AGRICULTURAL COOPERATIVES: A UNIFIED THEORY OF PRICING, FINANCE, AND INVESTMENT

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Cooperative Principles, Objectives, and Social Science Method

Introduction

Agricultural cooperatives are a significant form of business enterprise. In many respects, they are similar to the investor-owned, profit-maximizing firms that, along with other organizations such as households and government agencies, form the institutional framework for western economic theory. Yet as so many authors have pointed out, cooperatives also are distinctly different from investor-owned firms (IOFs).

A considerable body of literature exists on the theory of agricultural cooperation, and it is very diverse in method as well as subject matter. Cooperatives have been analyzed from both a normative perspective, i.e., how cooperatives should perform to attain a particular norm or objective, and from a positive perspective, i.e., how they actually do perform. Prior theoretical work has primarily focused on static price theory and resource allocation. Little purely theoretical work has been done on cooperative finance and investment. As recently as 1978, Moore and Fenwick clearly recognized the deficiency, writing:

> A theory of "cooperative finance" does not exist. All we know is that corporate finance capital budgeting models fail to provide assistance on cooperative management decisions. (P. 30)

Cooperative taxation, and unique cooperative finance methods such as revolving funds and the related issues of equity allocation and redemption, have attracted most interest (Erdman and Larsen; Dahl and Dobson; Cobia et.al.; Beierlein and Schrader; Royer 1983). Recent articles by VanSickle and Ladd, and Knoeber and Baumer present advanced analyses of cooperative finance issues.

This paper explores the possibilities for a unified theory of agricultural cooperation. It does so by developing a theory of cooperative price, investment, and finance decisions under conditions of risk as well as certainty. This work also is a unified approach to theory in another sense. It jointly examines two areas of cooperative action that usually have been studied separately since 1945. Those two areas are the theory of the

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*Several people have contributed to the completion of this paper. James Shaffer initially encouraged me to do this research. Randall Torgerson's enthusiasm for the project was energizing. V. James Rhodes and Jeffrey Royer provided helpful insights at various stages. Charles Kraenzle, Peter Vitaliano, and Andrew Condon deserve special recognition for having read earlier drafts and providing detailed comments. Dorine Nagy typed and retyped this paper with a cheerfulness that was extraordinary. Of course, errors, oversights, and omissions of any sort are the exclusive responsibility of the author.

cooperative firm and the impact of a cooperative on market performance.[1] Examining the link between theories of the cooperative firm and market performance is timely for two reasons. First, there is a renaissance of interest in the appropriate role of cooperation in the food system. Second, the efficient market approach that has enabled economists to make great advances in the theory of corporate finance has not been extended to cooperatives. Using it here provides powerful new insights into several issues facing cooperatives.

Among the many questions that this unified theory addresses are the following:

> Exactly how does a cooperative improve the efficiency of the economy, and what does this imply for cooperative membership education efforts and public policy in areas such as cooperative taxation and antitrust?
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> What rate of return do cooperative members require on their equity?
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> What is the role of unallocated equity, most notably retained earnings, in a cooperative? Do they enhance member welfare?
>
> How can one measure the benefit stream for a projected cooperative investment?
>
> How can one develop risk-adjusted discount factors to evaluate investments that have different levels of inherent risk?

As implied by these questions, the theory is testable. Empirical evidence can provide cooperatives with direct operational guidelines.

<u>The Coonerative Dilemma: An Obstacle to Progress in Coooerative Theory</u>--Perhaps the greatest obstacle to progress in the pure theory of cooperation has been the lack of agreement on how to define a cooperative. Briscoe describes this discord as the cooperative dilemma (1971a, 1971b). He explains that cooperators tend to be attracted to two very different concepts. According to him, idealists are concerned with how cooperatives <u>should</u> be organized and what they <u>should</u> do to improve the welfare of their members. Traders, on the other hand, focus on the actual organization and readily observable monetary performance of cooperatives. Basically what is at issue is a normative versus positive approach to the definition of a cooperative.

Many cooperative practitioners derive their energy from a conceptualization of what a cooperative should be. They fear that losing sight of the ideal will harm the cooperative movement. One of the difficulties of this normative approach to defining cooperation is that once one moves beyond the cooperative principles--which have the approval of more than a century of practice to support them--any concerned cooperative philosopher can produce a set of cooperative organizational rules. This impedes advances in cooperative theory as well as practice. Energy is focused on determining whether a cooperative follows this or that creed. The normative approach often degenerates into an exercise in catechism. On the other hand, it certainly is healthy for cooperative thinkers to envision how the cooperative enterprise form can evolve to serve more perfectly its member owner-users.

Rather than shunt these normative issues aside, a theory of cooperation should provide a vehicle for analyzing them. This is an important endeavor because public policy toward cooperatives and the legal status of cooperatives are based, to a large degree, on their unique structural and operating features. Torgerson provides a concrete example of the need for a broad approach:

> In recent years a few cooperatives have taken on business characteristics not entirely in keeping with cooperative character. They include investment unrelated to use of the business, an orientation to growth through mixed ownership arrangements, and capitalization techniques relying increasingly on tax-paid surplus rather than patronage-based investment. They appear to be changing to businesses that just happen to have farmer ownership, but further similarity to cooperative character is purely coincidental. ... This trend spells trouble if it continues. It poses a policy dilemma and raises concerns about the direction of cooperation. (p. 2)

The concern is for "cooperative character" and "the direction of cooperation." What is needed to answer these questions is a scientific, i.e., positive approach that analyzes different cooperative structures and operating procedures to determine how they influence cooperative performance. Then perhaps some insight can be gained into the normative policy issues that cooperative strategic planners face, as well as the more visible public policy issues.

One can begin defining what a cooperative is by reviewing the cooperative principles. Of course, there are other approaches. A standard approach common in many texts, e.g., Roy, is to compare cooperatives with other forms of business enterprise to highlight what a cooperative is and how it differs from other business forms. To do this, however, one must first identify, i.e., define, a cooperative business. Yet another approach is to examine the way cooperatives are defined in the incorporation statues of the states and in federal statutes such as the Capper-Volstead Act. This involves a large amount of legal research and does not contribute much. Different states appear to have written the cooperative principles into law in different ways, but the principles were the starting point for all statutory constructions.

The Organization of This Paper--This section proceeds by reviewing the cooperative principles. A short introduction to the questions of defining a cooperative's objective follows. It helps to delimit the scope and method of this paper. The last part of this introductory section addresses more general methodological issues. It does not purport to be comprehensive. Rather, itis a convenient vehicle for identifying those aspects of cooperative activity that are important but unaddressed components of a unified theory of cooperation. Briefly acknowledging some of the underlying canons of scientific inquiry and related areas of inquiry is important for an endeavor of this sort.

The second section proceeds from a microeconomic perspective. It focuses attention on the cooperative as a firm within a market to analyze the price and output performance of agricultural supply and marketing cooperatives. The third and fourth sections incorporate investment and finance functions in a model of a supply cooperative. The result is a unified theory of cooperation comprising price, output, investment, and finance activities.

The Cooperative Principles

Abrahamsen provides the most complete readily available discussion of the history and evolution of the cooperative principles. Roy also has a chapter on them. Bakken's classic article (1954), his book (1963), and Robotka (1947) provide more perspective on the principles than the textbooks mentioned.

The principles originated with the Society of Equitable Pioneers, a purchasing cooperative, in Rochdale, England in 1844. The original Rochdale principles, as they have come to be called, included the following:

1. Open membership to all regardless of sex, race, politics, or religious creed;

2. One vote per member;

3. Any capital required should be provided by members and should earn a limited rate of return:

4. Any net margins should be returned to members in proportion to patronage;

5. Cooperatives should allocate some funds for education in the principles and techniques of cooperation;

6. Market prices should always be charged, i.e., no price cutting to pass on cooperative savings directly;

7. Cash trading: no credit given or asked;

8. Products should be accurately formulated and labeled;

9. Full weight and measure should be given;

10. Management should be under the control of elected officers and committees; and

11. Accounting reports of financial health should be presented frequently to members.[2]

Over time many of these have come to be recognized as business practices that any firm may or may not follow for better or worse. The first five principles, with minor modifications, plus the requirement that cooperatives cooperate among themselves are the six principles that the International

Cooperative Alliance (ICA) recognizes today as the Rochdale principles of cooperation.

Table 1 gives the ICA version of the Rochdale principles. Agricultural economists, most notably Nourse; Bakken and Schaars; Robotka (1947); Bakken (1954, 1963); Schaars (1980); and Abrahamsen, have interpreted and refined these principles so that they more directly address the particular situation of agricultural cooperatives. With regard to the first principle, membership in an agricultural cooperative is always voluntary, but there are additional considerations. Membership is available only to producers of agricultural products, and agricultural cooperatives can have open or closed membership policies. An open membership cooperative admits producers when they apply for membership. A closed cooperative may refuse a prospective membership application until such time as the cooperative wishes to expand its ranks. Commodity marketing associations often have closed or selectively open membership policies for two somewhat similar reasons. First, closed membership helps to avoid the short-run free-rider problem that can occur when producers who are playing the open market realize that the crop is very large and, after the fact, wish to join the cooperative marketing effort to obtain a higher price. Such late joiners do not contribute to the group marketing plan by committing product and investment capital or by participating in the group marketing decision in a timely fashion. Second, membership policies that are closed over periods longer than the production season allow the members to benefit from long-run investment strategies to develop market channels and establish popular brands that command a premium price. Agricultural purchasing cooperatives, especially secondary or tertiary associations, also ration membership on occasion. The interregional cooperative CF Industries is a tertiary cooperative because it is owned by regional cooperatives such as Farmland Industries (secondary), which is federation of local cooperatives (primary). Until recently, CF Industries produced fertilizer only for the cooperatives that set it up. As will be seen in the last three sections, whether a cooperative's membership policy is open or closed can have a large impact on cooperative performance.

Note that with regard to the second principle, democratic choice systems other than one-member/one-vote (e.g., voting proportional to patronage) are explicitly allowed for secondary cooperatives. The third principle, limiting the rate of return on share (equity) capital, helps to ensure that the benefits of cooperation are distributed to users of the cooperative rather than their investors. In many cases, users and investors are a common group of farmers who are the members of the cooperative. Even then, however, this principle helps to ensure that benefits accrue to members as users rather than members as investors.

The fourth principle is the "operation at cost" principle. The modern version allows considerably more latitude for the disposition of net margins. Members must directly, or indirectly through their board of directors as is usually the case, decide how to honor the operation-at-cost concept. There are three possibilities. First, according to the ICA, members can choose to retain net margins as capital to expand the business. In the United States, this is done by declaring net margins to be earnings, incurring any corporate income tax liability that arises, and using the

Table 1.--The Rochdale Principles of Cooperation Established by the 1966 Congress of the International Cooperative Alliance

1. Membership of a cooperative society should be voluntary and available, without artificial restriction or any social, political, racial, or religious discrimination, to all persons who can make use of its services and are willing to accept the responsibilities of membership.

2. Cooperative societies are democratic organizations. Their affairs should be administered by persons elected or appointed in a manner agreed by the members and accountable to them. Members of primary societies should enjoy equal rights of voting (one-member/one-vote) and participation in decisions affecting their societies. In other than primary societies the administration should be conducted on a democratic basis in a suitable form.

3. Share capital should only receive a strictly limited price of interest.

4. The economic results arising out of the operations of a society belong to the members of that society and should be distributed in such a manner as would avoid one member gaining at the expense of others. This may be done by decision of the members as follows: (a) by provision for development of the business of the cooperative; (b) by provision of common services; or (c) by distribution among the members in proportion to their transactions with the society.

5. All cooperative societies should make provision for the education of their members, officers, and employees and of the general public in the principles and techniques of cooperation, both economic and democratic.

6. All cooperative organizations, in order to serve the interest of their members and their communities, should actively cooperate in every practical way with other cooperatives at local, national, and international levels.

net-of-tax retained earnings for investment. Torgerson has called these unallocated retained earnings "tax-paid surplus" (p. 2). Currently there is major disagreement over whether cooperatives that employ unallocated retained earnings are honoring the operation at cost principle. Torgerson seriously questions whether such financial policies are operation at cost. Some cooperative analysts point out that it is not known who owns the retained earnings, and, except when a cooperative dissolves, they are not returned to member-users. Perhaps more important to this position is a concern that the management of cooperatives that are heavily capitalized by retained earnings may not be as responsive to member-users (Torgerson, p. 2). A related consideration is that members of cooperatives with large amounts of unallocated capital may feel less need to control management through their democratic voting rights because they do not have a direct claim on the cooperative's investment capital. If one has little or no investment capital to lose, why get involved? If member control is weak or nonexistent, is the organization a cooperative?

These concerns are a very important example of the disagreement over what constitutes a cooperative. I choose to include the retained earnings method of operating at cost precisely because of this controversy. Some cooperatives in the United States use it, most notably Agway Inc. The theory developed in subsequent sections will suggest possible reasons why cooperatives' use retained earnings and shed considerable light on their impact on cooperative performance.

A second way for cooperatives to operate at cost is to allocate the net margins to common services for the members. Such common services may be as simple as an end-of-the-year banquet or as complex as a concerted political action program to represent member concerns in public forums.

The third and most common way of operation at cost is to refund net margins to members in proportion to patronage. Such patronage refunds may be in cash or allocated to patrons' capital accounts and used for investment in the cooperative. Note that allocated patronage refunds are different than retained earnings because members have specific ownership claims on the assets. Allocated patronage refunds may ultimately be returned to members. Except for dissolution, retained earnings are not.

Historically, most agricultural economists have regarded principles two, three, and four--democratic control by users, limited return on capital, and operation at cost--as the core of the cooperative business enterprise structure. Both Bakken and Schaars emphasized that they are fundamental for agricultural cooperatives. Abrahamsen reflects the opinion of most agricultural economists today when he includes principle five, cooperative education, in the set of core principles. Also, the fact that members own a cooperative is now separated from the general principle of democratic control to examine the relationship between ownership and control. In practice, one may have ownership without effective member control. Control relates most directly to the internal political process of a cooperative, whereas ownership has major economic consequences: most notably, that owners bear the risk of success or failure of their firm.[3]

Rochdale principle six, cooperation among cooperatives, usually has been regarded as a "practice" that cooperatives should undertake to satisfy the more fundamental "principles." It is not essential for identifying a cooperative. Some cooperative thinkers, nonetheless, have resisted demoting it to secondary status (Rhodes).

