidly retires its members' equities may not be bothered at all by the horizon problem. As in all of institutional economics, the details of design are important.

Farmer Cooperatives in a Dynamic Environment

Whether a farmer cooperative offers its members advantages over alternative forms of organization such as IOFs depends on the environment in which the firms operate. As the economy evolves, certain justifications for cooperative activity decline in importance while new ones arise. For a farmer cooperative to survive, its activities must evolve with the changing environment.

One important way that farmer cooperatives have served their members in the past is through the pooling of purchases and sales in order to obtain volume discounts and premiums for the members. Cooperatives that have relied heavily on this justification for their existence face an increasing challenge, as many members have grown so large that they can now obtain the advantages of high-volume sales and purchases on their own. If these cooperatives are to retain such farmers as members the cooperatives must offer these farmers additional advantages.

Similarly, the argument that cooperatives are needed to protect farmers from the opportunism of their trading partners may have been strongest when product and factor markets were poorly integrated, making it difficult for farmers to shift their resources to other uses. Increased economic integration does not totally obviate this justification for cooperatives, however, as integration is often accompanied by increased asset specificity, which results in rents that can be appropriated through opportunistic behavior (see chapter 4). In addition, increasing economies of size in the processing of highly perishable products may lead to greater local monopsony, strengthening the justification for bargaining and processing cooperatives.

Greater market integration, particularly of capital markets, may also reduce the importance of product pooling as a risk management device, as farmers develop alternative ways of dealing with risk, such as relying on the capital and futures markets. In addition, the increased diversity of cooperatives' members, discussed below, has raised tensions in cooperatives concerning cross-subsidies, making it politically more difficult to use pooling as a risk management device.

Changes in the environment also open up new opportunities for co-operatives. Farmer cooperatives may be particularly useful to their members during periods of rapid technological change in agriculture, as the potentially better information flows between buyer and seller can lead to the development of goods and services well-attuned to the buyer's needs. Such two-way communication is particularly important when neither the buyer nor the seller of the good or service is initially sure of the exact product characteristics needed (Hirschman, 1970). Similarly, as discussed in chapter 4, cooperatives may have greater incentives than IOFs to train farmers in the use of new production technologies, which may open up new income-earning opportunities for cooperative members.

As individual cooperatives become larger and as cooperatives as a whole increase their market share in certain industries (particularly declining industries), cooperatives may increasingly take on market-balancing activities, attempting to equilibrate supply with demand. This is most apparent in the dairy industry, where large dairy cooperatives play an important role in allocating available supplies of milk over space and among alternative uses. Although this role may become increasingly important for some cooperatives, it will also probably be accompanied by a tendency of some individual farmers and small cooperatives to act as free riders with respect to these market-balancing activities.

As government agricultural policies change, the proportion of co-operatives' resources devoted to influencing those changes (as opposed to increasing operational efficiency) is likely to increase. Initially, political activity may be greatest by single-commodity cooperatives, in

which members' interests are closely aligned. Multicommodity cooperatives, however, may also play a role similar to that of the general farm organizations of an earlier era, serving as a forum in which political positions regarding general policies that affect all farmers, such as macroeconomic policies, can be formulated.

Changes in the economy will not only affect the functions of farmer cooperatives but also how cooperatives will attempt to achieve their goals. As markets become increasingly dynamic, the cost to cooperatives of time-consuming decision making by consensus is likely to rise. As a result, increased centralization of federated cooperatives may occur. A major challenge for farmer cooperatives is to develop ways of reducing their decision-making costs without entirely sacrificing the grass-roots involvement of the membership typical of local and federated cooperatives.

As stressed throughout this study, another change that has dramatically affected farmer cooperatives is the increased diversity of their memberships, which reflects the increased diversity of farmers in general. This diversity, and the income transfers it implies through cost-sharing and revenue pooling, generates divisive tensions in many cooperatives, raising the question of whether one cooperative can serve all types of farmers. The game-theoretic analysis presented in this study seems to indicate that the answer to this question is "not always." At some point the economies of size and scope imparted by a larger and more diverse membership may be offset by the instability generated by tensions over cross-subsidies. Exactly when these diseconomies of diversity become dominant depends very much on the internal structure of the individual cooperative and on the magnitude of the economies of size and

scope in the industries in which it operates; nonetheless, it would not be surprising if the increased diversity of U.S. agriculture were accompanied by an increased diversity of farmer cooperatives.

Implications for the Design of Cooperative Structures and Public Policies

Chapter 1 outlined several concerns that have arisen in recent years among cooperative members, managers, board members, and society at large regarding the performance of farmer cooperatives. The analysis presented above suggests several ways in which farmer cooperatives could modify their practices and internal structure to improve that performance. Five areas of improvement will be discussed here: (a) practices that could capitalize on cooperatives' potential for better communication with their customers, (b) ways of dealing with the heavy demands placed on the chief executive officers of cooperatives, (c) innovations to increase the liquidity of cooperative equities, (d) ways of dealing with the increasing imbalance of information between cooperative management and the board of directors, and (e) possibilities for increasing cooperative loyalty. In addition, several changes in public policies towards cooperatives will be discussed.

Improved Information Flows

Chapter 2 discussed the reasons why the flow of information between customers and the firm may be better in farmer cooperatives than in IOFs. Surprisingly, many cooperatives fail to take advantage of their unique opportunities for gaining information about their customers' needs, even though for some of these cooperatives it might be very cost effective to do so (Mirowsky). Whereas an IOF might have to pay a market research

firm a great deal of money to conduct surveys of its customers' production practices and input and marketing needs, a farmer cooperative could gather such information at low cost through questionnaires that farmers would be required to fill out when they applied for membership and through periodic resurveys of the members. One of the potential strengths of farmer cooperatives in a dynamic environment is their ability to anticipate changes in their members' demands for goods and services; for this strength to be exploited many cooperatives need to expand their information-gathering activities.

The Role of the CEO

Because of the greater stockholder involvement in decision making in farmer cooperatives compared with IOFs, much of the chief executive officer's time is devoted to member-relations work, trying to build the consensus necessary to reach decisions. He may also be heavily involved in trying to inculcate cooperative ideology in the members and the staff in order to help overcome the frequent prisoner's dilemmas that face cooperative participants (see chapter 6). Because of these demands on his time, the CEO may have less time than his IOF counterpart for other aspects of the business, which may put cooperatives at a competitive disadvantage. Farmer cooperatives should consider alternative administrative structures to deal with this problem, perhaps moving to a dual CEO or vesting greater decision-making authority in vice presidents, who would then be directly accountable to the board rather than to the CEO.

Overcoming the Horizon Problem

The study has emphasized how the illiquidity of cooperative equities can lead members to underinvest in their cooperatives, particularly in facilities that have long economic lives. Several actions by cooperatives could reduce the importance of this horizon problem. First, rapid equity redemption via revolving funds and base capital plans help increase the liquidity of the member's investment by reducing the amount of time he has to wait to gain access to his accrued investment in the cooperative. Encouraging the creation of such equity redemption mechanisms has been a major focus of public policy (see Cobia et al.).

Second, the horizon problem could be reduced by encouraging cooperative members to incorporate their farms and to register the corporations rather than themselves as members of the cooperative. Under most cooperatives' bylaws the corporation would remain a member of the association even if the farm were sold; hence, the value of the cooperative would be fully capitalized into the value of the farm. As a result, farmers nearing retirement would have no incentive to try to dismantle the cooperative; they could obtain their accrued investment in the cooperative by selling the farm.

A third way of reducing the horizon problem would be to require members to purchase an annuity, payable upon retirement, whose annual value would depend on the earnings of the association. This, like corporate membership in the cooperative, would give farmers an interest in the long-term viability of the organization.

Another way of reducing the horizon problem would be to encourage the creation of a secondary market in nonvoting equity certificates, such as retain certificates. If the cooperative kept intact its

automatic capital retention mechanisms, such as per-unit retains and patronage refunds issued as stock, the creation of a secondary market in nonvoting equity certificates would not threaten the capital base of the cooperative. It would, however, provide a mechanism by which members facing cash-flow difficulties could immediately redeem their equity certificates, albeit at a substantial discount from their face values. Because the market would be limited to nonvoting certificates it could be open to all investors, not just members of the cooperative. Not only would such a market increase the liquidity of cooperative equities, but it might also serve as an external indicator of managerial performance. If managers habitually favored short-term goals over the long-term financial integrity of the cooperative, the value of the traded equity certificates would fall, which could induce members to put pressure on management to modify its behavior.¹

A variation of the secondary market would be to create a carefully designed limited partnership between the cooperative (the general partner) and the members and possibly others, such as the employees (the limited partners). The partnership would sell shares to raise capital for the physical facilities to be used by the cooperative, which the partnership would then lease to the cooperative. This arrangement would allow farmers who bought shares in the limited partnership to benefit from the

¹A possible difficulty with this scheme could arise if a few members of the cooperative ended up buying most of the nonvoting equity certificates of the association. These members would then have a concentrated interest in trying to influence the board to devote most of the co-op's cash flow to equity retirement; if they were successful, other uses of cash flow, such as retained earnings and patronage refunds, could suffer.

capital gains accruing from the growth of the cooperative because they could sell their stock through a secondary market for those shares.¹

Overcoming the Information Imbalance between Management and the Board

Chapter 6 stressed how the increasing cost to the board of obtaining and processing information in large, complex cooperatives has redistributed power in favor of management. Some cooperative boards have attempted to cope with this informational imbalance by the use of ad hoc advisory committees and by allotting a limited number of positions on the board to outside members. Additional measures may also be needed. One alternative would be to move to a full-time board chairman, who could devote all his energies to evaluating the management's proposals and performance. Another alternative would be for the board to hire a full-time team of analysts who would provide the board with an ongoing evaluation of management's proposals. Such a team might help offset the informational imbalance between management and the board in the same way that the U.S. Congressional Budget Office has helped offset the informational imbalance between the legislative and executive branches of government.