In summary, for agricultural cooperatives, the cooperative principles are commonly listed as follow:

1. Operation at cost;
2. Member control;
3. Member ownership;
4. Limited returns on equity capital; and
5. Duty to educate.

Coonerative Business Practices--Schaars establishes six other practices for agricultural cooperatives. They generally have been regarded as good business management practices so "business" has been inserted to emphasize this fact.

1. Members (of the business) should provide equity capital in proportion to patronage.
2. All (business) transactions should be at market prices.
3. (The business) should strive for operational efficiency.
4. (The business) should grow through horizontal and vertical integration.
5. (The business) should control or own marketing facilities.
6. (The business) should remain neutral on political, religious, and racial issues. (Schaars 1951)

The first is most relevant for the theory developed in this paper. Investment proportional to patronage greatly simplifies the analysis of cooperative performance. Although this rule has not been followed by many agricultural cooperatives, the outpouring of concern by farmer patrons, public agencies, and cooperatives on the equity redemption issue suggests that cooperatives will have to increasingly honor it or some other equity investment plan that allows cooperatives to redeem equity on a systematic basis. Otherwise they may have to pay market rates of interest on capital that is not provided by current members in proportion to patronage (U.S. General Accounting Office; Cobia et. al.). For theoretical purposes then, it seems appropriate to assume that equity investment is, at least in the ideal situation, proportional to patronage. One might add that this practice supports an important aspect of the service-at-cost cooperative principle: it helps to avoid one member benefiting at the expense of another.

The Cooperative Objective--Structure based on cooperative principles is not sufficient to develop an economic theory of cooperation. One also must know something about organizational behavior. Organizational behavior can be very complex. For an economic--as opposed to an organizational or political--theory of cooperation, identifying a cooperative's objective simplifies things a great deal. Once the objective is known in an operational fashion, it can be used in conjunction with the constraints imposed by the organization's structure and market environment to produce a set of predictions or hypotheses about the organization's economic behavior. Alternatively, the theory provides prescriptions for behavior that the firm can follow to obtain its objective. Within the literature, there have been two distinctive approaches to the economic objective of cooperatives issue. One is market-oriented, and it usually has focused on the aggregate welfare of the agricultural sector by examining the performance of the markets in the sector. The other is microeconomic. It focuses on more narrow and immediate firm goals. A cooperative, for example, that cannot pay its bills can hardly advance the welfare of the agricultural sector.

Different schools of cooperative thought propound different market-oriented objectives. There are several, but two have played an historically important role in the development of agricultural cooperatives in North America. The competitive yardstick school, as typified by the writing of Edwin Nourse, reasons that cooperatives should seek to make the marketing system more efficient, thereby benefiting the consuming public as well as farmers. The commodity marketing school, as typified by the vibrant and visionary speeches of Aaron Sapiro, argues that all producers of a particular commodity should organize themselves into a single marketing cooperative. Sapiroism counsels that strength through group action will improve the performance of markets and benefit farmers.

To have historical validity, a theory of agricultural cooperation must at least address this divergence in vision. Does the debate between the efficiency and group power camps, which was most strident during the 1920s and 1930s but lively and often heated today, imply that two distinctly different economic theories of agricultural cooperation exist? The answer to this question is no. The role of cooperatives in markets is circumscribed by the political and economic philosophies of the country in which they operate (Cotterill 1984). In the United States, cooperatives generally are envisioned in law as market-perfecting instruments as Nourse argued, but the concept of workable competition does allow for group action through commodity marketing and bargaining cooperatives. Although cooperatives can exert market power in some cases, they cannot pursue Sapiro's philosophy to its logical extreme--complete control of the marketing system through a producer cartel.

At the microeconomic level, work on cooperative theory has borrowed heavily from the neoclassical theory of the firm. In static models, the IOF maximizes profits. In dynamic models that analyze investment, production, and consumption over time, the IOF maximizes the wealth of current shareholders by maximizing the net present value of the company's stock (Haley and Schall, p. 23). For cooperatives, there is even less agreement here than there is among the proponents of market-oriented theories of cooperation. In fact, some organization theorists assert that a cooperative does not seek to maximize any objective. They prefer to conceptualize a cooperative as a set of coalitions that makes decisions through a complex political process like a legislature (Vitaliano).

A nonmaximizing approach to decisionmaking may be very useful for explaining the rich detail of organizational behavior in cooperatives. However, the approach taken here is more neoclassical. The reasoning that supports this approach is as follows. Cooperative members cannot only voice their preferences through the democratic control structure of a cooperative, they also can exit the cooperative if it does not meet their needs as well as the next best alternative (Hirshman).[4] For a cooperative firm, the possibility of entry and exit by members is a more general example of changing patronage when the price of cooperative goods and services change. There is a demand curve for cooperative services that represents the sum of members' preferences for the cooperative's services. If the cooperative is a marketing- -rather than a supply--cooperative then there is a supply curve. Given that the cooperative faces such member supply or demand curves, the quest for an economic objective assumes a well-known form. Cooperative management must decide where to operate on the member supply or demand schedule. This involves setting prices and is a market transaction rather than an exercise of administrative fiat. There is need for an objective function of the standard microeconomic sort to guide management price, finance, and investment decisions.

The second section of this paper examines several objective functions that have been proposed for agricultural cooperatives. Because different objectives can produce significantly different predictions about cooperative behavior, it would be a significant advance in cooperative theory if several objectives could be eliminated or shown to produce the same result when particular competitive conditions and/or cooperative structural features are given.

A Note on Social Science Methods and Unexplored Areas in the Theorv of Coooeration

Clark has described the method of inquiry in economics as follows:

> General economics must simplify in order to interpret; otherwise its description will be just as unwieldy and baffling as the world itself. . . . It will be a never ending search for generalizations that are significantly true and for that very reason are often neither one hundred percent accurate, nor universally applicable. (P. 78)

In other words, a theory cannot be a complete catalogue of activity, nor can it be, at the other extreme, a tautological statement that by construction is impossible to reject. Friedman (1953) concurs by describing useful theory as parsimonious and robust in the sense that it predicts observed behavior well.

Because economics is a social science, a feature of theory construction that is undoubtedly more mettlesome than for the physical sciences is the issue of scientific objectivity. Friedman and the logical positivists argue that value (i.e., normative) premises are irrelevant. As long as the resulting theory has descriptive content that is testable for empirical validity, it is useful. A definition of the operation-at-cost principle, for example, that includes the possibility of the cooperative retaining unallocated earnings for investment can serve as a building block for a theory that may predict many aspects of cooperative behavior well.

Others disagree, arguing that a vibrant and often implicit relationship exists between value premises, the resulting theory, and its analysis of economic events. Continuing the example, a concern for the impact of unallocated retained earnings on cooperative performance may lead a theorist to formulate a different theoretical model than he or she otherwise might. Science may be objective, but in deciding what angle of attack to take in their search for order, scientists are not. Myrdal has emphasized the importance of this interdependence for social science theory. He writes:

> In order to avoid biases in research and to make it "objective" in the only sense this term can have in the 'social sciences we need to select and make explicit specific value premises, tested for their feasibility, logical consistency, relevance, and significance in the society we are studying. (p. 146)

Aresvik argued for this approach in diffuse fashion during the 1950s debate on whether a cooperative is a firm or an association (p. 142). With regard to the theory presented in this paper, perhaps the most important general value premise is: that the cooperative is a firm rather than an association of firms. A substantial collection of scholarly work based on the anarchist philosophy of Kropotkin and the economic analyses of Emelianoff and Phillips views the cooperative as an association. Robotka (1947); Savage; and Helmberger and Hoos argue otherwise and conclude that the appropriate premise is to regard the cooperative as a firm. In response to the question does a new economic entity emerge when a cooperative is formed, Robotka dismissed the decentralist and individual approach of the anarchists. He wrote:

> "The cooperative organization is a business enterprise firm" is almost universally accepted without question or verification. ... Although a cooperative does not appear to meet all the specifications of a firm, it cannot be denied that it is an economic entity. ... A new decision making body is created; ... a new risk bearing body emerges. (Robotka 1947, p. 103)[5]

Less attention will be paid to related avenues of inquiry that are very important for a complete theory of cooperation if one values member control, democratic organizations, and the quality of cooperative management. To proceed in this area, one must examine the structure and operation of the member control process. Ostergaard and Halsey pioneered formal analysis in this area with Power in Cooperatives. Craig's "Representative Control Structures in Large Cooperative" and subsequent work establish him as a skillful theoretician in this area. A recent research report by Mirowsky uses organization theory to explain how different democratic control systems can be analyzed in agriculture cooperatives. Finally, Vitaliano considers similar issues by applying the agency theory that Jensen and Meckling and others have developed to cooperatives. A truly comprehensive effort to establish the general theory of agricultural cooperation would integrate the current efforts with a theory of member control and the internal political process of cooperative firms. That, however, is beyond the scope of this effort.

The Coonerative Objective and Coooerative Price Eauilibrium Without Investment or Finance

Introduction

One way to expand the theory of cooperation is to begin with the competitive yardstick theory, critique it, and ultimately generalize it. Nourse first explained that a major objective of the agricultural cooperative movement is to act as a competitive yardstick for farmers in the food system (Cotterill 1984). As cooperatives perform this strategic function, the economy becomes more efficient because competitive pricing allocates resources without waste. Efficiency gains accrue primarily to farmers and consumers.

A yardstick cooperative, Nourse explained, produces this result by moving into a oligopolistic input or oligopsonistic processing industry. Like an invention that lowers costs, the cooperative provides its members benefits directly and other farmers benefit indirectly because IOFs must match the cooperative's performance. With a farm marketing cooperative, farm prices are higher and farm output increases. These results can be attained without raising prices to consumers. With a farm supply cooperative, input costs are lower and farm production and income increase. Increased output in the supply cooperative case ultimately produces lower food prices for consumers.

However, the monetary reward for innovation (in this case, organizational innovation) that farmers enjoy can be transitory. This is because farming is a competitive industry. Once equilibrium is regained, farmers' profits will be no higher than they were at the outset. The only exception to this rule is that rents for any resource in limited supply and owned by farmers may be bid up as output expands. Strictly speaking, however, increased rents are capitalized into increased factor values, e.g., value of land or the genetic potential of purebred cattle. Such capital gains are due to resource ownership rather than farming per se.

Two criticisms commonly are made of the competitive yardstick theory. To some, it is simplistic. Cooperative performance has more dimensions than this competitive price model suggests. Marketing cooperatives often benefit their members by differentiating their product to improve producer returns. Cooperatives also benefit members and society in other ways not captured by the yardstick theory, for example, leadership training or representation of farmers in the political arena as well as results of a more economic sort, for example, services directly related to product use. They point out that such cooperative activities are public goods that benefit many, and it is difficult if not impossible to charge a price for them. This is a more general, even sociological, approach to cooperative theory.[6]

The second major criticism of the yardstick theory manifests itself in a subtle but pervasive fashion. Economists and cooperative executives making public statements, such as speeches at annual meetings, often shy away from yardstick pronouncements because they feel that the theory does not focus attention on the activities and performance of the cooperative enterprise in a constructive fashion. Under the yardstick theory, cooperatives must not only be well-run businesses that provide members value through desirable prices or handsome year end net margins; they also must change the competitive behavior of IOFs with whom they compete. It is this second charge that creates uneasiness, especially if the cooperative is not a well-established firm with a leading position in the industry. Executives in smaller cooperatives understandably do not like to make claims or promises about their ability to change industry conduct. Executives in larger cooperatives may prefer to be known in the industry as good corporate citizens rather than tough competitors. This reticence to embrace the yardstick philosophy in a day-to-day operational sense suggests an important proposition. The competitive yardstick objective at best is a long-run goal.

A similar situation exists for IOFs. No IOF reports to its stockholders that it had a good year because it caused other firms to lower prices. Its executives report the amount of profits earned. Profitability is a goal in itself. It directs business decisions. Adam Smith's invisible hand ensures that such overt self interest serves broader social interests. In other words, competitive markets ensure that the long-run performance goal (price efficiency) is met when firms maximize profits.

For a cooperative, then, an intensive approach to theory would be to articulate and analyze an analogue to the IOF profit maximization-invisible hand combination. To do this, one needs a theory of the cooperative firm that is an integral part of a theory of market equilibrium. The analysis presented here demonstrates that cooperative membership policies, financial practices, and members' expectations interact with cooperative objectives to produce considerable variation in cooperative price-output performance. Some results produce competitive yardstick equilibria; others do not.

The approach planned is as follows. First, here in the introductory part of this section, there will be a brief discussion of cooperative equilibrium. This concept has implicitly played a central role in many early theories of cooperation (Helmberger and Hoos; Phillips). Cooperative and market equilibrium concepts are the core of the theory developed here. Next the basic assumptions of this analysis and the cooperative objectives commonly advanced by economists will be presented.

The next part of this section will examine agricultural supply or purchasing cooperative theory. First, some facilitating assumptions will be made. Second, the demand curve for a monopoly purchasing cooperative (the market demand curve) will be partitioned in a useful way. Then supply cooperative equilibrium will be explored in different market environments--most notably in monopoly and oligopoly markets. An important feature of this section is that it extends the cooperative yardstick concept to cover supply cooperatives that are monopolists. Monopoly cooperatives, do not, for example, behave like IOF monopolists. The impact of retained earnings, of closed versus open membership, and cash patronage refunds will be examined. Finally, the question of competition among cooperatives and the implications of extending the theory to the multiproduct case are discussed.

The third part of this section will explain agricultural marketing cooperative price theory. First, some facilitating assumptions are made. Then the input supply curve is partitioned, and, finally, cooperative performance is analyzed in monopsony and oligopsony markets. The possibility of a marketing cooperative developing market power through product differentiation in the processed product market will be introduced, but not analyzed. Such an analysis is a straightforward and major extension of the theory developed in this section.

Cooperative Eauilibrium--A cooperative that transacts business in a market is considered to be in equilibrium as an organization when its management has attained its objective and no members or potential members determine that, as a result or' the cooperative management policies, they must change their business relationship with the cooperative to attain their own business objectives. A cooperative objective, for present purposes, need not be an exact quantitative target such as a 15 percent growth rate. It could be a more general commitment, e.g., to maximize sales within the constraint that net margins are nonnegative.