Increasing Cooperative Loyalty

If, as argued in chapter 4, cooperatives provide their members with important public goods, such as more competitive markets, then it may be too easy for members to exit the cooperative and act as free riders. Particularly where such exit imposes a heavy cost on the remaining

¹One of the cooperatives discussed in chapter 7, Pacific Coast Producers, is organized in this manner.

members (through idle plant capacity, unfulfilled contracts, and the like) cooperatives may need to consider more stringent penalties for exit, such as the forfeiture of accrued retains. The danger of adopting such policies, however, is that they might simply remove member exit as a means of disciplining management. Therefore, moves to increase the cost of exit should be coupled with reforms of the board structure such as those outlined above in order to enhance the effectiveness of members' voice in disciplining management.

Public Policies Toward Cooperatives

Implementing some of the above recommendations may require changes in public policies regarding cooperatives, such as those that limit the salability of cooperative stock and restrict interest payments on capital invested in cooperatives. In addition, the increasing diversity of cooperative members poses special problems for public policy. As demonstrated in chapter 5, under certain circumstances a cooperative may have to differentially price its services to members if it is to survive. Some public policies (e.g., Section 521 of the Internal Revenue Code) limit the degree to which cooperatives can price discriminate and still receive favorable tax treatment; consideration should be given to whether such policies encourage cooperatives to follow policies that are financially untenable.

More fundamentally, the increasing diversity of American agriculture raises the question of whether one cooperative can serve both large and small farmers for whom the costs of service greatly differ (see Black). The analysis presented in this study suggests that under certain circumstances, it cannot. If, indeed, the future witnesses the

emergence of two types of farmer cooperatives, those serving very large farms and those serving smaller operations, then the public will have to decide whether similar policies should apply to each. Increased cooperative diversity may require increased policy diversity.

Implications for Future Research

The analysis presented in the preceding chapters strongly suggests that understanding how the benefits and costs of joint action are allocated among the participants in farmer cooperatives is crucial to understanding the behavior of these organizations. Furthermore, the study has illustrated how concepts from game theory and transaction cost economics can lend insight into the behavioral consequences of alternative allocations of costs and benefits. The research presented here could be extended in at least four ways: (a) hypotheses derived from the theoretical analysis could be tested more thoroughly empirically, (b) characteristic functions for individual farmer cooperatives could be estimated empirically in order to test hypotheses and to derive price schedules for the cooperatives that are both stable (do not induce member defection) and are in some sense "fair," (c) theoretical work could be undertaken on aggregating from the behavior of individual cooperatives to the behavior of the cooperative system and the market as a whole, and (d) many of the analytic approaches developed here could be extended to analyze the behavior of investor-owned firms.

Empirical Testing of Hypotheses

The analysis presented in the preceding chapters has been primarily theoretical, although it has drawn on empirical observations to illustrate concepts and provide limited testing of hypotheses. The

theoretical analysis has generated many hypotheses, and empirical testing of these would be extremely useful in assessing the strengths and weaknesses of the theoretical approach developed in this study. For example, the theory suggests that cooperative loyalty is likely to be low among highly leveraged farmers facing cash flow difficulties, such as might result from rapidly rising interest rates or falling farm prices. Using a cooperative's membership list as a sampling frame, a sample could be drawn and this hypothesis could be tested empirically, both cross-sectionally and, if farm records existed for several earlier years, longitudinally. The testing would involve comparing the purchase and sales patterns of farmers who were highly leveraged with those who were not and/or the purchase patterns of highly leveraged farmers during periods of both rising and falling farm prices or interest rates. If the data supported this hypothesis and if assuring highly leveraged members' loyalty was essential to the vitality of the cooperative, then the association might want to consider introducing special pricing or credit arrangements for such members during periods when they faced cash flow difficulties.

Similarly, the theory outlined above suggests that because of the illiquidity of cooperative securities, cooperatives comprised largely of older members will tend to invest fewer resources in facilities having long gestation periods than will cooperatives whose members are younger. This hypothesis could be tested by examining how the investment patterns of a cross-section of farmer cooperatives varied with the age structures of their memberships. If the data strongly supported the hypothesis, one would want to seriously consider ways, such as those outlined earlier, of dealing with the horizon problem.

The two examples just cited involve examining how characteristics of the members affect individual and cooperative behavior. One could also empirically test how different cooperative structures affect participant behavior, for example, comparing the turnover of managerial staff in similarly sized federated and centralized cooperatives to test the hypothesis that centralized cooperatives are more effective in recruiting and retaining highly trained personnel.

The theory presented here suggests that because of their structure cooperatives may face certain problems not encountered by IOFs, such as the horizon problem. Empirically testing the theory might allow the relative and absolute magnitudes of these problems to be measured. Knowledge of their absolute and relative importance could help guide decisions regarding which of these problems, if any, merit remedial action.

Estimation of Characteristic Functions

The game-theoretic analysis presented in chapter 5 posits that cooperative members decide whether to patronize the cooperative by comparing the payoff they receive from the cooperative with the payoffs available elsewhere. As stressed in chapters 5 and 6, these payoffs include the expected present value of both pecuniary and nonpecuniary returns, appropriately adjusted to take account of the risk preferences of the member. In many situations, however, the current prices charged by the cooperative and its competitors for various goods and services may provide a fair approximation of the payoffs available to a member. If the cooperative is a local monopsony, the member may compare the prices charged by the cooperative with what it would cost the member

to provide those services himself, either alone or with other disaffected members.

The lowest price at which a member can obtain a given service outside of the cooperative, either from another firm or by setting up his own firm, represents that member's security value for the service. The security value represents the price that the cooperative must meet in order to avoid the member's possibly taking his business elsewhere. The list of all the security values for all possible coalition members in the cooperative constitutes the cooperative's characteristic function (see appendix C). A simplified characteristic function could be estimated empirically as follows. Several "model members" (much like the model farms of linear programming) would be selected, each representing a stratum of the cooperative's membership. The security values of each model member for each service offered by the cooperative could be determined through market surveys of the prices available to these members from the cooperative's competitors (these prices should be appropriately adjusted to take account of any transaction costs to the member of shifting his sources of supply) and through economic engineering studies that would show the cost to the member of setting up his own source of supply. The security levels for each member, combined with the cooperative's break-even constraints (both its overall break-even constraint and the break-even constraints for individual pools) would constitute the core constraints within which the cooperative would have to set its prices in order to avoid inducing member defection (see the example in chapter 5).

If such characteristic functions were estimated empirically they would be useful both as a way of testing the theory presented here and

as a guide to cooperatives' management in setting prices. The theory predicts that instances of members leaving a cooperative (for example, the recent defection of several local supply cooperatives in the Midwest--the "superlocals" or "miniregionals"--from their federated cooperatives to deal directly with suppliers) results from the cooperative's prices being inconsistent with its core constraints. Empirical estimation of characteristic functions for cooperatives experiencing member defection would allow this hypothesis to be tested.

If the data supported the hypothesis, then cooperatives could use their empirically estimated characteristic functions to set prices that are consistent with their core constraints and are hence "stable." Furthermore, if more than one set of prices were consistent with the core constraints, a cooperative could use game-theoretic solution concepts such as the Shapley value to help choose "fair" sets of prices.¹

Aggregating from the Cooperative to the Market Level

This study has focused on the relationship between individual behavior and the behavior of the cooperative as an organization. Further research, using similar techniques, could focus on the relationship between the behavior of individual cooperatives in specific situations and the behavior of the markets in which the cooperatives are active. This would involve viewing cooperatives and IOFs as market participants, hypothesizing about their goals in particular circumstances (such hypotheses could be drawn from analyses like those presented here), and

¹As described in detail in appendix C, the Shapley value is a game-theoretic solution concept that, if used to set prices, would assign to each good or service a price equal to the "average marginal cost" of producing that good or service.

then using game-theoretic analysis to aggregate from individual firm behavior to market behavior. Economists such as Shubik (1959) have used game theory to look at industrial organization issues under the assumption that all firms strive to maximize profits. Broadening this approach to include cooperatives, whose objectives may differ from those of IOFs, might provide more realistic industrial-organization analyses of how cooperatives affect social welfare.

Extensions to the Investor-Owned Firm

Throughout this study the behavior of farmer cooperatives has been compared with that of investor-owned firms, often under the implicit assumption that IOFs are interested primarily in profit maximization. In reality, participants in IOFs have partially conflicting goals, and much of the effort expended in IOFs is aimed at harmonizing the actions of the different participants. An approach similar to that presented here, which combines elements of game theory with a recognition of the importance of transaction costs and organizational ideology, might therefore lend insight into the behavior of investor-owned firms as well as that of farmer cooperatives.

APPENDICIES

APPENDIX A

A GLOSSARY OF TERMS RELATED TO FARMER COOPERATIVES

The definitions presented in this appendix are drawn from Cobia et al., Griffin et al., Touche-Ross (1978), and U.S. Department of Agriculture (1976), which readers can consult for a fuller explanation of these terms. Phrases underlined in the definitions are themselves defined elsewhere in the appendix.

Allocation of equity -- The process by which a farmer cooperative assigns ownership of some part of its equity to its patrons even though the patrons may not be able to redeem that equity for several years (see equity redemption). Equity allocated by the cooperative may represent retained-patronage refunds, per-unit capital retains, or retained margins. The cooperative notifies patrons how much equity has been allocated to them by issuing a written notice of allocation. Allocated equities are typically redeemed by the cooperative for cash after several years.

Base capital plan -- A plan for providing equity to the cooperative where each member's capital obligation is determined each year by the member's share of patronage for a base period. Members who are underinvested (that is, whose ratio of capital contribution to patronage is below the average) are required to build equities through additional capital contributions to the cooperative, while overinvested patrons' equities are redeemed in several ways.

Capper-Volstead Act -- An act passed by the U.S. Congress in 1922 that allows farmers to "act together in associations...in collectively processing, preparing for market, handling, and marketing in interstate and foreign commerce, the products of persons so engaged" without being in violation of section six of the Clayton Act, provided that the cooperatives thus formed meet certain conditions. (For details see USDA [1976], pp. 293-317.)

Certificate of ownership or certificate of interest -- A security issued by a cooperative to a member, often as the noncash component of a patronage refund, that indicates an ownership interest in the cooperative. Certificates of ownership may not always confer voting rights. (See also qualified and nonqualified certificates of equity.)

Common and preferred stock -- Securities issued by the cooperative as shares of ownership which may also confer some voting rights. Stock is usually divided into more than one class, primarily to control voting rights and to vary income and risks of stockholders. The characteristics of different types of stock vary by cooperative and are spelled out in the cooperative's bylaws.

Equity certificates -- A generic term that includes all securities issued by the cooperative to indicate an ownership interest in the organization. In addition to common and preferred stock, equity certificates include membership certificates and qualified and nonqualified certificates of equity. These latter include certificates of interest, certificates of ownership, revolving fund certificates, patronage certificates, and retain certificates.

Equity redemption -- The payment to cooperative patrons of cash or other property for previously issued cooperative equity certificates. Farmer cooperatives redeem equities mainly through base capital plans, facilitating plans, percent-of-all-equities plans, revolving fund plans, and special plans.

Established value (EV), Economic Value, or Commercial Market Value (CMV) -- The per-unit value of patrons' raw product that a marketing cooperative engaged in pooling agrees to pay (provided that earnings are sufficient to do so) before any funds from the product's pool are devoted to patronage refunds. The board and/or management sets the established values, usually attempting to make them comparable to the returns received by producers outside the cooperative.

Exempt Cooperative or Section 521 Exempt Cooperative -- Under Subchapter I, Chapter 1 (Sections 1381-1388) of the U.S. Internal Revenue Code, any corporation operating on a cooperative basis is permitted to deduct from its otherwise taxable income patronage refunds distributed to patrons in cash and/or noncash form in compliance with the requirements of these sections of the Code (see qualified allocations), to the extent that such distributions represent earnings from business done with the patrons receiving the distributions. In addition, cooperatives that meet the requirements of Section 521 of the Code ("exempt cooperatives") are permitted to deduct from their taxable income (a) limited amounts paid as dividends on capital stock and (b) distributions to patrons of income from business done with the U.S. government or its agencies and from nonpatronage sources. The requirements of Section 521 include:

- (a) supply cooperatives must conduct at least 85 percent of their business for the taxable year with farmers or other farmer cooperatives;
- (b) at least 50 percent of the patronage business of both supply and marketing cooperatives must be done with members;
- (c) substantially all of the product handled by a marketing cooperative must be acquired from the actual producers thereof;
- (d) substantially all of the voting stock of a cooperative having capital stock must be owned by producers; and
- (e) the cooperative must treat all patrons, both members and non-members, equally insofar as the pricing of goods and services and

the distribution of patronage refunds are concerned. (For more details see Touche-Ross [1978], pp. 93-95; and USDA [1976], pp. 384-426.)

Facilitating plan -- A program in which a cooperative facilitates the exchange of ownership of equity certificates between inactive or over-invested members and underinvested members. Sales are by private treaty, usually subject to board approval.

IOF -- An investor-owned firm (also frequently called a "private corporation," a "proprietary firm," or a "noncooperative firm"), which is a firm in which there is no legal limit on payments to equity capital and in which a stockholder's vote is proportional to the amount of stock (s)he owns, as contrasted with a cooperative firm.

Member -- a stockholder or patron that has an equity interest in the cooperative and is entitled to voting privileges.

Membership certificate -- A certificate issued by nonstock or unincorporated cooperatives primarily to voting members as an indication that the required membership fee has been paid.

Net margin -- Gross income of a cooperative minus all allowable expenses. Also called net savings, net earnings and net income.

Netting -- The practice of combining net margins earned from different activities of the cooperative before calculating and paying patronage refunds. The opposite of netting is calculating and paying patronage refunds to patrons of each cooperative service based on the net margin the cooperative earned in producing that particular service.

Nonexempt cooperative -- A cooperative that has not received approval for exemption under Section 521 of the U.S. Internal Revenue Code (see exempt cooperative). A nonexempt cooperative can deduct from its federal tax liability only those patronage refunds that derived from patronage business. Typically, nonexempt cooperatives pay patronage refunds only to members.

Nonqualified allocation of equity -- Under Subchapter T of the U.S. Internal Revenue Code cooperatives are granted single-tax treatment, that is, net earnings allocated to members are taxed either at the cooperative level or the member level, but not both. A nonqualified allocation of equity is a noncash patronage refund or per-unit capital retain allocation that is not deducted from the taxable income of the cooperative, that is, it is initially taxed at the cooperative level. When the patron later redeems a nonqualified allocation for cash, the cooperative deducts the allocation from its taxable income for that year and the patron recognizes (and pays taxes on) the amount, with minor exceptions, as ordinary income. For additional details, see qualified allocation of equity.

Nonqualified certificate of equity -- An equity certificate, such as a patronage refund certificate or a per-unit capital retain certificate, that does not meet the requirements of a qualified certificate of equity.

Overinvested -- The condition of patrons who have more than their share of equity invested in a cooperative based on their patronage.

Patron -- Any person or organization with whom or for whom the cooperative does business, whether a member or nonmember of the cooperative association.

Patronage certificate or patronage refund certificate -- An equity certificate issued by a cooperative to a member in lieu of immediate cash payment for all or part of the patronage refund due the member. Redemption of such certificates in cash is deferred, usually for several years. Such certificates may be qualified or nonqualified.

Patronage refund, patronage dividend, patronage distribution, savings, or rebate -- The net proceeds or net margins of a cooperative credited or paid to patrons of a supply cooperative or the amount paid or credited over the normal established value to patrons of a marketing cooperative. Patronage refunds are distributed to patrons based on the patrons' quantity or value of business with the cooperative and are issued in cash and/or equity certificates. The equity certificates may be qualified or nonqualified.

Percent-of-all-equities plan -- A system of redeeming cooperative equities where in a given year the cooperative redeems a percentage of all allocated equity regardless of year of issue.

Per-unit capital retain -- Equity which a patron is required to invest in a cooperative based on the value or quantity of products marketed or purchased for the patron. This equity is withheld ("retained") from the proceeds of products marketed or added to the purchase price of goods bought through the cooperative, and the patron is issued a retain certificate for the amount retained, redeemable for cash at a later date.

Pool -- An accounting control center used for the determination of proceeds or patronage refunds due to a particular group of patrons. (See chapter 7 for more details.)

Qualified allocation of equity -- A patronage refund or per-unit capital retain that the cooperative can exclude from its taxable income (under Subchapter T of the U.S. Internal Revenue Code) and that the patron agrees to have taxed as if received in cash. For the cooperative to qualify for the tax exemption, the patron must be issued a written notice of qualified allocation disclosing the dollar amount of equity allocated to the patron. In addition, at least 20 percent of a qualified patronage refund allocation must be paid in cash.

Qualified certificate of equity -- An equity certificate, such as patronage refund certificate or a per-unit capital retain certificate, that

meets the requirements for the cooperative to exclude the equity allocated to the patron by the certificate from its taxable income (see qualified allocation of equity).

Retain -- See per-unit capital retain.

Retain certificate or per-unit retain certificate -- Any written notice which discloses to the recipient the stated dollar amount of a per-unit capital retain allocation to him by the organization.

Retained margins, retained earnings, undistributed margins, or earned surplus -- Tax paid and non-tax paid net margins of a cooperative that have been retained by the organization and may or may not have been allocated to patrons.

Retained patronage refunds -- Noncash allocations of net margins disclosed to patrons in written notices of allocation. These allocations are usually redeemed in cash at a later date. Also known as deferred or noncash patronage refunds.

Revolving fund certificates -- An equity certificate issued to a patron indicating the dollar amount of the patron's equity in the cooperative's revolving fund.

Revolving fund plan -- A system of equity redemption where the earliest investments of members are redeemed first. Equities may originate from retained patronage refunds, per-unit capital retains, and cash investments.

Section 521 cooperative -- See exempt cooperative.

Special plan -- A system of equity redemption where no redemption is made until a specific event, such as death of a patron, triggers redemption of all allocated equities.

Subchapter T -- The portion of the U.S. Internal Revenue Code (Sections 1381-1388) that covers the tax principles applying to any business operating on a cooperative basis.

Unallocated reserves -- Equity not allocated to individual patrons. Sources include net margins retained but not allocated, unclaimed checks for redeemed equities, and appraisal surplus. The cooperative pays income tax on unallocated reserves. Also known as unallocated equities, tax-paid surplus, reserves for losses, and retained earnings.

Underinvested -- The condition of patrons who have less than their share of equity invested in the cooperative based on their patronage.

Written notice of allocation -- A written notice from a cooperative that discloses the stated dollar amount allocated and the portion constituting patron refund and/or per-unit capital retains to the patron. A written notice of allocation may be qualified or nonqualified (see qualified allocation of equity and nonqualified allocation of equity.)

APPENDIX B
AN EXAMPLE OF THE AMBIGUOUS NATURE OF
COOPERATIVE ACCOUNTING DATA

As discussed in chapter 2, cooperative equity certificates represent both an ownership interest in the cooperative and a subordinated debt obligation of the organization. Referring to them in cooperative accounts as simply member equities can therefore lead to erroneous conclusions regarding the financial strength of the firm. This is illustrated by the experience of a mid-Michigan grain and farm-supply cooperative between 1961 and 1974.

According to several observers, in the early 1960s this cooperative was in deep financial trouble. Losses over the 1961-64 period totaled nearly \$78,000 on sales of \$3.85 million, or 2 cents per dollar of sales. As a result of these losses, a new manager was hired, and by 1974 he had succeeded in substantially improving the cooperative's financial performance. Between 1963 and 1974 sales (in nominal terms) sextupled, from \$968,537 to \$6,081,173, and the value of fixed investments went up by a factor of four, from \$175,314 to \$689,234. The cooperative earned a net margin of \$419,647 in 1974, or 6.9 cents per dollar of sales. The cooperative used some of its increased income to retire member equities that had been held by the cooperative for many years.