The definition of cooperative equilibrium is comparable to the long-run equilibrium condition for an IOF. Such a firm is in equilibrium when its management has attained its objective, e.g., profit maximization, and no patrons or potential patrons determine that, as a result of the firm management's decisions, they must change their relationship with the firm to attain their own goals, i.e., there are not shifts of or movements along the supply or demand curves facing the firm.

Cooperative price-quantity equilibrium, however, can be different from IOF equilibrium even when the two firms have identical cost and demand conditions and the same objective. The reason for this is that a cooperative does not distribute net margins as profit to equity holders; it distributes net margins to members in proportion to patronage. Given the assumption that equity investment by members is proportional to patronage, net margins distributed according to patronage also are distributed proportional to investment as in an IOF. Nonetheless, as will be demonstrated, channeling the distribution through patronage can produce a different equilibria for the cooperative firm. Other features of a cooperative also can establish cooperative equilibria that differ from IOF equilibrium. These differences are the source of a cooperative's yardstick impact on market performance, i.e., the movement toward an efficient allocation of resources in a market economy.

Basic Assumptions--To analyze the relationship between cooperative objectives and cooperative equilibrium, it is convenient to assume the following. Assume that the economy is static. All production and consumption decisions

are made at a point in time. Points in time occur in a successive but unrelated fashion, i.e., there is no investment to link present and future economic activity. Thus equity capital is a purchased input for immediate use in the production process and its price (rate of return) is determined in the market for capital at that point in time. Also assume that there are no taxes. With regard to cooperative structure, the cooperative is organized according to the cooperative principles listed in table 2. With regard to the operation-at-cost principle, assume all net margins are paid as cash patronage refunds in the following period. The model could be generalized to encompass patronage refunds that are allocated into revolving funds. It also can accommodate per-unit capital retains commonly used in marketing cooperatives. With regard to the limited rate of return on capital, assume it is equal to the return on capital in alternative uses. If it is not, one can alternatively assume that members have provided the capital in proportion to patronage. Then prices paid can be adjusted so they are net of opportunity costs payments to equity capital. In addition to the cooperative principles, also assume the cooperative sells only to members. **This** assumption could, but will not, be relaxed to analyze the impact of nonmembers patronage on cooperative performance.

Coooerative Obiectives--Several objectives commonly have been advanced for use by cooperatives. The most important ones and some of the authorities that have argued for them are listed in table 3. Other objectives that have attracted some attention are minimizing the cooperative's costs and maximizing the patronage refund per unit (Kennedy, p.77). They are not included because the former is equivalent to characteristic three in table 2, and the latter produces no insights beyond those obtained from examining objective one.

Supplv Cooperative Theorv

To facilitate a systematic analysis, the following assumptions are made and will be relaxed at various points in this section. Assume members base their patronage decisions on the market transaction price. Members regard the cash patronage refund in the next period as a windfall gain. Also assume the cooperative is a monopoly and entry is blockaded. Finally, assume the cooperative sells only one product to farmers.

Partitioninr a Supplv Coooerative's Demand Curve--To analyze the objectives listed in table 3 within the context of a purchasing or supply cooperative, it first will be helpful to partition the cooperative's demand curve into demand from a set of members and demand arising from changes in that set of members. Because at this stage of the analysis the cooperative is by assumption a monopoly with blockaded entry, it faces the market demand curve DD in figure 1. D_1D_1 is the demand for the cooperative's product from a given set of cooperative members Ml. Thus it is the demand schedule for a closed membership cooperative. In a closed membership with Ml members, a price decline to P_2 would cause the quantity demanded from those members to increase from Ql to Q_{12}. This is a move down D_1D_1. If the cooperative were an open membership organization with membership Ml at price Pl, a price decline to P_2 also would increase demand because new members join the

Table 2.- -Basic Assumptions for Price Analysis

Static Model Assumptions

1. All economic activity occurs at unrelated points in time (exception: patronage refunds, if any, are distributed at the following point in time).

Coooerative Organizational Characteristics

1. Member control.

2. Member ownership.

3. Operation at cost by paying patronage refunds in cash at the next time point of economic activity.

4. Limited rate of return on equity capital that is:

   (a) equal to the market rate of return, and

   (b) equity capital input is provided proportional to patronage.

5. The cooperative promotes education about cooperatives.

6. The purchasing (marketing) cooperative sells (buys) only to (from) members.

Table 3.- -Possible Objectives for a Cooperative

1. Maximize cooperative net margins.

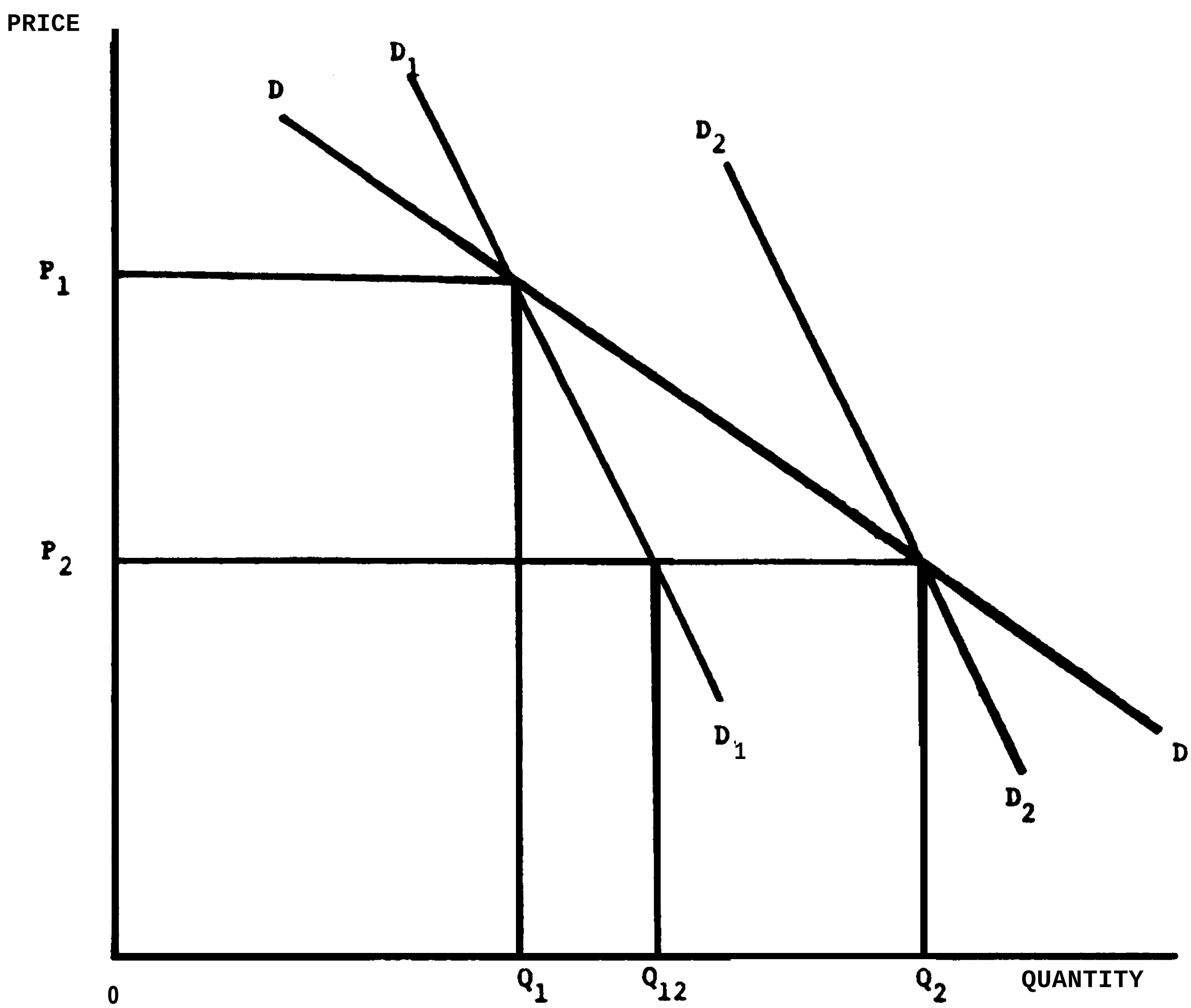
2. Maximize members' welfare (Ladd; Royer 1979, 1981; Enke).[a]

3. Minimize (maximize) price in a purchasing (marketing) cooperative (Nichols; Clark; Helmberger and Hoos; Heflebower).

4. Charge market prices and refund surplus (Rochdale pioneers; Walsh).

[a] Ladd and Royer address different types of agricultural cooperatives, and Enke examines only a consumer cooperative. Nonetheless, the objectives they proffer are the same.

Figure 1--Partititioning a supply cooperative's demand into demand from a set of members and changes in the set of members



cooperative. The quantity sold at P_2 would be Q_2. The market demand DD is a combination of these two separate effects. Thus an open membership cooperative faces the market demand curve. D_2D_2 is the new membership demand curve at membership level M2, which is greater than M_1.

It is insightful to note what happens when price increases in a closed membership cooperative. First, assume that members can quit the cooperative, i.e., there are no real or perceived barriers to exit. Then raising price from P_2 to P_1 will not reduce the quantity demanded by moving up D_2D_2. Rather the quantity demanded is reduced by members quitting until membership demand shifts to D_1D_1, and the remaining members purchase Q_1Q_{12} **less of Q.** An important conclusion follows. A closed membership cooperative's demand curve is kinked. Purchase behavior along any membership demand curve is bounded on the upper side by the market demand curve.

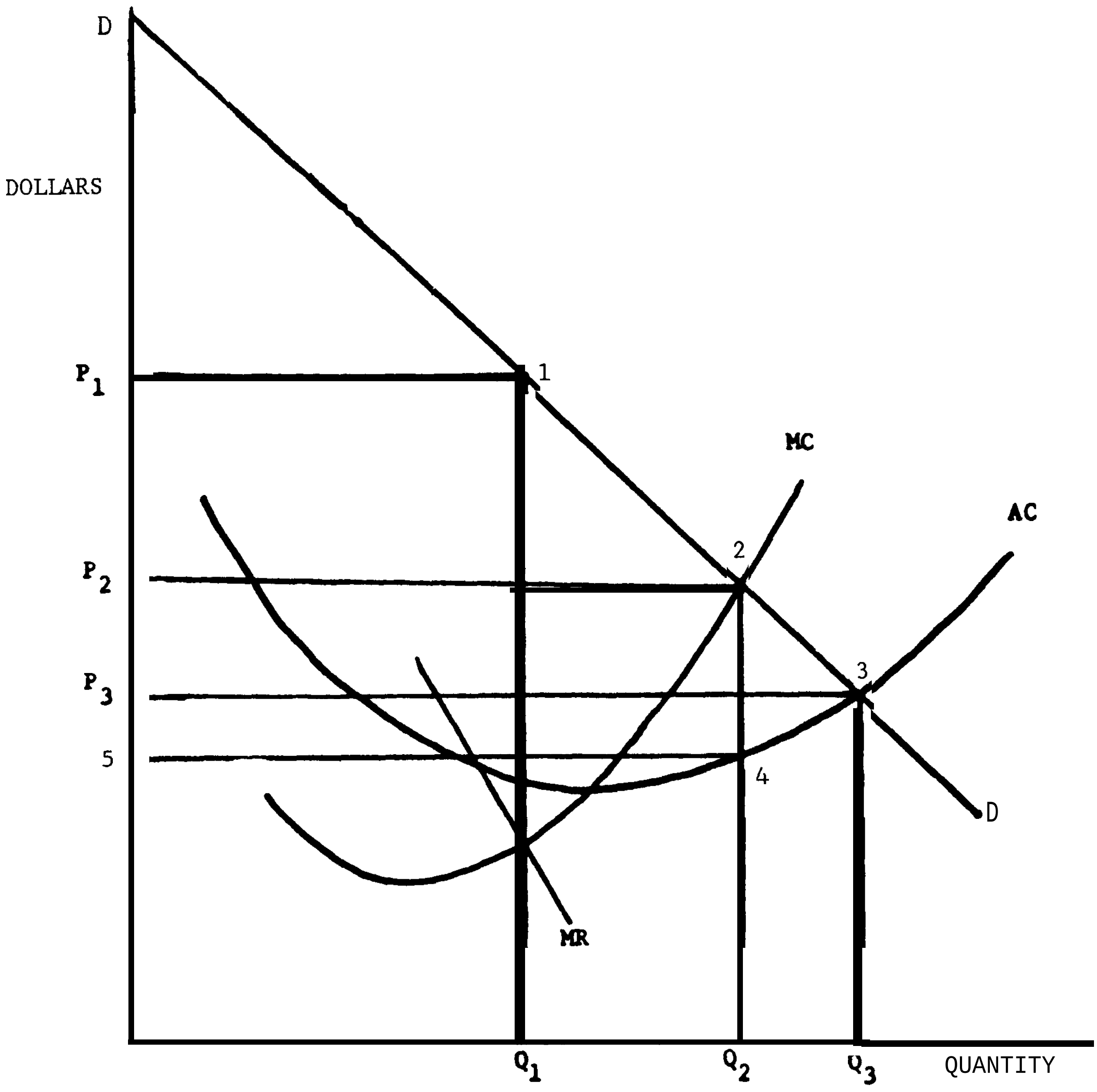
If members, for whatever reasons, cannot exit the cooperative when price rises, the new equilibrium would on D_2D_2 at price level P_2. Although there may be cases where members are **locked** in because of contracts or other ties to the cooperative, this probably does not occur often. Thus the demand curve in a closed membership cooperative normally will be kinked.

Analysis of Supply Cooperative Objectives--Turning now to the analysis of the four objectives listed in table 3, figure 2 portrays the cost and demand conditions for a supply cooperative with an open membership policy that has a monopoly and expects no entry by outside firms. Because the cooperative is the only firm in the market, DD is the market demand curve. Point 1 indicates the price a private profit-maximizing monopolist would charge, which is the price that a cooperative charge if it seeks to maximize net margins. Few cooperatives explicitly adopt this pricing objective.