Table B.1 provides comparative balance sheets for the cooperative in 1961 and 1974. In 1961 the cooperative listed as part of its net worth the value of shareholders' preferred and common stock, nearly

TABLE B.1
COMPARATIVE BALANCE SHEETS FOR A MID-MICHIGAN
COOPERATIVE, 1961-1974

<u>Assets</u>	<u>1961</u>	<u>1974</u>
Current Assets	\$233,282	\$1,050,121
Other Assets (Investments--stocks and membership)	105,614	187,562
Net Value of Fixed Assets	130,294	689,234
<u>Total Assets</u>	<u>\$469,190</u>	<u>\$1,926,917</u>
<u>Liabilities and Shareholders' Equities</u>		
Current Liabilities	\$ 84,018	\$ 682,442
Long-Term Liabilities		
Mortgage Payable	27,800	0
Debentures	111,040	102,140
Capital Stock and Patrons' Equities		
Preferred Stock	190,225	0
Common Stock	6,680	4,600
Donational Surplus	6,809	0
Allocated and Share Credits	26,392	904,547
Undistributed Earnings, including Reserves	<u>16,226</u>	<u>233,188</u>
Total Capital Stock and Patrons' Equity	<u>\$246,332</u>	<u>\$1,142,335</u>
<u>Total Liabilities, Capital Stock, and Patrons' Equities</u>	<u>\$469,190</u>	<u>\$1,926,917</u>

\$197,000. In reality, this "equity" represented a debt obligation of the cooperative to its original investors (many of whom had retired) but which the cooperative had been unable to repay due to its poor financial performance. As the financial performance of the cooperative improved, these debts were repaid, and the amount of member "equity" represented by common and preferred stock fell to \$4,600 by 1974. (Other forms of member equities, primarily allocated equities in the cooperative's revolving fund, grew substantially during the 1961-74 period). Focusing too closely on individual net worth items in the two balance sheets in Table B.1 would therefore give a misleading picture of the cooperative's performance. "Net worth" represented by members' stock declined because the cooperative was performing well; that "equity" was simply a debt that the cooperative retired.

APPENDIX C

ELEMENTS OF GAME THEORY

The purpose of this appendix is to present basic concepts of game theory useful in interpreting the analysis in chapter 5 and to define formally some of the terms used in that chapter. The appendix focuses on the applicability and limitations of game theory in modeling economic behavior, drawing heavily on the work of Bacharach and Schotter and Schwödiauer. Specifically, the appendix introduces the set-theoretic terms that are used in game-theoretic analysis, provides a brief description of the objectives of game theory, formally defines a game, describes various kinds of games, discusses different ways of describing a game (giving particular emphasis to the coalitional form of a game, which serves as the basis for much of the analysis in chapter 5), and examines alternative solution concepts.

Set Theoretic Notation

Because many of the concepts in game theory can be expressed most concisely using set-theoretic notation, some familiarity with that notation is useful. Table C.1 and Figure C.1 present the set-theoretic terms used in this study.

Objectives of Game Theory

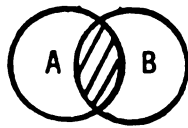
Game theory directly confronts two characteristics of economic decision making that traditional economic analysis often ignores: (1)

TABLE C.1
SET-THEORETIC TERMS USED IN THIS STUDY

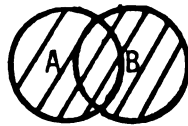
<u>Term</u>	<u>Definition</u>
:	such that.
$\in$	is an element of. For example, given that the set $A = \{1, 2, 3, 4\}$, $4 \in A$.
$\notin$	is not an element of. In the above example, $5 \notin A$.
$\forall$	All. For example, $\forall i \in T$ means "all i that is an element of the set T ."
$\subseteq$	is a subset of. $S \subseteq T$ means S is a subset of T , that is, every element of S is in T . This would be true, for example, if $S = \{1, 2, 3\}$ and $T = \{0, 1, 2, 3, 4\}$.
$\subset$	is a <u>proper</u> subset of. $S \subset T$ means that every element of S is in T and at least one element of T is not in S . In the above example, S is not only a subset of T , it is a proper subset of T .
$=$	is the same set as (has the same elements as). For example, if $X = \{4, 5, 6\}$ and $Y = \{4, 5, 6\}$ then $X = Y$.
$\emptyset$	the null set, the set containing no elements. See Figure C.1 for an illustration.
$\cup$	the union of two sets, that is, the combined elements of both sets. $L \cup M$ contains all the elements that appear either in L or in M . Mathematically, $L \cup M = \{x : x \in L \text{ and/or } x \in M\}$. For example, if $L = \{1, 2, 3\}$ and $M = \{2, 3, 4, 5\}$, then $L \cup M = \{1, 2, 3, 4, 5\}$. See Figure C.1.
$\cap$	the intersection of the two sets, that is, the elements common to both sets. Mathematically, $L \cap M = \{x : x \in L \text{ and } x \in M\}$. In the above example $L \cap M = \{2, 3\}$. See Figure C.1. Note that if L and M have no common elements $L \cap M = \emptyset$.
$S - T$	the elements of S that are not elements of T . Mathematically, $S - T = \{x : x \in S \text{ and } x \notin T\}$. For example, if $S = \{5, 6, 7, 8\}$ and $T = \{6, 7\}$ then $S - T = \{5, 8\}$.
u	the universal set or universe, that is, the set containing all elements of interest for a particular problem.

TABLE C.1 (Cont'd.)

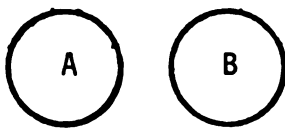
<u>Term</u>	<u>Definition</u>
S^c S' or $\sim S$	the complement of S , that is, all elements of the universe not contained in S . $S^c = U - S = \{x : x \in U \text{ and } x \notin S\}$.
Disjoint Sets	two sets containing no common elements. Sets A and B are disjoint if $A \cap B = \emptyset$, for example, if $A = \{0, 1, 2\}$ and $B = \{3, 4, 5\}$.



shaded area = intersection of A and B
 $= A \cap B$



shaded area = union of A and B $= A \cup B$



Here A and B have no common elements,
that is, A and B are disjoint sets
($A \cap B = \emptyset$).

Figure C.1 Illustration of the Concepts of the
Intersection and Union of Two Sets

the interdependence of different individuals' economic decisions and (2) the uncertainty under which individuals have to make those decisions (Bacharach, pp. vii-viii). Game theory challenges perfect competition's assumption that every economic agent behaves as if his actions were totally independent of those of his cohorts. By stressing mutual economic interdependence, game theory also draws into question the belief that the single-minded pursuit of self-interest inevitably leads to a social optimum.

Game theory addresses the issue of what constitutes rational individual choice in a situation where the outcome of an individual's decision depends on the decisions made by all other individuals in the system, each of whom faces the same problem of interdependence. This interdependence is typified by strategic decision-making in war:

If we build up our troops at Dover, Hitler will think we are going to land at Calais, not Normandy. But, then, he may think that we believe that he will think we are going to attack Calais and hence it would be rational for him to send his troops to Normandy, in which case we really should land at Calais. On the other hand, if he thinks that we believe that he thinks this way, he will send his troops to Calais. But then again...

Game theory asserts that there are rational ways of making decisions in situations of mutual interdependence like this.

Specifically, game theory attempts to outline what constitutes rational decision making in a situation where the utility an actor derives from his actions depends on the actions of others in the system, each of whom faces the same mutual interdependence. Game theory assumes that an economic agent evaluates alternative outcomes in terms of the utility they provide him, not just their monetary payoff. Therefore, game theory is potentially capable of dealing with issues such as risk preferences and nonmonetary rewards.

In determining a course of action, a player in a game evaluates the utility he would derive from various courses of action based on different contingencies. Figure C.2 illustrates this process for a two-person nonzero-sum game.¹ Players A and B each have three courses of action open to them, and the expected utility that one player derives from a particular course of action depends on the course of action selected by the other player. The expected utilities that A and B derive from different combinations of behavior are denoted by the ordered pairs in the table.² For example, if A adopts action A1 and B adopts action B1, A will derive an expected utility of 1 and B will derive an expected utility of 3. Game theory investigates what constitutes a rational way of choosing among alternatives given such a situation.

		Player B's Choices		
		B1	B2	B3
Player A's Choices	A1	(1,3)	(0,6)	(9,1)
	A2	(4,6)	(7,3)	(2,5)
	A3	(0,1)	(3,6)	(8,2)

Figure C.2 Payoff Matrix for a Hypothetical Two-Person Nonzero-Sum Game

¹Formal definitions of two-person games and nonzero-sum games are presented below.

²Game theory is based on the Von Neumann-Morgenstern theory of cardinal utility; therefore, the expected utilities that players derive from different courses of action can be calculated and represented numerically. This theory does not assume that utility measurements are interpersonally comparable.

Definition of a Game

Formally, a game has four elements (Bacharach, p. 34):

- (1) A well-defined set of possible courses of action for each of a number of players. A player need not be an individual; it can be any decision-making unit.
- (2) Well-defined preferences of each player among the possible outcomes of the game and among probability distributions or mixtures of outcomes.
- (3) Relationships whereby the outcome (or at least a probability distribution for it) is determined by the player's choices.
- (4) Knowledge of all of this by all the players.

Elements (1) and (3) describe the structure or rules of the game; elements (2) and (4) describe the players. In addition, the rules of the game must define the information available to any player at the time he makes any of his moves (Schotter and Schwödiauer, p. 484). If the player knows all previous moves in the game, it is defined as a game of perfect information, while if he is ignorant of any past move, the game is one of imperfect information. The concepts of perfect and imperfect information should not be confused with those of complete and incomplete information. Complete information, which is the basic assumption of classical game theory embodied in condition (4), means that all players know the rules of the game, including the other players' utility functions.

The four conditions outlined above, if strictly applied, greatly limit the situations to which game theory can be applied. For example, condition (1) implies that game theory is not strictly applicable when all alternative courses of action are not known by any one of the players.

Condition (2) rules out changes in preferences as situations evolve. Condition (4) is perhaps the most restrictive. Although game theory allows for uncertainty by: (a) making the outcome of one player's action depend on the actions of all the other players and (b) allowing the results (payoffs) of various patterns of actions by all the participants to be known only up to a probability distribution, condition (4) embodies another type of perfect knowledge assumption. Chapter 6 discusses the limitations this assumption places on using game theory to model farmer cooperatives.

Describing Games

A game can be described in terms of the number of players involved, the nature of the payoffs, the amount of communication permitted among the players, and the detail, or form, of the game.

Number of Players

Games are usually divided into those involving two players (two-person games) and those involving more than two players (n-person games). The distinction is important because once more than two players are involved in a game, coalition building becomes possible and bargaining processes can become much more complex than in two-person games (see below).

Zero-Sum versus Nonzero-Sum Games

Game theory defines a zero-sum (ZS) game (sometimes also called a constant-sum game) as a game in which the sum of the game's payoffs to all players is always a constant. Because the payoffs in the game are levels of utility, for a game to be zero-sum, there must exist at least

one order-preserving linear transformation of the players' utility functions that results in the sum of the players' utility payoffs being constant for all strategy combinations. Intuitively, a zero-sum game is one in which the players' preferences are strictly opposed. In a two-person ZS game, if player A gains X , player B must lose X . The strict opposition of preferences in ZS games implies: (a) there are absolutely no gains to cooperation among players and (b) it is in each player's interest to keep his strategies secret.

In nonzero-sum (NZS) games, the sum of the utility payoffs is not equal to a constant.¹ In NZS games players' preferences, while rarely the same, are not diametrically opposed. This overlapping of interests implies that there are potential gains from cooperation among the players and that to capture these gains communication among the players is usually necessary. Therefore, in NZS games it is no longer necessarily damaging to let one's intentions be known; indeed, it may be advantageous to advertise them (for example, with threats).

Cooperative versus Noncooperative Games

Cooperative games are games in which the rules permit the players to communicate with one another about possible joint strategies and make binding commitments to one another. Noncooperative games are games in which such communication and commitment making are not permitted or in which agreements among the players cannot be enforced. Because players in noncooperative games cannot enter into binding contracts with other

¹Strictly speaking, there exists no order-preserving linear transformation which results in the sum of the players' utilities remaining constant for all strategy combinations.

players or make credible promises and threats, noncooperative games are characterized by a complete lack of trust among the players (Schotter and Schwödiauer, p. 486). All two-person ZS games are noncooperative because the strict opposition of preferences in these games means that neither player can possibly gain from cooperating with his adversary. Noncooperative games are frequently used to model situations in which communication between players is very costly and hence extremely limited. For example, the famous prisoner's dilemma is a noncooperative game whose adverse outcome is the direct result of the inability of the players to communicate and make binding commitments with one another.

A prisoner's dilemma is illustrated in Figure C.3. Payoffs are listed in terms of years in jail in part (a) and in terms of specific utility levels in part (b). Part (c) presents a generalized form of the game, with payoffs listed in terms of utility. The following story is usually told to illustrate the prisoner's dilemma. The police arrest two men suspected of burglarizing a home, but lack the evidence to convict them without one of them confessing. The district attorney puts the men in separate rooms and offers each the following deal, letting him know that his accomplice has been offered the same proposition. If neither confesses, the DA has enough evidence to convict them both on a trumped-up charge of petty larceny, for which they will each be sentenced to a year in jail. (This is denoted by the ordered pair (1,1) in Figure C.3(a).) If one confesses and turns state's evidence while his compatriot does not, the one who confesses will go free while his partner will have the book thrown at him and likely be sentenced to six years in prison. If both confess, the prosecution will be more lenient and ask that they each be sentenced to four years.

		Player B	
		NC	C
Player A	NC	(1,1)	(6,0)
	C	(0,6)	(4,4)

(a) Payoffs in terms of years in jail

		Player B	
		NC	C
Player A	NC	(8,8)	(4,10)
	C	(10,4)	(5,6)

(b) Payoffs in terms of expected utility

		Player B	
		NC	C
Player A	NC	(a_{11}, b_{11})	(a_{12}, b_{21})
	C	(a_{21}, b_{12})	(a_{22}, b_{22})

(c) Generalized form of the game with payoffs in expected utility, where:

$$a_{21} > a_{11} > a_{22} > a_{12} \quad \text{and} \quad b_{21} > b_{11} > b_{22} > b_{12}.$$

Figure C.3 Payoff Matrices for a Prisoner's Dilemma

NOTE: The strategies open to each player are: NC = Not Confess and C = Confess.

SOURCE: Adapted from Luce and Raiffa, p. 95, and M. Taylor, p. 5.

If the partners could communicate and make binding commitments with one another, then the best mutual strategy would be for both not to confess. Lacking the ability to make such deals, each has an individual incentive to confess, even though he realizes that his partner has the same incentive and that if they both confess, they will both be worse off than if they both had refused to deal with the DA. This dilemma illustrates the occasional difficulty in game-theoretic situations of defining "rational behavior" unambiguously. Here, rational individual behavior leads to a mutually less-preferred (Pareto-inferior) result.

Two characteristics of a prisoner's dilemma lead to this Pareto-inferior result. First, the players are unable to communicate with one another and make binding commitments regarding mutually advantageous joint strategies. Second, the prisoner's dilemma is usually pictured as an isolated game, played only once by the participants. The behavior of the players in this game is in no way linked to their behavior in other games--the players have no concerns about developing or preserving their reputations as reliable partners, etc. If, however, players face recurrent prisoner's dilemmas, patterns of cooperation among the players may evolve. This has been shown both experimentally and theoretically. (Raiffa, pp. 123-26; Schotter. See the discussion of "supergames" below.)

A second important type of situation that can be modeled using noncooperative games is the coordination problem, illustrated in Figure C.4. Schotter (p. 22) says that a coordination problem exists "if the payoff space of the game...is such that at any equilibrium, not only does no player have any incentive to change his behavior, given the behavior of other players, but no player wishes that any other player would

change either." For example, in Figure C.4 there are two equilibrium solutions, the pairs (6,4) and (3,7). At either of these solutions, neither player wants to change his behavior nor does he want the other player to change. At the same time, in a coordination problem the players may not be indifferent to which equilibrium is settled upon. In Figure C.4 player A would prefer the solution (6,4) while B would prefer outcome (3,7).

		Player B	
		1	2
Player A	1	(6,4)	(0,0)
	2	(0,0)	(3,7)

Figure C.4 A Coordination Problem

SOURCE: Adapted from Schotter, p. 23.

The strategic problem facing each player in this situation is that of coordinating his choice of strategy with those of the other players, for given any choice by his opponents, it is always beneficial to coordinate. At the same time, the player tries to achieve the coordinated strategy that is best for him. In this type of game, in contrast to a prisoner's dilemma, individual pursuit of self-interest does not inevitably lead to mutually less-preferred outcomes; nonetheless, there can be significant rewards to coordinating strategies so as to avoid recurrent nonequilibrium payoffs (Schotter, pp. 22-23).

Because there are advantages to cooperation in NZS games, NZS games will be cooperative unless the rules of the game prohibit

interplayer communication and the making of binding commitments or unless such commitments are unenforceable. In a cooperative game each player does not determine his course of action independently; coalitions of players plan joint courses of action which yield joint benefits. In cooperative games a major problem of ZS games is therefore overcome--uncertainty about what other players are going to do. This problem is replaced by the equally difficult problem of determining how the potential gains from cooperative activities will be distributed among members of the coalition. Unless conflict over who will get how much of the potential joint return is resolved, joint action is unlikely to occur.

In cooperative games there usually exists a set of Pareto-inferior outcomes that the coalition members can agree to reject, but there usually remain several outcomes that satisfy Pareto-optimality. Each Pareto-optimal outcome represents a different distribution of costs and benefits among coalition members, and there is no clear rationality principle to choose among the alternatives. The final outcome depends on bargaining among the players. In Bacharach's words:

In cooperative games...payoffs accrue to coalitions and so before we can say we have solved a cooperative game we must say how the proceeds are to be shared between the coalition's members. The problem in game theory is like a notorious problem in welfare economics: there, it is clear that a solution to the problem of the maximum welfare of society is somewhere on the Pareto frontier -- but whereabouts? The problem is also, however, distinctly game theoretic. For here the final distribution of utility must recognize the strategic strengths of individuals: it must be sensitive to the fact that, if a particular coalition does not promise me at least what I can get by independent action, I would be a fool to join it. In the theory, fools don't play games (p. 37).

Players in game theory constantly ask, "What's in it for me?" If they see the slightest advantage in action 1 over action 2, they adopt 1. This does not imply that players are necessarily selfish,

short-sighted, or have no loyalty to certain patterns of behavior, simply that their feelings for others, their long-run view of the world, and their loyalties are incorporated into their evaluation of the pay-offs to different courses of action.¹

As the number of players in a game increases, so do the possibilities of forming coalitions--for example, of A and B joining together in a particular strategy to play against a third player, C. Game theory assumes that in evaluating whether to join a coalition each player calculates whether he would receive a higher expected utility by participating in a coalition or by acting on his own.² This implies that the set of feasible solutions to a cooperative game is bounded by the solution to an underlying noncooperative game.

Supergames

Infinitely iterating a static one-period game (called a constituent game) defines a new game, called a supergame (Schotter, pp. 54-59). The payoff structure of the supergame may differ from that of the constituent game played in isolation. In particular, Schotter (pp. 61-62) and M. Taylor (pp. 29-62) have shown that a supergame made up of an infinitely iterated constituent game that is a prisoner's dilemma may not itself be a prisoner's dilemma. Conventions dictating cooperation among the

¹In the long run, these considerations may become institutionalized (e.g., in the form of ideology), be incorporated into the rules of the game and, thus, constrain future outcomes. Standard game theory does not address the evolution of the rules of the game, but the concept of supergames, discussed below, does attempt to explain ideology as a rational adaptation to the players' environment. Chapter 6 also discusses how ideology can be incorporated into game-theoretic analysis.

²See the discussion of the coalitional or characteristic form of a game below.

players may arise because the expected present value of playing the constituent game in a noncooperative manner over a long period may be less than that of playing it cooperatively even if there are short-term incentives to play the game noncooperatively. This can be illustrated for a simplified two-person prisoner's dilemma supergame created by infinitely iterating the constituent game shown in Figure C.5.¹ In the constituent game each player has the choice of cooperating (C) with his cohort or defecting (D), and the payoffs are such that each player has a short-term incentive to defect.²

		Player 2	
		C	D
Player 1	C	(x,x)	(z,y)
	D	(y,z)	(w,w)

where: $y > x > w > z$

Figure C.5 Payoff Matrix for a Prisoner's Dilemma Constituent Game

SOURCE: M. Taylor, p. 31.

¹This example is taken from M. Taylor, chapter 3. Taylor also provides several more detailed examples.