Enke; Ladd; Royer (1978, 1982); and undoubtedly others have reasoned that the appropriate goal for a cooperative is maximum welfare gain for members. Royer analyses a more complex cooperative than is presented here. For an agricultural cooperative that sells several inputs to farmers and purchases several products from them, he concludes that the maximum welfare gain for members occurs when the sum of the members profits from on-farm operations plus cooperative net margins (patronage refunds) are at a maximum (Royer 1982, p. 30)[7]

For a supply cooperative, one can express this condition in terms of maximizing the sum of the cooperative's producer surplus (profits) and the aggregate Hicksian consumer surplus members derive from purchasing the product (Royer 1982, p. 36; Enke). In figure 2, a cooperative can attain this result by charging P_2 and selling Q_2. At point 2, cooperative's marginal cost intersects the farmers' aggregate derived demand curve for the input. The cooperative's profits or net margins are represented by area $P_2$245. Because the area under the demand curve equals the amount farmers would be willing to pay rather than do without the input, that area is Hicksian consumer surplus. Both Royer and Enke demonstrate that, at point 2, the decrease in the cooperative's profits from an increase of one unit of output is just offset by the increase in the consumer surplus. Beyond that point, the marginal profit loss is greater than the marginal consumer surplus

Figure 2--Cost and demand conditions for an open membership supply cooperative with a monopoly and blockaded entry



gain, indicating that point 2 gives the output level that maximizes the sum of cooperative profits and members' consumer surplus.

In Enke's consumer cooperative framework, where the demand curve is for consumption, this member welfare-maximizing solution also maximizes social welfare. For the same property to hold in the agricultural purchasing cooperative situation, one need only require free entry and adjustment to a long-run equilibrium of zero profits in the farming industry. As this process occurs, any short-run quasi-rents (profits) are passed on to consumers, assuring economic efficiency. Cooperatives following the member welfare-maximizing goal could do so with the following pricing rule: charge farmer members the price (P_2) that produces the volume of business (Q_2) that equates price and marginal cost. Because price P_2 is greater than the average cost at output level Q_2, the cooperative enjoys a positive net margin. To honor the operation-at-cost principle the cooperative could, among other things, pay a patronage refund.[8]

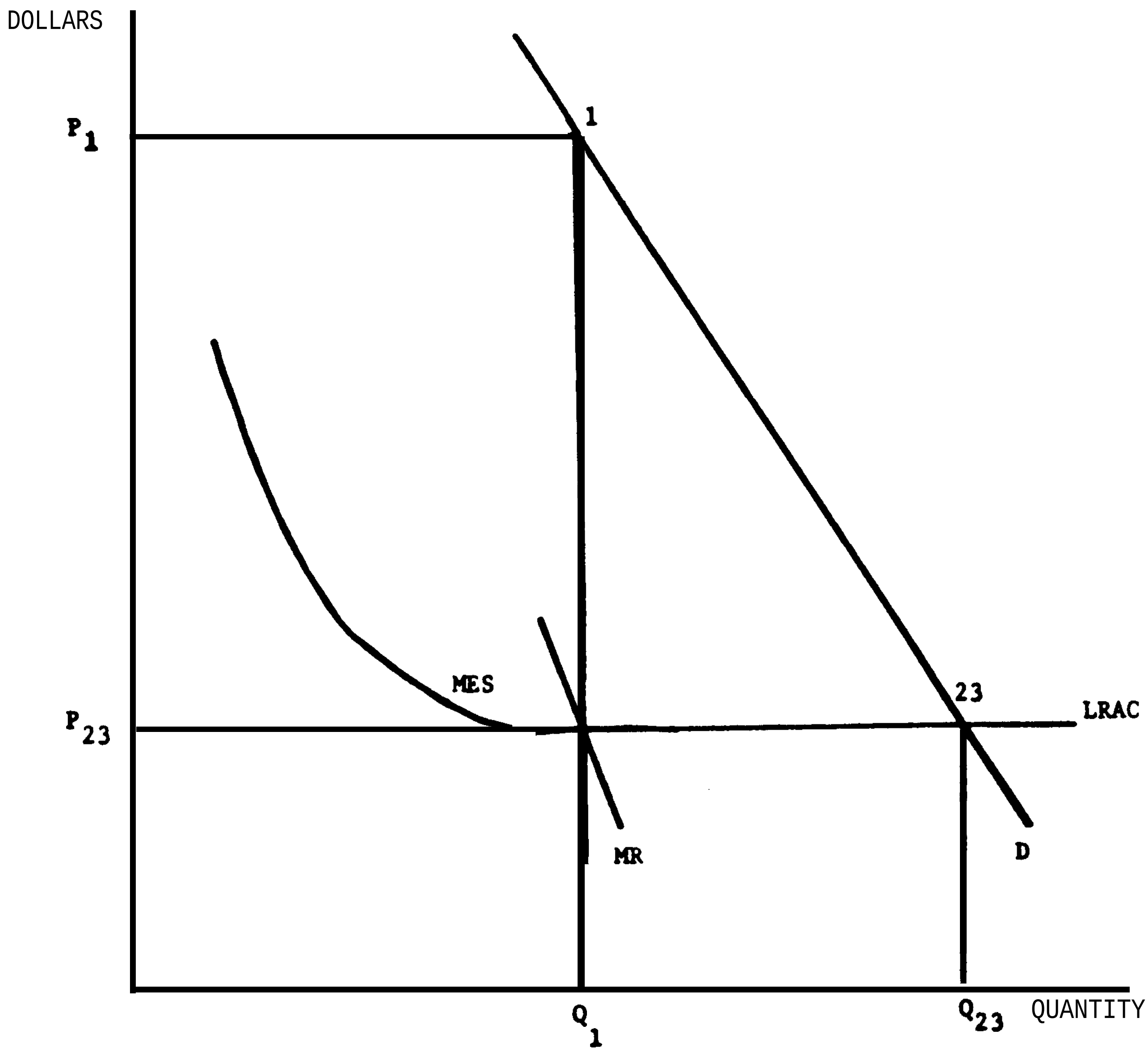
Helmberger and Hoos; Heflebower; and others have asserted that a single product open membership supply cooperative will seek to offer farmers the product at the lowest price consistent with covering the cooperative's costs. A cooperative would attain this goal by charging P_3 and selling Q_3. No net margins remain, so there are no patronage refunds, or any other type of surplus distribution, to members. This minimum price objective in an open membership cooperative also can be described as output maximization.

The fourth objective in table 3, charge the market price and refund any net margin, is not applicable under current assumptions. Because the cooperative is a monopoly, it sets the market price. It cannot follow other firms. Given the assumptions made about cooperative structure and market conditions, objective two is the most desirable objective for the cooperative because it maximizes member welfare.

Analysis of Cooperative Objectives: L-Shaped Long-Run Average Cost Curves--Consider figure 3 where the long-run average cost curve of the cooperative is now assumed to be L-shaped. A cooperative behaving like a profit-maximizing monopolist and maximizing net margins would charge Pl, sell Q_1, and return net margins to members as patronage refunds. The novel result is that objectives two and three, maximum member welfare and minimizing product price, occur at the same price-quantity point. Following a marginal cost pricing rule gives the same results as following an average cost pricing rule because long-run average cost equals long-run marginal cost beyond the minimum efficient scale (MES) in figure 3. Therefore, if long-run cost conditions are as portrayed in figure 3, objectives two and three are the same for analytical purposes, and one no longer needs to argue the merits of one over the other.

Analysis of Cooverative Obiectives: Consideration of Patronage Refunds--Relaxing the assumptions that members consider only the transaction price when deciding how much to buy from the cooperative produces an even more powerful result. Assume that member demand for the cooperative product is now a function of expected net price E(NP), which is defined as the transaction price P minus the expected patronage refund per unit E(PR).

Figure 3--Open membership cooperative monopoly with declining and then constant long-run average costs



That is,

(1) $E(NP) = P - E(PR)$.

Furthermore, assume that the expected patronage refund E(PR) in the current period equals the actual patronage refund of the preceding period. More realistic specifications of farmers' expectation formation processes could be developed. However, the added complexity adds little to the general results obtained here.

The cooperative equilibrium concept now becomes important. Management may seek to maximize net margins or member welfare, but in this dynamic model, they will be thwarted by member demand behavior. Consider the following scenario illustrated in figure 4. The cooperative has been charging P, selling Q, and paying no patronage refunds in the past. In the next period, period two, management decides to maximize member welfare by charging P_2 and returning $P_2 - AC2$ per unit as a patronage refund on quantity Q_2. In period three, management continues to charge transaction price P2, but members now expect a per-unit patronage refund of amount $P_2 - AC_2$. Thus they decide to purchase Q_3. The cooperative experiences higher average costs and the actual per unit refund is $P_2 - AC_3$. Given this lower patronage refund, in period 4, members only demand amount Q_4. This cobweb adjustment process continues until equilibrium is reestablished at Q. Management continues to charge P2, but expected net price is now equal to P because members know they will receive $P_2 - P$ as a per-unit patronage refund.

The conclusion of this analysis is as follows. The only objective for an open membership supply cooperative that is consistent with long-run cooperative equilibrium is objective three, minimize the price of the product. Alternatively, an open member supply cooperative will seek to maximize quantity sold given market demand and subject to covering costs of operations. This is a constrained sales maximization goal only if the elasticity of demand is greater than one.

Analysis of Coooerative Objectives: Consideration of Patronage Refunds and Closed Membership--How, one may ask, would converting to a closed membership cooperative affect the results of the previous section? Figure 5 can be used to answer this question. The market demand curve has been partitioned into two membership demand curves. D_1D_1 is the membership demand curve for all farmers who would purchase the product at expected net price Pl. As explained earlier, usually only the portion below the market demand curve has economic significance; an exception would occur if there are barriers of any sort that prevent members from ceasing to purchase the product at the cooperative. The same is true for D_2D_2, the membership demand curve for farmers who would purchase the product at P_2. The number of members here, M_2, is less than Ml, the number associated with D_1D_1. Restricting membership to the M_2 level would temporarily raise the price to P_3. However, it is not a long-run equilibrium solution. The cobweb adjustment process would ultimately lead the cooperative to equilibrium at expected net price P_2 and output level Q_2. Expected net price would be composed of a

Figure 4--Dynamic analysis of a cooperative equilibrium when members recognize the value of expected patronage refunds

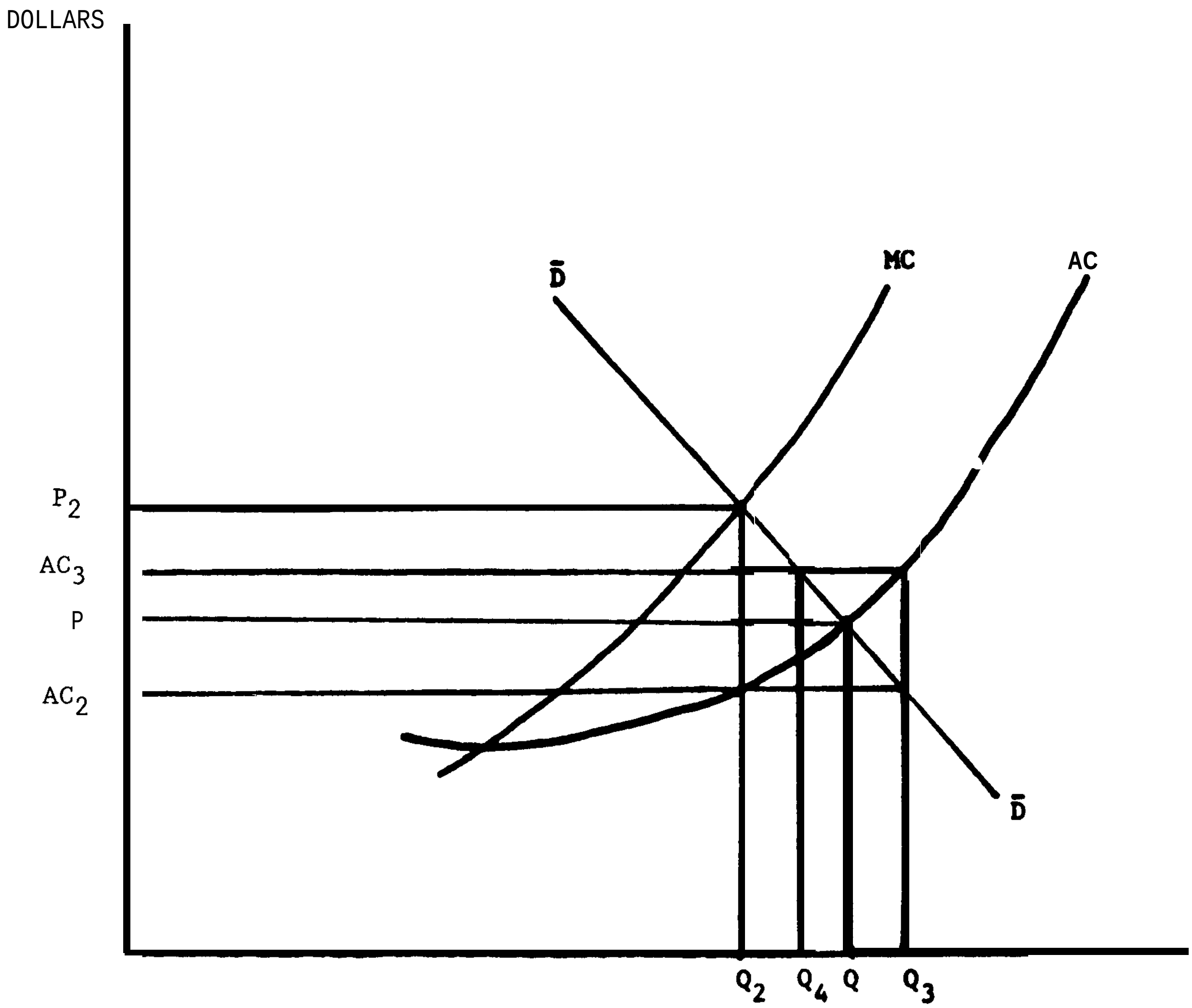
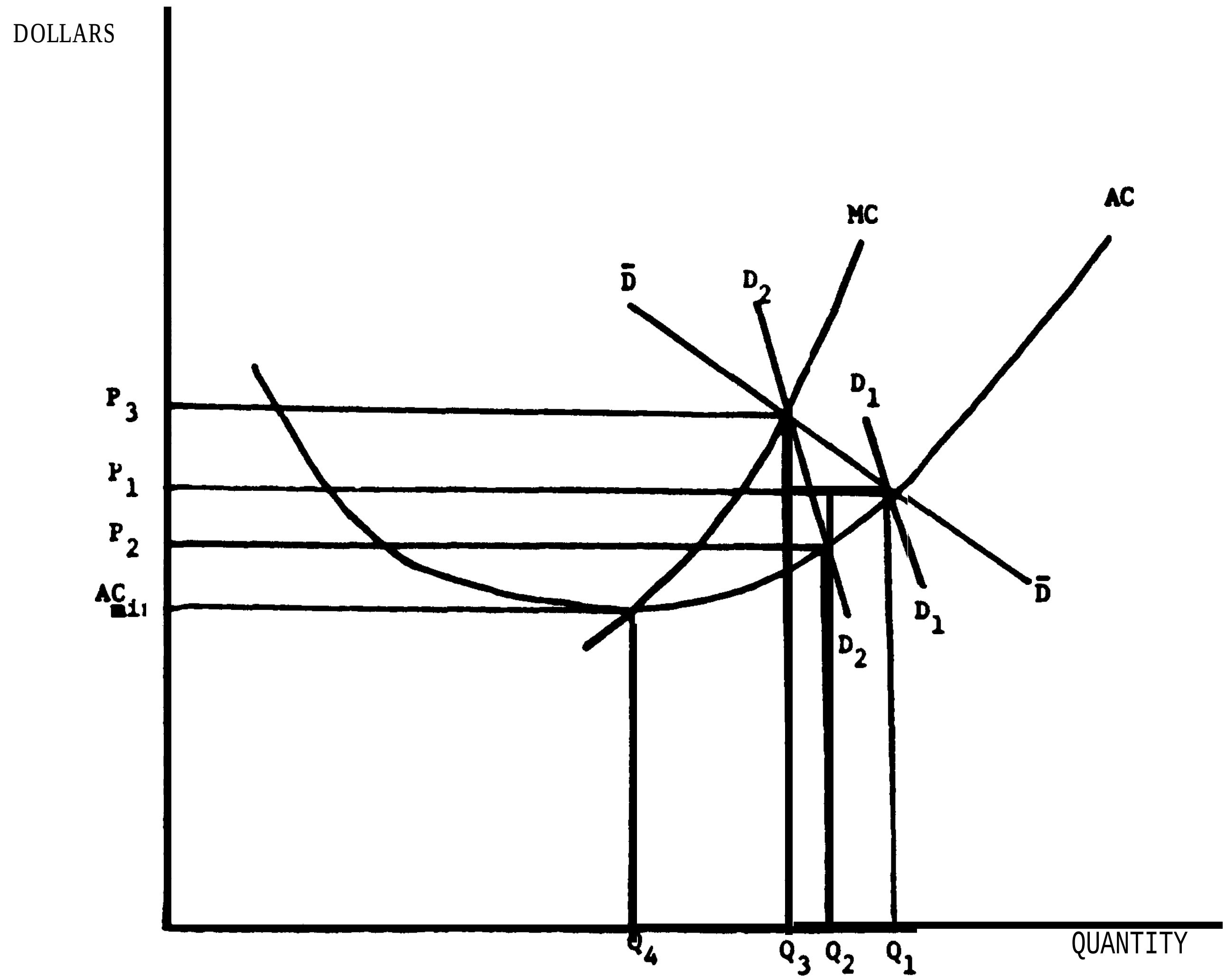