²When there is one strategy in a game (such as defection in the prisoner's dilemma) that gives a player a higher payoff no matter what the other players do, that strategy is said to be dominant. In Figure C.5, D is the dominant strategy for both players. For example, if player 2 chooses C, player 1's payoff is higher if he chooses D since $y > x$. If player 2 chooses D, player 1's best choice is still D since $w > z$.

Assume that in playing the supergame each player considers only three strategies:

- (1) C^∞ : C is chosen in every constituent game regardless of the other player's behavior in previous games.
- (2) D^∞ : D is chosen in every constituent game.
- (3) B : C is chosen in the first game; thereafter, a player chooses whatever the other player chose in the preceding game. This has been called the "tit-for-tat" strategy in the literature on the prisoner's dilemma.

In order to determine whether it will ever be in a player's interest to cooperate in the supergame, either unconditionally (C^∞) or conditionally, that is, cooperating if his cohort also cooperates (B), it is necessary to calculate the payoffs to the different strategies in the supergame. Let the discount parameter (one minus the discount rate) of player i equal a_i . Then the payoffs in the supergame to player i from the nine possible combinations of these three strategies are those shown in Figure C.6. These payoffs are derived as follows.

If both players choose C^∞ , then (C,C) is the outcome in every constituent game, yielding each player a payoff of x in each of these games; therefore the total discounted payoff in the supergame to each player ($i = 1,2$) is:

$$x(a_1 + a_1^2 + \dots + a_1^n + \dots) = \frac{xa_1}{1 - a_1}$$

(since $0 < a_1 < 1$).¹

¹ For $0 < a_1 < 1$, the infinite series $(a_1 + a_1^2 + \dots + a_1^n + \dots)$ converges to $\frac{a_1}{1 - a_1}$.

		Player j's Strategy		
		C^∞	D^∞	B
Player i's Strategy	C^∞	$\frac{xa_i}{1 - a_i}$	$\frac{za_i}{1 - a_i}$	$\frac{xa_i}{1 - a_i}$
	D^∞	$\frac{ya_i}{1 - a_i}$	$\frac{wa_i}{1 - a_i}$	$ya_i + \frac{wa_i^2}{1 - a_i}$
	B	$\frac{xa_i}{1 - a_i}$	$za_i + \frac{wa_i^2}{1 - a_i}$	$\frac{xa_i}{1 - a_i}$

Figure C.6 Payoffs to Player i from a Two-Person Prisoner's Dilemma Supergame

SOURCE: Adapted from M. Taylor, p. 35.

Analogously, if both players choose D^∞ , the payoff to each is w in every constituent game, yielding each player a supergame payoff of:

$$w(a_i + a_i^2 + \dots + a_i^n + \dots) = \frac{wa_i}{1 - a_i}.$$

If both players chose B, then (C,C) will be the outcome in every constituent game, and therefore the supergame payoff will be the same as if both had chosen C^∞ , that is,

$$\frac{xa_i}{1 - a_i}.$$

This will also be the payoff if one player chooses C^∞ and the other chooses B, since this strategy combination will also always lead to (C,C) in every constituent game.

If player i chooses C^∞ while player j chooses D^∞ , then i will receive a payoff of z in every constituent game and hence a total discounted payoff for the supergame of

$$\frac{za_i}{1 - a_i}.$$

If player i , on the other hand, chooses D^∞ while player j chooses C^∞ , then i will receive y in every constituent game, yielding a total discounted payoff for the supergame of

$$\frac{ya_i}{1 - a_i}.$$

Suppose that player i chooses B while player j chooses D^∞ . In the first constituent game i therefore chooses C , but upon discovering that j has defected in this game, i chooses D in all subsequent games. The payoff to i is therefore z in the first game and w in the second and all succeeding games, yielding a total discounted payoff for the supergame of

$$za_i + w(a_i^2 + a_i^3 + \dots + a_i^n + \dots) = za_i + \frac{wa_i^2}{1 - a_i}.$$

Finally, suppose that player i chooses D^∞ and player j chooses B . In the first constituent game the outcome will therefore be (D, C) . Player j , upon discovering player i 's defection in the first game, will defect in all subsequent games. The payoff to i will therefore be y in the first constituent game and w in every subsequent game, yielding a total payoff for the supergame of

$$ya_i + \frac{wa_i^2}{1 - a_i}.$$

For a strategy combination to be rational for the two players, it must represent an equilibrium outcome. An equilibrium outcome exists when each player, given the other's strategy choice, has no incentive to change his own strategy choice. A game can have more than one equilibrium outcome.

Consider first the strategy of unconditional mutual cooperation (C^∞, C^∞) . From Figure C.6 it can be seen that this strategy combination is never an equilibrium outcome of the supergame because given player j 's choice of C^∞ , player i can always increase his supergame payoff by switching from C^∞ , which yields a payoff of

$$\frac{xa_1}{1 - a_1},$$

to D^∞ , which yields a payoff of

$$\frac{ya_1}{1 - a_1}.$$

(Remember that $y > x$.) Since player j also faces a similar set of payoffs, mutual unconditional cooperation will not persist.

Consider next the strategy of mutual unconditional defection (D^∞, D^∞) . From Figure C.6 it can be seen that this strategy combination will always be an equilibrium outcome because given j 's choice of D^∞ , i 's payoff is greatest if he also picks D^∞ (since $w > z$ and $a_1 < 1$). Therefore, mutual repeated defection is always one possible outcome of a prisoner's dilemma supergame.

Finally, consider whether mutual conditional cooperation based on the tit-for-tat strategy (B, B) is ever an equilibrium result. Given j 's choice of strategy B , i will do at least as well by choosing B as he will by choosing any other strategy if:

$$\frac{xa_1}{1-a_1} \geq ya_1 + \frac{wa_1^2}{1-a_1},$$

which will be true if:

$$(C.1) \quad a_1 \geq \frac{y-x}{y-w}.$$

If (C.1) holds, mutual conditional cooperation based on the tit-for-tat strategy is an equilibrium outcome of a prisoner's dilemma supergame, that is, mutual cooperation may be rational even though the constituent games are prisoner's dilemmas.

This result depends on the value of the discount parameter and the payoffs for cooperation and defection in the constituent games. If the discount parameter is too low (that is, if the discount rate is too high¹) mutual cooperation will not be rational in the supergame. In addition, the greater the incentive for defection in the constituent game (that is, the greater is $y - x$), the less likely mutual cooperation is to emerge as an equilibrium outcome. On the other hand, the greater the punishment imposed on a defecting player by his cohort's defecting in subsequent games (that is, the greater is $y - w$), the more likely mutual cooperation is to emerge as an equilibrium result.

Michael Taylor has broadened this analysis, examining additional strategies of conditional cooperation, both in two-person and n-person games, and his results are generally similar to those presented here. Mutual unconditional cooperation is never an equilibrium strategy in a prisoner's dilemma supergame, but mutual conditional cooperation can be

¹Since the discount rate equals $1 - a_1$.

a rational (equilibrium) outcome. This result depends critically on the discount rates of the players, the response of a group of players when their cohorts deviate from cooperative behavior, and their cohort's knowledge of what this response will be.¹ For example, if noncooperative behavior is punished severely (even at some cost to the players imposing the punishment) and if the offender's discount rate is not above a certain level (e.g., if he is not a fly-by-night operator) then the supergame may not be a prisoner's dilemma even if the constituent games are.

Schotter argues that in a situation like this an equilibrium outcome characterized by mutual conditional cooperation represents a social norm or institution that has evolved to deal with a recurrent prisoner's dilemma:

A set of societal norms will be developed as each agent observes what the other does and upon these common observations a behavioral convention (or institutional rule) will be established (p. 55).

Schotter's argument that societal institutions arise to capture social benefits that might otherwise be lost in recurrent prisoner's dilemmas and coordination problems is discussed in chapter 5; it is similar in many ways to Hayami and Ruttan's concept of induced institutional innovation and to the arguments of other advocates of "the new institutional economics" (e.g., Roumasset).

¹This implicitly assumes that noncooperative behavior by a player or group of players can be accurately perceived by the other players in the game.

Forms of a Game

Games may be described on several levels, each involving a different degree of detail. The amount of detail an investigator desires depends on the type of game being investigated and the results envisaged. Three common levels of description or "forms" of a game are the extensive form, the normal or strategic form, and the coalitional or characteristic function form (Schotter and Schwödiauer, p. 483).

The Extension Form

The extensive form is the most detailed description of a game; it pays close attention to the rules of the game and to the game's dynamic sequential movement. The extensive form is a move-by-move description of the game that:

- (1) identifies all the players;
- (2) specifies the rules of the game that denote whose turn it is to take an action and the set of alternative actions available at each move;
- (3) defines the information available to each player at each of his moves; and
- (4) associates a set of outcomes with each sequence of alternatives chosen by the n players and associates with each set of outcomes a set of n utility payoffs, representing the utility derived by each of the n players from that set of outcomes (Schotter and Schwödiauer, p. 484).

The extensive form is useful for analyzing the decisions facing a player at any particular point in a game and in evaluating how changes in the rules of the game affect those decisions.

The Strategic or Normal Form

While the extensive form of a game focuses on the individual moves players make at each point in the game, the strategic or normal form of a game focuses on the overall strategies of each of the players. A strategy is defined as "a course of action that prescribes exactly what a player would do in every conjunction or current state in which he may conceivably discover himself ... It is an extended contingency plan" (Bacharach, p. 38).

The normal form of a game pictures each of the n players as selecting an individual strategy from his strategy set (the set of potential strategies open to him, see below), with the resulting n -tuple of strategy choices determining the outcome of the game. In noncooperative games each player is forced to make his strategy choice without knowing the strategy choices made by the other players. In cooperative games players can make binding commitments about strategy choices and hence the outcome of the game. Consequently, cooperative games are usually not described in normal form, which focuses on the question of individual strategic choice; rather, they are described in coalitional or characteristic function form (Roth, p. 20n).

Note that in devising a strategy, which is a complete contingency plan, a player prepares many conditional moves he will never use. Because game theory assumes that players have unlimited computational ability (i.e., there are no decision costs) choosing a complete strategy before the game starts is logically equivalent to selecting individual moves as the game proceeds.

The normal form of the game focuses on strategic choices. Formally, for a game with a set of players, I , the normal form specifies the following (Schotter and Schwödiauer, p. 484):

- (1) a family of strategy sets, (S_i) , $i \in I$, one set for each player; and
- (2) a set of payoff functions, (P_i) , $i \in I$, each of which defines the payoff, $P_i(s)$, that each player receives depending on the strategic choices made by each of the n players. The payoff functions are assumed to be von Neumann-Morgenstern utility functions, showing the utility a player receives from each possible outcome of the game.

The Coalitional or Characteristic Function Form

For many purposes, including modeling of some of the behavior in farmer cooperatives, it may be sufficient to study a game from afar, ignoring some of the details of the game's rules and of the range of possible strategies open to each player. The coalitional or characteristic function form of a game focuses on describing what each possible coalition of players could guarantee itself if it coalesced and acted as a unit.

A coalition is defined as any subset of the set of n players, ranging from the group of n players as a whole to a single individual. Although game theory defines any subset of players as a coalition, there is no guarantee that a particular coalition will act as a group. "A coalition in the sense of the formal definition is something which it might be more natural to call a potential coalition" (Bacharach, p. 118).

Given a set of players I , the coalitional form of the game is described by a characteristic function, V , which shows the minimum payoff that each possible coalition in I can guarantee itself. For example, if K is a subset of I and if the coalition K can guarantee itself a payoff of at least 700 (dollars, utils, or whatever) no matter what the other members of I do, then $V(K) = 700$. Allowing K to take on all possible values in I , that is, letting it represent all possible subsets of I , traces out the values of the characteristic function.

More formally, the characteristic function V associates with each possible coalition $K \subseteq I$, $K \neq \emptyset$, the set of payoff vectors $V(K)$ that are attainable by K . It is usually assumed in game theory that the payoff vectors for any two disjoint coalitions are superadditive, that is, if two coalitions that have no members in common join forces they can do at least as well as they could do separately.¹ The superadditivity assumption therefore implies there is always an incentive to form the grand coalition consisting of all the players. If the grand coalition is not formed it is because of external constraints on coalition formation (e.g., antitrust laws) or because of the players' inability to agree on how the net benefits of the coalition ought to be shared among the coalition members.

The discussion of games in characteristic function form is greatly simplified if one assumes transferable utility and side payments. In order to define these two terms it is necessary first to explain some additional terms (Bacharach, pp. 119-121).

¹Mathematically, the superadditivity assumption is stated as:
 $K \cap L = \emptyset \rightarrow V(K) + V(L) \subseteq V(K \cup L)$ (Schotter and Schwödiauer, p. 485).

First, it is necessary to distinguish among the outcome, the share-out, and the payoff of a game. The outcome refers to the physical consequences of the game--X tons of pears processed by co-op Y, a \$5 million loss by co-op Z, and so on. The share-out refers to the distribution of outcomes (money, goods, etc.) among coalition members that was agreed to by coalition members before the game began. (It is assumed in cooperative game theory that coalition members make binding agreements prior to the game and do not recontract after the game's outcome is known.) The payoff to an individual from the game is the utility the individual derives from his share of the outcome. The payoff of the game as a whole is represented by an $n \times 1$ vector showing the utility that each of the n players derives from his or her cut of the outcome.

Side payments are said to exist when there is some means of payment (not necessarily money) available to the players which they can freely transfer among themselves, either before or after the game, to redistribute the individual shares of the outcome as determined by the share-out. Utility is said to be transferable if any side payments that occur among coalition members after the game has ended do not change the sum of the utilities derived by the coalition members from the game. In the simplest case, this would occur if players valued the outcomes of the game purely in terms of dollars (more specifically, if their utility functions were linear in money) and all side payments were also in money. If the coalition initially "won" \$500 in the game, redistributing shares among

the members using side payments then would not change the total payoff to the coalition.¹

Perhaps the easiest way to visualize transferable utility is to assume that all payoffs are in terms of money, which can be freely transferred among members of the coalition in any way they choose. One can then unambiguously talk about the payoff to the coalition as a whole, not simply the payoff to the individual coalition members.

Assuming transferable utility in essence allows one to equate the outcomes of a game with the payoffs of the game (i.e., there is no longer any distinction between the objects of utility and the utilities themselves because the utilities derived from an outcome are assumed to be proportional to the outcome). By assuming transferable utility we can discuss the utility the coalition receives from a given outcome. For a coalition K , $u(K) = \sum_{i \in K} u(i)$,

where

$u(K)$ = the utility of the coalition, and

$u(i)$ = the utility of the i th individual player.

The coalition is said to prefer outcome A over outcome B if

$$\sum_{i \in K} u_A(i) > \sum_{i \in K} u_B(i).$$

¹Remember that in game theory we are dealing with von Neumann-Morgenstern (VNM) cardinal utilities. "By suitable linear transformations of the utility scales we can always make the proportionality constant for all the players such that a redistribution of money among players in coalition K will not change the sum of their payoffs associated with a certain outcome of the game" (Schotter and Schwödiauer, p. 485). Therefore, all that transferable utility requires is that the increment in payoff that a player receives from a side payment be proportional to the amount of the side payment. Because utility functions remain unchanged if they are rescaled by any constant, the assumption of transferable utility in no way implies interpersonal comparisons of utility.

Note that this preference criterion is a potential Pareto one. Coalition K prefers outcome A over outcome B if A generates payoffs, which if redistributed, could increase the utility of at least one coalition member beyond that which he would obtain under B while leaving other coalition members as well off as with B (Bacharach, p. 138).

In a game with transferable utility the characteristic function can be interpreted as follows. Imagine a coalition K playing a game and deriving a utility $u(K)$. K cannot do worse in the game than if all other players not in K join in a single coalition (denoted as K^C) to play against K . The game is thus transformed into a two-person non-cooperative game between K and K^C . Let $v(K)$ be the maximin value of $u(K)$ in the two-person game, i.e., the worst payoff K would have to accept in the two-person game. Because K can do no worse in the n -person game than in the two-person game, $v(K)$ also represents worst payoff K would have to accept in the larger game as well. Even if all the other players do everything they can to hurt K , K is guaranteed a payoff of at least $v(K)$. The quantity of $v(K)$ is called the security level of K or the worth of the coalition K . Now consider $V = v(K)$ as a function defined on all possible coalitions--i.e., for all $K \subseteq I_n$, where I_n is the total set of all players. V thus defined is the characteristic function, which is a complete description of the game in coalitional form. The game, summarized in this way, describes the minimum payoff that each possible coalition in I can guarantee itself given the rules of the game.

Solution Concepts

Game theorists have spent much of their time trying to predict the outcomes or "solutions" of specific types of games. The search for

alternative solution rules has involved investigating whether the behavior of players in various types of games will lead to stable equilibria. Where more than one outcome is compatible with the rules of the game, different solution concepts lead to different allocations of payoffs among players; hence each solution concept embodies a different concept of fairness (Raiffa, pp. 242-46, 267-73).

While there is only one basic solution concept for noncooperative games, several solution concepts have been proposed for cooperative games. Four of the most commonly used cooperative-game solution concepts are discussed here: the core, the Nash-Zeuthen bargaining solution, the Shapley value, and the nucleolus. For details on other solution concepts see Luce and Raiffa (chapters 8 and 9) Schotter and Schwödiauer (pp. 485-88), and Raiffa (pp. 242-46, 267-73).

The Nash Solution for Noncooperative Games

The basic solution concept for noncooperative games is that of the Nash equilibrium. An outcome is a Nash equilibrium if the payoffs associated with it are such that no player wants to change his behavior nor does he want any of the other players to change their behavior.¹ At a Nash equilibrium each player's strategy is the best response he could make to the strategies chosen by each of his opponents. Therefore, if the players reach a Nash equilibrium they will not depart from it.

Formally, each of the n players in the game must pick a strategy s_i , $i = 1, \dots, n$. Let the set of chosen strategies be the vector $\underline{s} = (s_1, s_2, \dots, s_n)$. In selecting his strategy, player i searches

¹For example, the coordination problem shown in Figure C.4 had two Nash equilibria, corresponding to the payoffs (6,4) and (3,7).

for the best strategic response to the choices $(s_1, \dots, s_{i-1}, s_{i+1}, \dots, s_n)$ made by the other players, each of whom is simultaneously faced with the same problem as player i , that of "outguessing" his opponents. Assume that s_i represents player i 's best response or "reply" given the choices made by the other players, and let $\underline{s}|s_i'$ equal the vector $\underline{s}$ with the i th element equal to s_i' . If $P_i(\underline{s}|s_i')$ is the payoff to player i from this choice of strategy then the strategy set $\underline{s}^* = \underline{s}|s_i'$ is a Nash equilibrium if and only if

$$P_i(\underline{s}_i^*) \geq P_i(\underline{s}^*|s_i)$$

For all

$$s_i \in S_i \text{ and all} \\ i \in I_n.$$

In other words, with the set $\underline{s}_i^*$ the payoff to each player is higher than would exist if any single player changed his or her strategy. Each player is behaving optimally given the other player's actions (Schotter and Schwödiauer, p. 486; Varian, p. 72).

Much of the analysis in the theory of noncooperative games involves investigating the situations under which Nash equilibria may exist in different types of games and the dynamics that may lead players to move toward them. Bacharach provides a good introduction to that analysis.

Solution Concepts for Cooperative Games

Because players in cooperative games can work together for joint gains, the range of possible outcomes is broader than in noncooperative games. Game theorists have proposed many different concepts regarding which outcomes or "solutions" are most likely to emerge from cooperative

games and, where more than one solution is possible, which one is most fair.