Figure 5--Impact of a closed membership policy on monopoly supply cooperative equilibrium when members recognize the value of expected patronage refunds



transaction price equal to P_3 set by management and a patronage refund equal to $P_3 - P_2$.

Two important results of this analysis follow. Membershlp restrictions cannot be used to establish the maximum member welfare objective. To attain it, the cooperative must adopt some form of quota or production control scheme. Note, however, that membership restrictions can be used to lower the cooperative's expected net price to the minimum value of the long-run average cost curve. This produces a member welfare maximum for the remaining members because at that point price equals marginal cost, but it does not produce maximum social welfare for the obvious reason. A number of producers have been excluded from the input market. The quantity of the product sold is considerably less than Q_3, the socially desirable amount. As a result, the amount of agricultural production is less than it would otherwise be. Consumers pay higher prices and the fortunate farmers who are in the cooperative earn economic rent (profit) on their cooperative membership. If the membership was attached to the farm, it would be capitalized and raise the value of the farm. Thus a restrictive membership policy would not benefit future cooperative members who buy the farm and have to pay for cooperative access as well.

Retained Earnings in a Monopoly Supply Coooerative--Retained earnings, i.e., net margins that are not distributed as cash or allocated to members' equity accounts, affect cooperative equilibrium. A cooperative that retains net margins can attain any price output point on the market demand curve in figure 2, including points 1 and 2. Because members do not expect to receive any patronage refunds, they base their purchase decision on the transaction price. The cooperative can, for example, price like a profit- (retained earnings) maximizing firm by setting price at level Pl. Setting price at level P_2, however, does not maximize member welfare because members do not receive retained earnings.

The Three Stages of Coonerative Output--A useful concept worth mentioning is related to the conclusion that the price received by members is determined by the intersection of the market demand curve and the average cost curve. One can define three different stages of cooperative output according to the economic relationship that exists among members. If demand intersects the average cost curve to the left of its minimum, this is known as the complementary output stage. Increases in demand lower price for all cooperative members. If demand intersects a flat section of the average cost curve, if any exists, this is known as the supplementary output stage. If demand intersects the rising portion of the average cost curve, the cooperative is in the conflictive output stage. A cooperative's membership policy and membership education effort may depend very strongly on the particular stage in which it is operating (Croteau, pp. 9-10).

Conclusions for the Coonerative Monopoly Model--This section on cooperative objectives under monopoly conditions concludes with three general points. First, the supply cooperative objective that is consistent with cooperative equilibrium, when farmers expect patronage refunds, is to minimize the price of the product subject to covering the cooperative's costs. This price occurs where the demand curve for an open or restricted membership cooperative intersects the long-run average cost curve. Therefore, a monopoly cooperative that pays patronage refunds acts as a competitive yardstick against itself. In the long run, cooperative price equals average cost.[9] This generalization of the competitive yardstick concept is novel and potentially quite important as a guideline for antitrust analysis of cooperative business practices. Even monopoly cooperatives may attain desirable social welfare norms such as allocative efficiency.

Second, the allocation of cooperative benefits between the transaction price and the patronage refund per unit cannot be used as an instrument by management to maximize member welfare, and it need not be used to minimize the price subject to covering costs. No matter how the allocation is set, the cooperative will attain long-run equilibrium.

Third, a cooperative that retains earnings has the flexibility to select any price-output combination on the demand curve facing it. This includes the net margins (retained earnings) maximizing point. Retained earnings, however, cannot be used to earnings maximize member welfare. These results also hold for cooperatives that are not monopolies.

Fourth, controlling the size of the membership can benefit those who are not excluded, but such policies are not socially optimal. One might, however, correctly point out that a restricted membership cooperative may be able to move the economy toward a more efficient allocation of resources if entry is not blockaded. The existence of several potential or established farmers who do not have access to this input might signal a private firm to enter or provide incentive for excluded farmers to organize a second cooperative. If a second cooperative was established and demand in figure 5 was shared between them, the result would be that all farmers would enjoy price near the level minimum average cost level. Member and social welfare would be even higher than it was at the unattainable price output point (P_3,Q_3). Whether social welfare would be higher if an IOF enters takes us into an analysis of how cooperative objectives are influenced by market structures where the cooperative has investor-owned rivals.

Relaxing the Independence Assumption--Analyzing cooperatives as if they were monopolists with blockaded entry essentially assumes that they are unaffected by and do not have an impact on other firms in the market environment. This independence assumption is now relaxed to examine what different competitive environments can tell us about a cooperative's objective and its performance. The fourth objective in table 3 now has content because there is a market price and the cooperative can choose it or some other price level as its transaction price. The competitive yardstick concept, as Nourse envisioned it, also becomes operative. Previously a cooperative was only working against itself or, more accurately, its members. Now it is working against other firms as well, and one can ask whether it pulls rivals as well as members toward a more efficient allocation of resources. Continuing the example of a purchasing cooperative, there are three structural configurations that merit analysis--perfect competition, monopolistic competition and oligopoly.

The first two, perfect competition and monopolistic competition, can be dismissed as trivial for cooperative theory. In a perfectly competitive market, entry is easy, firms are numerous, and they are price-takers. No firm, including a cooperative, has discretion over price so the objective must be to charge the market price and refund any net margins to members. In long-run equilibrium, market price equals minimum average cost. Net margins are zero, and members receive no patronage refunds. Member and social welfare would be at a maximum because price equals marginal cost. With regard to monopolistic competition, it is sufficient to note that long-run equilibrium occurs for each firm where its demand curve is tangent to the long-run average cost curve (Ferguson, p. 299). Therefore, as in the perfectly competitive situation, it makes no difference which objective a cooperative pursues. Each produces the same equilibrium price-output result.

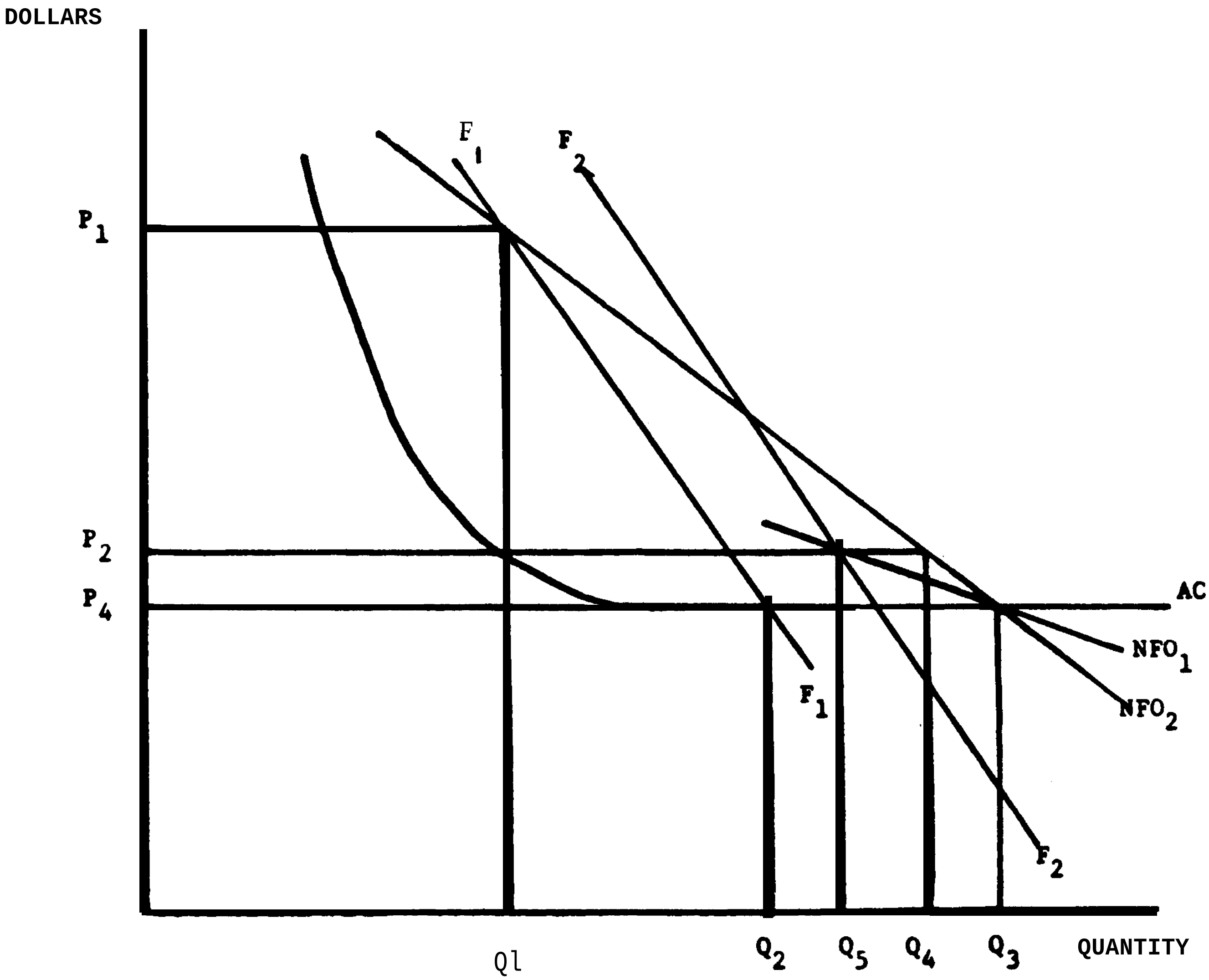
Oligopoly is the most relevant real-world, theoretically interesting environment for most cooperatives. Assume that all firms, including the cooperative, have symmetric costs, IOFs recognize their interdependence, and they jointly maximize profits as in Chamberlin's small-numbers case (Chamberlin, pp. 46-51). To analyze this joint profit-maximizing solution, industrial organization economists have defined followship and nonfollowship demand curves (Greer, pp. 257-61). A followship demand curve for a firm is that amount of industry sales that it receives when all firms raise or lower prices in tandem. Assuming that farmers do not switch among firms when all firms change prices at the same time, the followship demand curve construct is equivalent to the closed membership demand curve. As all firms in the industry raise or lower prices in tandem, they keep the same set of customers. Thus they are moving along what has heretofore been called a membership curve. A nonfollowship demand curve is analogous to the market demand curve of the monopoly cooperative case in that it is predicated on the assumption that changes in a firm's price are not followed by (are independent of) rival firms. The nonfollowship demand curve therefore is considerably more elastic than the followship curve.

Figure 6 illustrates how the followship and the nonfollowship demand curve can be used to analyze cooperative equilibrium in an oligopoly. Given initially the followship demand curve F_1F_1 and that the IOFs maximize profits by charging P_1, the cooperative has some important choices.

<u>Oligopoly: Closed Membership Cooperative Equilibria</u>--If it is a closed membership cooperative, it can price at P_1 and pay a per-unit patronage refund equal to P_1P_2. Ultimately membership demand will attain equilibrium at Q_2. The cooperative will continue to charge P_1, but it will pay a per-unit patronage refund equal to P_1P_4. A very important result follows. A closed membership cooperative equilibrium will not disturb the oligopolistic joint profit-maximizing equilibrium.

There will be no competitive yardstick effect on the market price. This case occurs because the cooperative captures no customers from the proprietary firms. In essence, the closed membership cooperative structure allows the cooperative to move down its followship demand curve while the other firms do not. If it prefers, a closed membership cooperative could lower price from P_1 to P_4 rather than charge market prices and pay patronage refunds.

Figure 6--Supply cooperative equilibrium in an oligopolistic industry



Again, in theory, there would no impact on other firms in the market because buyers could not switch to the cooperative.

This theoretical result may describe reasonably well the impact of agricultural supply cooperatives that have integrated into oil refining. Because these cooperatives sell primarily in rural areas to agricultural producers, they are essentially closed membership organizations. Urban consumers cannot switch their patronage to farm cooperatives. Therefore, any benefits from cooperatives entering the oligopolistic refining industry accrue to cooperative members (rural areas) rather than the general public (urban areas).

Oligopoly: Open Membershin Coonerative Eauilibria--The situation is quite different for an open membership cooperative. First it could refuse to go along with the joint profit-maximizing price and charge P_4. Rivals would follow by charging P_4 to produce cooperative equilibrium at output Q_2. This is a competitive yardstick result. All farmers now can purchase the input from all firms at price P_4.

An open membership cooperative, however, has what may be a superior alternative. It can pursue objective four from table 3, which is charge market prices and pay patronage refunds. A cooperative would do this even if it had no fear of a price war because it benefits members most. The open membership cooperative would charge P_1, sell Ql, and pay a per-unit patronage refund equal to P_1P_2. Until nonmembers became aware of the benefits to cooperative membership, established members enjoy benefits just like a closed membership cooperative. However, as the patronage refund becomes common knowledge, membership would expand to Q_4 if IOFs do not respond. Assuming no response by rivals, equilibrium would occur at (P_4,Q_3) where the membership demand curve intersects the average cost curve. The IOFs have exited the market and the cooperative output Q_3 accounts for 100 percent of industry sales. This is because no one would buy from the higher priced rivals.

Even if rivals respond by matching the net price in the next market period, and they most certainly will rather than see their market shares fall to zero, some farmers who are upset that they did not share in the already awarded patronage refund may join the cooperative. Although IOFs match the expected net price of the cooperative P_2, these farmers have revised their expectations to reflect their lack of trust in the proprietary firms' performance. Thus the cooperative's market share might increase, and its followship demand might now be F_2F_2. The cooperative also would charge P_2 in period 2. At (P_2,Q_5), the cooperative pays a patronage refund at the end of period 2. The process continues in period 3. More farmers would shift patronage to the cooperative, causing the followship demand curve to shift to F_3F_3 (not shown). Equilibrium is at P_4 and a quantity between Q_5 and Q_3. This is a competitive yardstick result. All firms offer the input at a price equal to long-run average and long-run marginal cost.

Of course, these results change if the firm eventually experiences size diseconomies, which cause the long-run average cost curve to be U-shaped. The cooperative then may or may not move the industry toward an efficient allocation of resources. As with a monopoly cooperative, if entry is possible, adding one or more additional firms may shift the cooperatives followship demand curve until it intersects the long-run cost curve at its minimum. The entering firms do not necessarily have to be cooperatives.

Comoetition Among Cooperatives--Recently Rhodes and Ratchford have rejuvenated concerns about the sixth Rochdale principle by looking at its negation, competition (not cooperation) among cooperatives. The theory presented here addresses the issue. First, consider an oligopoly market where economies of size are not the major determinant of market structure. Where long-run average cost curves are U-shaped (diseconomies of large scale) and minimum efficient scale occurs at or below 50 percent of the market, two or more cooperatives may produce lower prices for farmers than a single dominant cooperative. If, however, the result is several cooperatives and each has a relatively small share of the market, individually they may not have sufficient market power to influence IOFs that have amassed larger shares through multiplant operations (combinations of two or more units each operating at efficient cost levels). The solution, which may at first seem unorthodox, is collusion, i.e., cooperation, among the cooperatives in the market. If they set price strategies as a group, they may be able to lower prices farmers pay toward the competitive price level. If IOFs in oligopolies can tacitly collude to raise price above the competitive levels, cooperatives in that industry should certainly be allowed to collude, even openly collude through joint marketing efforts and price discussions to provide a competitive yardstick. Of course, an alternative that is often preferred to open collusion is merger.

A second situation, which is more relevant in many midwestern market areas, is that two or three cooperatives currently make all sales. There are no IOFs. If further cost efficiencies can be gained by consolidation, i.e., these cooperatives are in the complementary output stage, then these cooperative should merge. A monopoly cooperative would increase social welfare as well as benefit farmers. Competition among cooperatives would be wasteful.

The Multioroduct Case: A Solution to the Joint Cost Allocation Puzzle--This analysis of a farm supply cooperative can be generalized to address a multiproduct cooperative. Some other researchers have not fully appreciated this fact. When arguing for the "maximum member welfare objective," Ladd dismissed the "minimize price subject to covering costs" objective. He reasoned one cannot add up the prices across commodities to produce a single measure of cooperative performance (Ladd, p. 18). He prefers to add the two measures of welfare, producer and consumer surpluses, across commodities. Yet a cooperative does not need to have a single measure of performance. Its decision rule can be to set market level prices in each market and refund net margins as they materialize. Cooperative equilibrium will be attained. If the cooperative wishes, it can limit membership until expected net price equals minimum long-run average cost for each product.

Methods exist and are regularly used by multiproduct cooperatives to compute patronage refunds (Davidson). The allocation of joint (overhead) costs to individual products is a problem the equilibrium theory developed here can address. Consider a purchasing cooperative that sells two products in oligopolistic markets. If it allocates all of the overhead cost to one product, that product's cost curve shifts up and the favored product's cost curve shifts down. How will this affect equilibrium in the two markets? Costs in the favored market are not only lower, they are lower than the costs of single-product rivals that do not have the ability to shift costs. Therefore, the cooperative's expected net price will be lower than the price that rivals require to earn a competitive return on their invested capital. They will exit the market and the cooperative market share will rise. Joint cost allocation practices in a cooperative are analytically equivalent to price cross-subsidization in a conglomerate IOF (Greer, chap. 17).

Cooperative performance in the unfavored market also will change. Because the joint costs are being charged to users of this product, the cost curve shifts up. In cooperative equilibrium, the expected net price will be higher and rival joint profit-maximizing firms will enjoy positive profit levels.

Note that this approach finesses the issue of how to allocate joint costs across several products--a theoretical puzzle that continues to baffle microeconomists. Here only the deviation from the historical norm matters. The norm may be set by tradition, custom, happenstance, or collusion.

This analysis suggests an empirical test for the direction and extent of deviation of joint cost allocation from industry norms. A complete model would be more complex than what is suggested here. However, the current purpose is only to show the direction that research can proceed. Note that in cooperative equilibrium, the net margin for each product will be zero, regardless of how joint costs are allocated. The cost allocation effect registers on market share, measured as the percent of quantity sold. Examining the unfavored market first, if rivals follow the cooperative up the followship demand curve, the cooperative's market share will not change.

Market share variation for the favored product depends on the shape of the long-run average cost curve. If it is L-shaped, the cooperative's market share would expand to 100 percent. All rivals would be forced out of the market. On the other hand, if unit costs rise at larger volumes, market share would only expand until the increase in unit costs equals the amount of the excess joint cost allocation. At that point, the cooperative's expected net price would equal the minimum long-run average costs of IOFs. Market shares would stabilize with the cooperative having a larger share than before. Because both the cooperative and the remaining IOFs charge the competitive price, one might think that the equilibrium is socially optimal. It is not. The cooperative's market share is too large. Members who buy the favored product gain at the expense of farmers who must pay a higher price for the unfavored product.

Marketing Cooperative Theory

There are two major types of agricultural marketing cooperatives: bargaining and processing cooperatives. Bargaining cooperatives act as the common selling agent for members. They may or may not take title to the farm commodity. The Michigan Agricultural Cooperative Marketing Association is an example of a bargaining cooperative. It negotiates with processors to establish contract terms for fruit and vegetable growers in Michigan. Some bargaining cooperatives act on behalf of only their members. Others are exclusive agency bargaining associations. By law these cooperatives establish the terms of trade for all producers, members and nonmembers alike in a market area. Exclusive agency bargaining cooperatives are analogous to a closed union shop situation. As such, they are in a much stronger bargaining position with processors. When farmers bargain collectively, they are attempting to exert market power (monopoly power) to offset the buying power (monopsony power) processors possess due to control over market information, processing facilities, market access, or other resources. Galbraith explained that farmers who bargain collectively are developing countervailing power. The price-quantity equilibrium resulting from this bilateral monopoly situation, he concluded, depends on the relative bargaining strength of the two sides. Nonetheless, he felt it could be closer to the competitive (efficient) equilibrium than if there were no farmer bargaining.

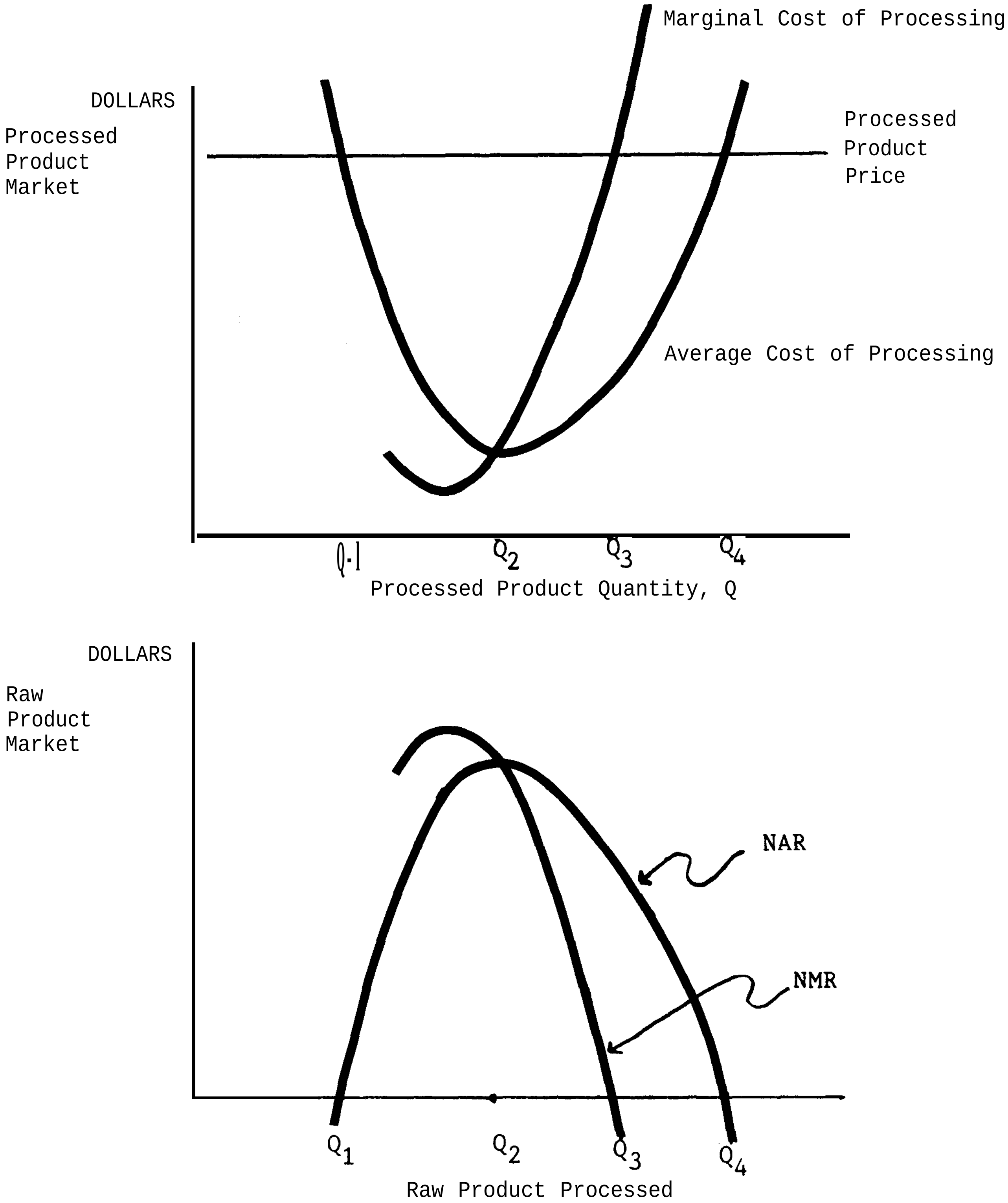
Processing cooperatives procure raw product from members, transform it, and sell the processed product to wholesalers and retailers. Land O'Lakes and Ocean Spray are examples of such marketing cooperatives. The theory developed here is most pertinent for processing cooperative activities. However, it also can provide insights for bargaining cooperatives. An exclusive agency bargaining cooperative would, for example, seek to move an investor-owned monopsonist toward one or more of the equilibrium points discussed for cooperative monopsony.

Marketing cooperatives often have special payment arrangements that are related to the pooling of products and the timing of sales over a market period. Growers receive several installment payments as the marketing process continues. Those that deliver products that go into higher quality pools also receive higher prices. To facilitate the examination of the general price-output behavior of marketing cooperatives the complex timing of payment and pooling arrangements will not be included in this analysis. Here it is assumed that members receive a transaction or market price when the product is delivered to the cooperative. Any net margins remaining at the end of the market year are refunded as cash patronage refunds at that time. Per-unit capital retains, a financing arrangement that often is used by marketing cooperatives instead of allocated patronage refunds, will not be analyzed. It also will be assumed that the cooperative markets only one product for members and the processed product market in which it sells is perfectly competitive.

At the outset of the analysis, this marketing cooperative is assumed to be a monopsony with blockaded entry. The only marketing alternative available to growers is to sell product through the cooperative. This assumption will be relaxed at a later point to examine cooperative conduct in oligopsonist markets.

Deriving Net Revenue Curves for a Marketing Cooperative--A marketing cooperative that processes raw farm product and then sells it is an intermediate stage firm in a food marketing channel. Figure 7 conceptualizes

Figure 7--**Derivation** of net revenue product curves for a marketing cooperative



this activity in a useful fashion. It helps us determine how much revenue net of processing costs is left to pay the farmer for delivery of the raw product. First we assume it takes exactly one unit of raw product to produce one unit of processed product. This is not necessary, but it makes the graphical presentation easier. It allows us to derive net revenue product directly from the price and cost conditions displayed in the processed product market.