All of the solution concepts discussed below are based on the description of a game in characteristic function form. To understand these solution concepts it is useful to define one additional term, imputation. There are many different ways in which payoffs from a game might be allocated among different coalitions of players. For example, in a constant-sum game whose total payoff is 10, coalition A might receive 4, coalition B might receive 5 and coalition C might receive 1. Any such distribution of payoffs among players that meets two conditions is called an imputation. Formally, an imputation is a payoff vector x that satisfies the following conditions:

$$(C.2) \quad x(i) \geq v(i)$$

For all

$$i \in I,$$

that is, the payoff an individual receives from the imputation is at least as great as the player's security level (the level of payoff he could obtain by acting independently); and

$$(C.3) \quad x(I) = v(I),$$

that is, the payoff for the group as a whole implied by the imputation (if the group worked together) equals the worth of the grand coalition (Schotter and Schwödiauer, p. 487).¹

¹By requiring the payoff to the grand coalition to equal at least its worth, equation (C.3) guarantees Pareto optimality. By constraining the payoff from equaling no more than the worth of the grand coalition, equation (C.3) prevents an imputation from "promising" members of the grand coalition more in payoffs than the coalition can earn.

Not all proposed imputations will be acceptable to all the players. In the above example, C may object and refuse to cooperate in the game unless it receives a payoff greater than 1. The search for solution concepts to cooperative games involves determining which imputations are in some sense acceptable to all the players. In other words, solutions are imputations that are not eliminated in the bargaining process among players.

The Core

The core is perhaps the most widely used solution concept. The core includes the set of imputations in which each coalition receives at least its security level. If a proposed imputation does not guarantee a coalition a payoff at least equal to the coalition's security level (the minimum payoff the coalition can guarantee itself) then that coalition will refuse to participate in the game and the imputation is said to be blocked. For example, if a player can gain more participating in coalition A than in coalition B, he will block any game involving him in coalition B.¹ The core corresponds to that set of imputations in which no player can do better for himself by cutting an alternative deal with some of the other players. More specifically, the core is that set of imputations that: (a) are Pareto optimal (since rational players in a cooperative game will never agree to Pareto-inferior outcomes) and (b) give each possible coalition a payoff greater than or equal to its security level. These conditions are referred to as the core constraints.

¹Bacharach (p. 88) refers to this as the "get-stuffed principle." If you don't offer me at least as much as I can get elsewhere, I'll tell you to get stuffed.

The core may include more than one imputation, that is, there may be more than one allocation of benefits that keeps everybody happy. Alternatively, the core may be empty--there may be no possible way of allocating payoffs that makes everyone better off than they could be under some alternative imputation. For example, consider the game of three people, A, B, and C, trying to decide how to divide \$1.00 among them. Any possible imputation can be blocked by some coalition. If the imputation $x(A) = 33¢$, $x(B) = 33¢$, $x(C) = 34¢$ is proposed, A and B might counter with a proposal of $x(A) = 50¢$, $x(B) = 50¢$, $x(C) = 0¢$. C could block this imputation by offering A 60¢ and keeping 40¢ for himself. B could then block this imputation by offering A an even more lucrative deal, and the bargaining would go on ad infinitum.¹ If the core is empty, there is no stable, Pareto-optimal solution, and game theory predicts a situation of constant turmoil as players contract and recontract with alternative coalitions, each of which blocks the others.

The theory of the core argues that the solution to a cooperative game must lie within the core (if the core is not empty), but it does not predict which imputation within the core the players will settle upon. This indeterminacy has led game theorists to search for unique solutions to cooperative games. As will be seen, each of the proposed

¹ All three-player constant-sum games have an empty core. The possibility of an empty core increases as the number of players grows because number of constraints an imputation must meet to lie within the core increases very rapidly with an increase in the number of players. For example, a two-person game has three core constraints (Pareto-optimality and the security levels of each of the two players), while a three-person game has seven core constraints (Pareto optimality, three individual security levels, and three security levels for the different two-player coalitions).

solution concepts embodies a different concept of what a fair solution should be.

The Nash-Zeuthen Bargaining Solution

Nash, building on earlier work by Zeuthen, argued that in a two-person cooperative game the players would eventually select the imputation that maximized the product of their utilities above that which they could obtain by acting independently. For example, in a two-person game in which player A had a security level of $v(A)$ and player B had a security level of $v(B)$ the two players would pick an imputation $(x(A), x(B))$ such that the product $(x(A) - v(A)) \cdot (x(B) - v(B))$ would be maximized. The logic of this solution is explained in chapter 5. Note that the Nash-Zeuthen solution, by maximizing the product of the utilities of the players above that which they could obtain by acting independently, could be viewed as maximizing a social welfare function or some measure of the gains from cooperation (Bacharach, pp. 93-94).

The Shapley Value

Shapley proposed a solution to cooperative games based on the superadditivity of the characteristic function. Shapley's solution is based on the following logic. Given superadditivity of the characteristic function, the marginal contribution of a player to a coalition depends on the order in which he joins the coalition. This is illustrated in Table C.2, which shows the contributions of different players to a three-player coalition. In all cases, the three players, working together, can earn a total payoff of 121. The incremental value added by each player, however, depends on the order in which the player joins the coalition. For example, A working alone can only muster a payoff of 0,

TABLE C.2
THE SHAPLEY VALUE OF A COOPERATIVE GAME

Order of Players Forming the Grand Coalition	Incremental Value Added by Each Player			Total
	A	B	C	
ABC	0	118	3	121
ACB	0	37	84	121
BAC	118	0	3	121
BCA	71	0	50	121
CAB	84	37	0	121
CBA	71	50	0	121
Average				
(Shapley Value)	57.33	40.33	23.33	

SOURCE: Adapted from Raiffa, p. 269.

but by working with B the two can earn a payoff of 118. B's marginal contribution in this case is 118, and if C joins them, her incremental contribution will be 3. If, however, the order of formation of the coalition is ACB rather than ABC, B's incremental contribution is only 37, and C's incremental contribution is 84.

Imagine that Table C.2 represents the profit function (in thousands of dollars) of a cooperative cannery that processes apples (A), beets (B), and corn (C). Processing only a single product would result in the plant's just breaking even; processing apples and beets together would yield a profit of \$118,000; processing apples and corn together would yield \$84,000 profit; processing beets and corn would produce \$50,000 profit; and processing all three products would result in a profit of \$121,000. In deciding how to divide the total profits of \$121,000 from the three-product plant among the producers of the different crops, one could not simply pay each crop its "marginal" contribution to firm profits, because that contribution would depend on the order in which the crop was judged to have "joined" the coalition.

Shapley reasoned that it was unfair for a player's payoff to depend simply on the order in which he joined or was counted as joining a coalition. Therefore, Shapley argued, a player tended to (and ethically should) view the value of the game to him as the mean of his different possible "marginal" contributions to group payoffs. This value is the average payoff that the player would receive from playing the game repeatedly over a long period of time. In the example in Table C.2 the Shapley value is the vector (57.33, 40.33, 23.33), represented by the figures shown in the last row of the table. Mathematically, the Shapley value for an individual player i is defined as:

$$\phi(v_i) = \sum_{K \subset I} \frac{(n-k)!(k-1)!}{n!} [v(K) - v(K - \{i\})]$$

where

n = number of players in the game and

k = number of players in coalition K .

The expression $[v(K) - v(K - \{i\})]$ represents the marginal contribution of player i to coalition K . The expression

$$\frac{(n-k)!(k-1)!}{n!}$$

represents the probability that in a random build-up of the grand coalition of n players, player i will join in the coalition in the k th position. Summing the product of these expressions over all K yields the average of player i 's possible marginal contributions.

Although the Shapley value has certain desirable characteristics (see Raiffa, pp. 269-70; and Luce and Raiffa, pp. 245-52), it has one major drawback: it may not always lie within the core. In other words, although the Shapley value may be a fair solution, in certain games individual and group incentives may be structured in a way that precludes the players from agreeing to it. For example, the Shapley values shown in Table C.2 do not lie within the core of that game. If they were proposed as an imputation they could be blocked by a coalition of A and B, who working together can produce 118, but who would receive only $57.33 + 40.33 = 97.66$ under the Shapley solution. B might therefore approach A, offer him 60 (making A better off than he would be under the Shapley solution) and keep 58 for himself (making B also better off than under the Shapley solution). C, which would get 0 in this imputation could in turn block the arrangement. C and A together can produce 84;

therefore C could lure A away from B by offering A 70 and keeping 14 for herself; B would be left with nothing. B, in turn, could block this imputation. Bargaining would continue like this until a solution within the core was found.¹

The Nucleolus

The search for a "fair" solution that also lies within the core led to the concept of the nucleolus. Let us define the difference between a coalition's security value, $v(K)$ and what the coalition would receive under a given imputation, $x(K)$, as the coalition's complaint, $e(x, K)$, that is,

$$e(x, K) = v(K) - x(K).$$

The complaint can be positive or negative, and the core consists of imputations whose complaints are all less than or equal to zero.² For example, in the canning cooperative discussed above, the corn growers' complaint would equal the difference between what they are charged for canning and marketing their corn in the multiproduct cooperative and what the growers would have to pay if they set up their own plant, either alone or with disaffected growers of one of the other crops.

¹In fact, in this example, as in the earlier one, the bargaining will continue ad infinitum because the core of this game is empty; there is no imputation that can satisfy all four of the following binding core constraints:

- | | | |
|-----|----------------------------|------------------------------------|
| (1) | $x(A) + x(B) + x(C) = 121$ | (Pareto optimality). |
| (2) | $x(A) + x(B) \geq 118$ | (Security level for coalition AB). |
| (3) | $x(A) + x(C) \geq 84$ | (Security level for coalition AC). |
| (4) | $x(B) + x(C) \geq 50$ | (Security level for coalition BC). |

²If $e(x, K) = v(K) - x(K) > 0$, coalition K would reject the imputation x because it could do better on its own; therefore x would lie outside the core.

The nucleolus is that imputation which minimizes the maximum complaint that any coalition could have against that imputation. The nucleolus always consists of a single imputation, which lies within the core if the core is not empty. Since the nucleolus minimizes the maximum complaint of any coalition, some authors have compared it to a Rawlsian system of justice, whose purpose is to maximize lexicographically the payoff to the worst-off player in the game (Schotter and Schwödiauer, p. 492).

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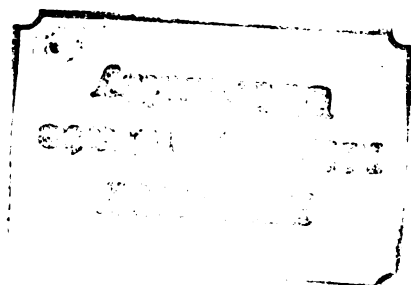
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