Because we have assumed the processed product market is perfectly competitive, the demand curve for processed product is perfectly elastic and is the processed product price line in figure 7. Introducing imperfect competition in the processed market, such as product differentiation of the Land O'Lakes butter or Ocean Spray cranberry juice type, would produce a negatively sloped processed product demand curve. That will not be done here. However, the extension of the theory is straightforward and important for analysis of many real-world situations.

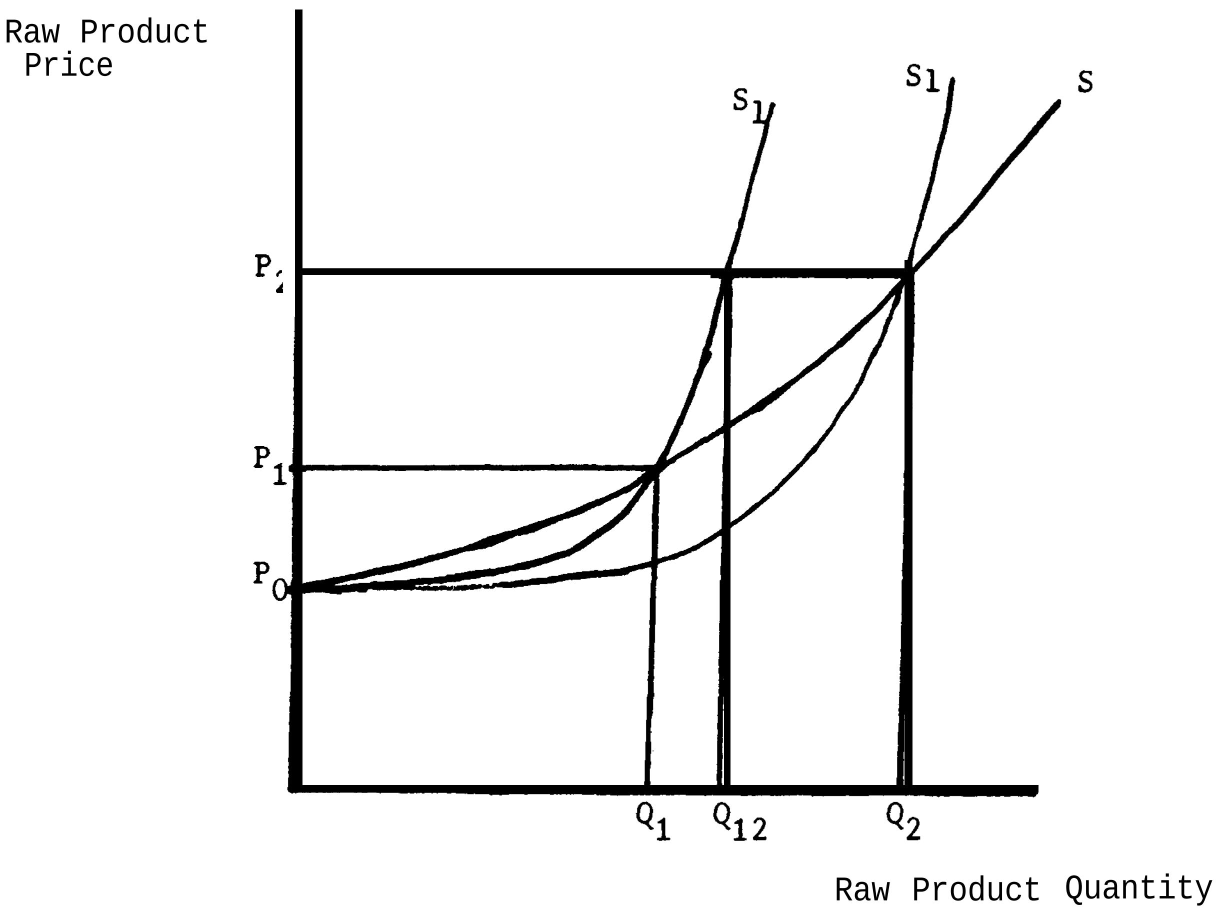
The average marginal cost of processing curve in figure 7 includes all costs _except_ the cost of raw product supplied by members. Subtracting these unit costs from the price received for the processed product produces the net average revenue (NAR) and the net marginal revenue (NMR) product available. The NAR indicates for each quantity of product processed net revenue per unit or _price_ the cooperative can pay the farmer for raw product.

Representative NAR and NMR curves are displayed in lower part of figure 7. Note that NAR equals zero at Q_1 and Q_4 because processed product price equals the average cost of processing at these output levels. NAR attains at maximum value at Q_2 where the vertical distance between processed product price and its average processing cost is greatest. NMR equals zero at Q_3 because for output levels above Q_3 the marginal cost of processing is greater than the marginal revenue (processed product price) gained from selling the product.

The exposition of marketing theory that follows will use only the NAR and NMR curves displayed in the bottom section of the figure. Before analyzing how raw product prices and quantities marketed actually are determined, we must first describe in a specific fashion the raw product supply conditions the cooperative firm faces.

Partitioning the Raw Product Supply Curve of a Marketing Cooperative--As in the case of a supply cooperative, partitioning the offer curve a marketing cooperative faces provides powerful insights into price-output performance. For a marketing cooperative, the relevant offer curve is the supply curve. It is partitioned in figure 8 into supply arising from changes in output from a set of members and supply arising from changes in the number of members in the cooperative. Because at this stage of the analysis the marketing cooperative is assumed to be the only buyer of the farm product (monopsonist) S in figure 8 is the market supply curve for raw product. At price PC, no farmer will produce the product. As price increases from P_0, the market supply curve S indicates that the quantity of product forthcoming from all farmers increases. At price P_1, the amount supplied is Q_1. At this point, some number M_1 of farmers are member-patrons of the cooperative.

Figure 8--Partitioning the raw product supply curve faced by a marketing cooperative into supply from a set of members and changes in the set of members



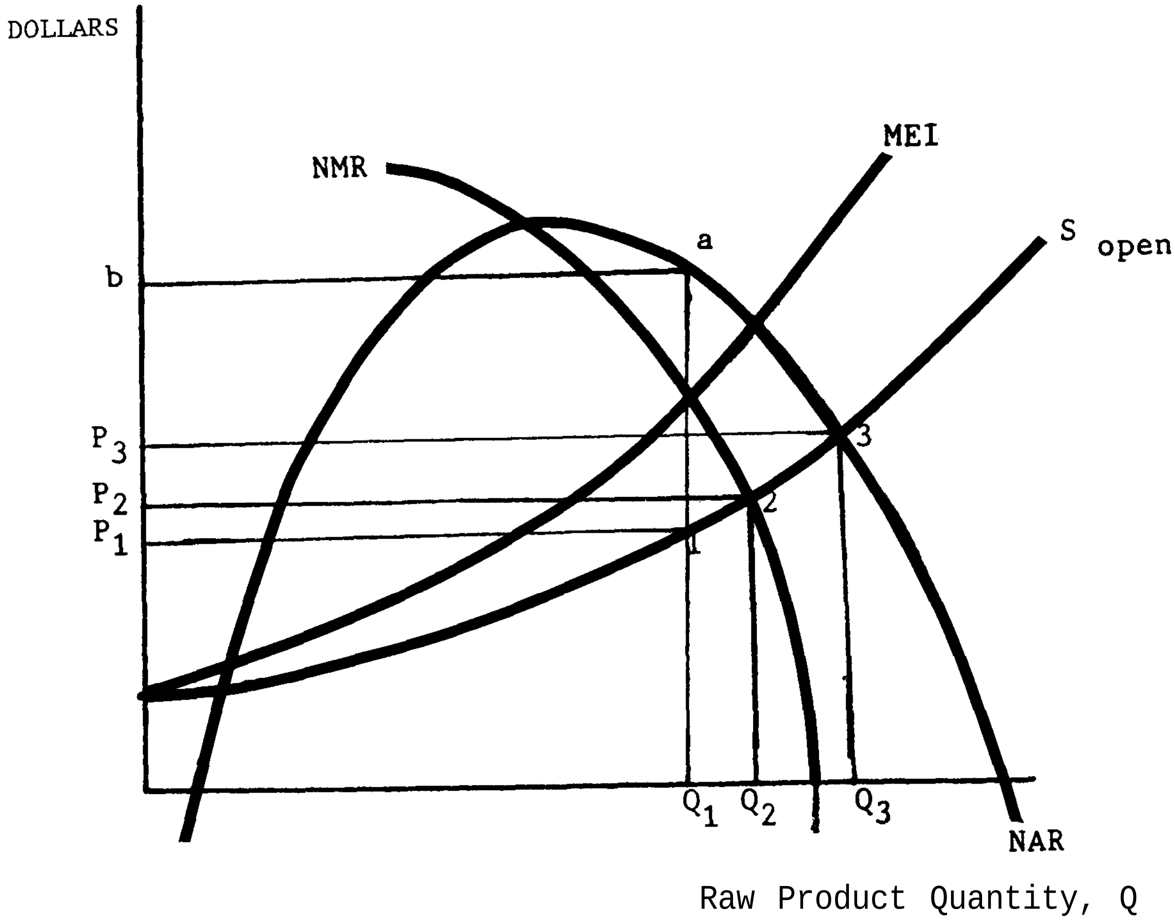
The curve S1 is the supply curve for that given set of members. Thus it is a supply schedule for a closed membership marketing cooperative with M1 members. In such a closed membership cooperative, a price increase to P_2 would increase raw product supplied to the amount Q_{12}. This is a move up the S1 curve. If the cooperative were an open membership organization with membership M1 at price P1, a price increase to P_2 also would increase supply because new members would join the cooperative. The quantity supplied at P_2 would be amount Q_2. The market supply curve S is the combination of these two separate price responses. S_2 is a second membership supply curve. The number of members M_2 is greater than M1, the number of members associated with curve S1.

If there are no real or perceived barriers to exit in a closed membership cooperative, the cooperative faces a kinked supply curve for raw product. For example, if the cooperative has M1 members and price is at level P1, increases in price will produce output increases along the membership supply curve S1. For price decreases from level P1, however, the relevant supply curve is not S1. It is s. Some members free to exit the cooperative will do so, and supply reductions are larger for this reason.

Analysis of Marketing Cooperative Objectives--The revenue product curves and supply curve constructs previously developed can be used to analyze desirability and feasibility of the four cooperative objectives listed in table 3. The analysis is analogous to that presented for a supply cooperative, so it will be abbreviated here. Because at this stage we are analyzing a monopsony marketing cooperative, only the first three objectives of table 3 are relevant: (1) maximize net margins, (2) maximize member welfare, and (3) maximize the price farmers receive for raw product. At the outset, assume the cooperative has an open membership policy. Any grower can market product through the cooperative. Given this assumption, a monopsonist cooperative in figure 9 faces the market supply curve S_{open} for raw product. Also assume cooperative net margins, if any, are not returned to members as patronage refunds. However, assume farmers consider only the price paid at delivery when making production decisions. They regard patronage refunds as windfall gains.

In figure 9, the three objectives are illustrated by the corresponding price-output points 1, 2, and 3. At point 1, the cooperative behaves like a profit-maximizing monopsonist and maximizes net margins, area P11ab, by processing raw product Q1 and paying farmers price P1. At point 2, member welfare is maximized, as explained in the supply cooperative discussion, because net marginal revenue equals the supply price at output level Q_2. The price farmers receive is P_2 and cooperative net margins are lower than they are when the first objective is pursued. At point 3, the price farmers receive is maximized subject to covering processing costs. The cooperative has zero net margins. As was shown for a supply cooperative, if members of this marketing cooperative base their production-supply behavior on the expected raw product price, which is the known transactions price at delivery plus any expected patronage refunds at year-end, the only sustainable equilibrium is point 3 in figure 9. In other words, a monopsonist marketing cooperative with an open membership policy will process more of the product and pay producers a higher price (point 3) than an

Figure g--Alternative microeconomic objectives for an agricultural marketing cooperative that is a monopolist with an open membership policy



investor-owned monopsonist firm (point 1). This is a generalization of Nourse's competitive yardstick theorem.

How, one might ask, do these results change if the cooperative pursues a restrictive, closed membership policy? Figure 10 illustrates the impact of closed membership. The price-maximizing equilibrium for an open membership occurs at point 3. If the cooperative restricts membership to a number smaller than the number of producers at point 3, the relevant supply curve will be a closed membership supply curve such as S_1. Equilibrium will change to point 3'. Those producers who continue to sell to the cooperative receive a higher price, and the amount of raw product processed is reduced. Note that consumers do not suffer from this output restriction because the price for the processed product does not change. The losers are the excluded growers who no longer have a market for their product.

Relaxing the Independence Assumption: Oligopsony--When the assumption the marketing cooperative is a monopsony is relaxed, the most relevant market structure to analyze is oligopsony. The cooperative no longer faces the market supply curve. Instead, it competes for raw product with a small number of investor-owned processors.

To facilitate the analysis, assume all firms, including the cooperative, have symmetric processing costs and face the same processed product price line, i.e., there is perfect competition in the processed product market. Then all processors have the same net average revenue and net marginal revenue curves. Also assume that the investor-owned oligopsonists recognize the interdependence in the raw product market and jointly maximize profits as in the Chamberlin small-numbers case for oligopolists (Chamberlin, pp. 46-51).

To analyze industry equilibrium and the impact of a marketing cooperative on it, define the analogues to the followship and nonfollowship demand curves introduced in the supply cooperative discussion. These are the followship and nonfollowship raw product supply curves. A firm's followship supply curve is the amount of raw product that is offered when all buyers raise or lower their prices in tandem. Because farmers would not switch among firms when all firms follow each other's price changes, the closed or set membership construct is equivalent to the followship supply curve. As all firms raise or lower prices at the same time, they keep the same set of customers, thus they are moving along what has heretofore been called a set membership supply curve. A nonfollowship supply curve is analogous to the market supply curve of the monopsony cooperative case in that it is predicted on the assumption that changes in a firms price are not followed by (are independent of) rival firms. The nonfollowship supply curve is considerably more elastic than the followship supply curve because the price mover receives increased supply from producers that switch to take advantage of the higher price as well as increased supply from its prior customers who increased output.

Figure 11 illustrates how the followship and the nonfollowship supply curve can be used to analyze cooperative equilibrium in an oligopsony. Given initially that the IOFs maximize profits by charging P_1, i.e., all firms in

Figure 10--Impact of a closed membership policy on monopsony marketing cooperative equilibrium when members recognize the value of expected patronage refunds

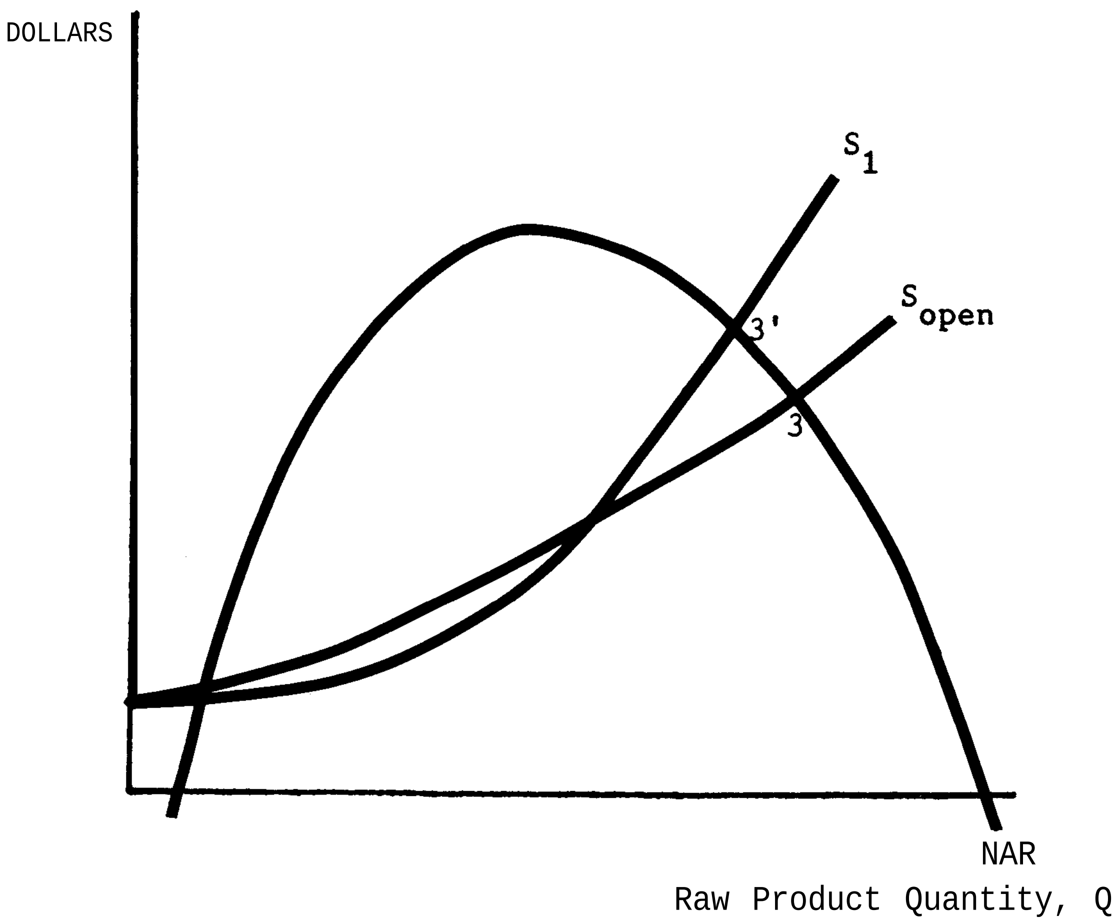
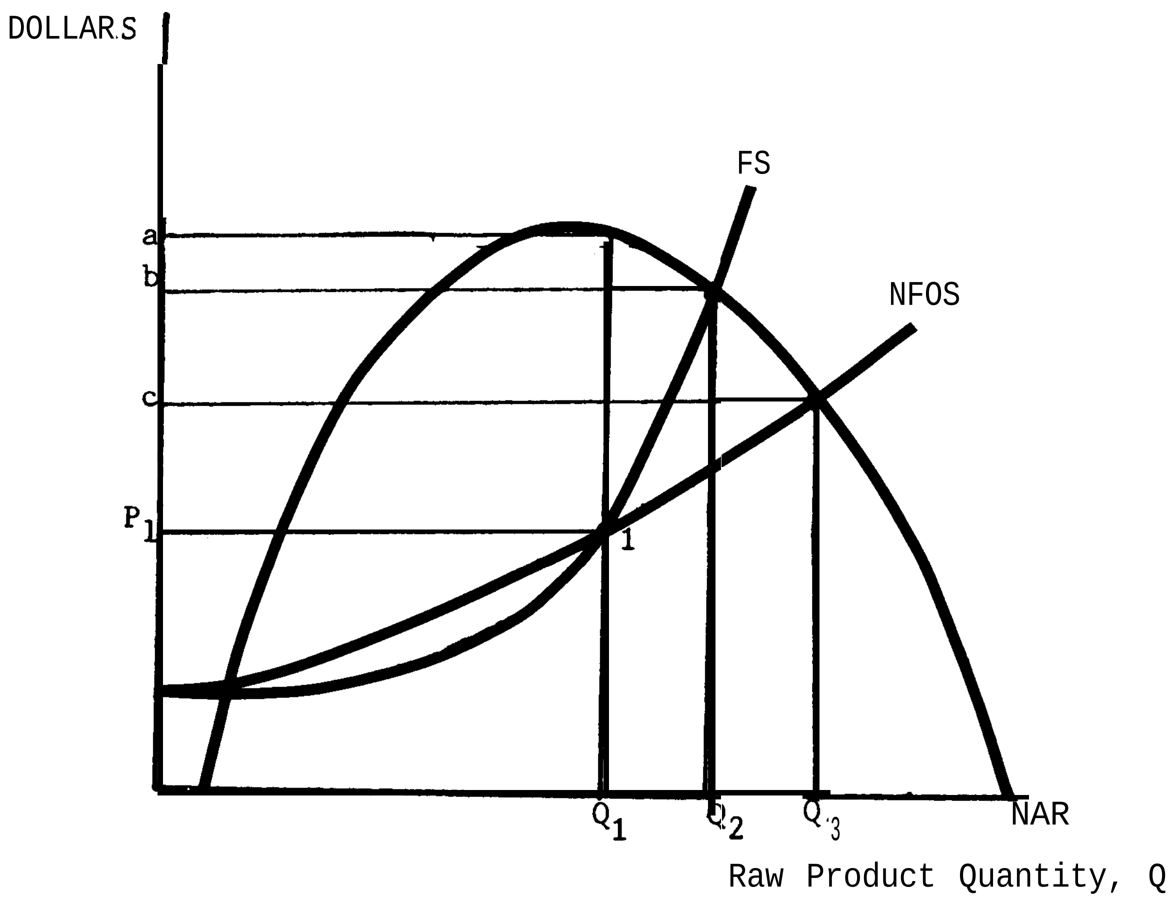


Figure ll--Marketing cooperative equilibrium in an oligopsonistic industry



the market are following objective 1, the cooperative faces followship supply curve Sl and some important strategic choices.

Oligopsony: Closed Membership Coonerative Equilibria--If the cooperative is a closed membership organization, it can price at Pl and pay a per-unit patronage refund equal to Pla. Ultimately membership supply will attain equilibrium at Q_2. The cooperative will continue to charge Pl but it will pay a per-unit patronage refund equal to Plb.

A very important result analogous to that for a supply cooperative follows. This closed membership cooperative equilibrium will not disturb the oligopsonistic joint profit-maximizing equilibrium of the industry. There will be no competitive yardstick effect on the market price. This is the case because the cooperative captures nó customers from the proprietary firms. In essence the closed membership cooperative structure allows the cooperative to move up its followship supply curve while the other firms do not. If it prefers, a closed membership cooperative could raise price from Pl to b rather than charge market prices and pay patronage refunds. Again, in theory, there would be no impact on other firms in the market because suppliers could not switch to the "closed" or "waiting list" cooperative.

Oligopsony: Open Membership Coooerative Eauilibria--The situation is quite different for an open membership marketing cooperative. First, it could refuse to go along with the joint profit-maximizing price and pay amount b as a transactions price to farmers when they deliver product. Rivals would follow by paying b to produce cooperative equilibrium at output Q_2. This is a competitive yardstick result. All farmers now can sell this product to all firms at price level b.

A second possibility is that the IOFs, for whatever reason, do not follow the cooperative's price increase. Then the relevant supply curve is NFOS. The cooperative would not only receive increased product from existing members, but producers would switch from other firms, increasing the cooperative's market share and producing equilibrium at price level c and output level Q_3. This also is a competitive yardstick result. Although it does not force other firms to raise their prices, it does reduce their market shares. If they continue to refuse to raise price the cooperative conceivably could expand to supply 100 percent of the market.

A Closing Comment

Perhaps an appropriate closing for this section is to recall that open membership cooperatives in oligopolistic markets that are in equilibrium pay no patronage refunds. This is contrary to what is commonly observed. Some agricultural cooperatives do pay patronage refunds on a regular basis. It is unattractive to conclude that this is because they are in perpetual disequilibrium. Other factors obviously are at work. One of the assumptions in this paper has been that cooperative capital earned it opportunity cost rate of return. This amount is built into the cost curves. In the'real world, members furnish equity capital to their cooperatives and the fixed dividend rate they are paid often is below the opportunity cost rate. Thus a cooperative in equilibrium may have positive patronage refunds to cover fully the opportunity cost of invested funds. In fact, this point is central to the analysis of the next two sections of this paper.

Coooerative Eouilibrium with Investment; The Certaintv Case

> Market values for corporation stock can appreciate. This value is related to capitalizing a stream of anticipated future earnings by the opportunity cost of the investor. A nice neat package. No such package, however, exists for cooperatives. There is no standard way to measure performance of a cooperative in terms of making the member-patron better off. (Fenwick, p.208)

Introduction: Basic Concepts

This section develops a unified theory of cooperation that seeks to meet the cogent need for performance measures described in the opening quote. Fenwick; Beierlein and Schrader; and others have pointed out that, unlike an IOF, a cooperative cannot examine ex post changes in its value in the capital market to evaluate investment performance. The analysis presented here demonstrates that for ex ante evaluation of potential investments and ex post evaluation of investment performance cooperatives must measure the flow of benefits to members via the product market if any product price adjustments occur. In such cases, one must analyze more than cash flows to the cooperative.

This section proceeds by generalizing the supply cooperative equilibrium models of the last section to include investment and its related concern, the financing of investment. The resulting theory will be used to analyze several important issues including the following: (1) the impact of unallocated retained earnings on cooperative equilibrium performance, member welfare, and cooperative investment analysis; (2) the appropriate form of investment analysis models for cooperatives in differently structured markets and with different operating procedures; and (3) the significance of the free-rider problem to cooperative performance.

This section is divided into several subsections. Each covers a distinct topic. For convenient reference, table 4 identifies all the variables used in the mathematical analyses in this section.

The Risk-Free Rate of Interest--Investment, by definition, is the outlay of funds today to obtain an income in the future. Investment activity makes economic analysis more challenging. This is true for cooperatives as well as IOFs. One must analyze how a cooperative makes and finances investment choices today that will generate income in the future. The economic problem not only gains an intertemporal dimension, but investment links present and future economic activities.

The counterpart of investment, savings, performs a similar function. Cooperative members, for example, will reduce consumption and save money if

Table 4.--A Key to Symbols Used in the Analysis of Cooperative Equilibrium with Investment (Equations (2) Through (28))

Equation where first introduced	Symbol	Definition
(2)	V_0	net present value of cooperative at time t_0
	CO	cash payment to cooperative members at time t_0
	Cl	cash payment to cooperative members at time t_1
	i_1	risk-free rate of interest
(3)	X_0	net cash margins from operations at time t_0
	F	equity capital paid in by new members at time t_0
	B	amount of funds raised by selling debt securities or preferred stock at time t_0
	I_0	investment by cooperative at time t_0
(4)	f_i	ith member's share of equity capital paid in by new members at time t_0
	m	number of farmers that join at time t_0
(5)	a_l	ith member's share of total cooperative sales at time t_0
	It	total investment of cooperative at time t_0
(6)	s_i	ith member's purchases at time tl
	S_1	total cooperative sales at time tl
(7)	I_p	investment in cooperative prior to time t_0
	IO	investment in cooperative at time t_0
(8)	c_i	ith member's cash payment at time t_1

(Continued)

Table 4.- -A Key to Symbols Used in the Analysis of Cooperative Equilibrium with Investment (Equations (2) Through (28)) (Continued)

Equation where first introduced	Symbol	Definition
	X_1	cooperative's net cash margins, including net cash from dissolution, at time t_1
(11)	Q_1	total cooperative sales at time t_1
	P_1	cooperative transaction price (market price) at time t_1
(12)	Q_1^o	t_1
	Q_1^n	t_1
(14)	C_1^o	t_1
(15)	V_0^o	t_0
(19)	RE_1	t_1
(23)	X_1'	t_1 I_0
	ΔX_1	t_1 hange in net margins at time I_0
(25)	ΔV_0^o	$t_0 I_0$
(26)	$\Delta X_1'$	t_1 me
(27)	V	t_0
(28)	AV	I_0

the interest rate is high enough to reflect their rate of time preference for consumption (Samuelson). Such savings are loaned to other consumers, who wish to borrow against future income to increase their current consumption, and to firms, such as cooperatives, if the rate of return on investment is high enough. In equilibrium, the supply of funds from savers and the demand for funds from borrowers determine the interest rate in the capital market.

There are, of course, more powerful models of interest rate determination than this classical supply demand analysis which has been attributed to Fisher. One class of models recognizes that savings preferences also vary by age (Friedman's life-cycle consumption function (1957)). Another class of models recognizes that monetary authorities can influence the rate of interest and thereby influence aggregate investment and consumption patterns to manage the level of aggregate economic activity (Keynes). This later theory of course, is an important component of macroeconomics. For current purposes it is not as important to know how the rate of interest is determined as it is to know that it exists and all economic agents can lend and borrow freely at that rate.

Under the certainty assumption of this section, decisionmakers know all economic facts. This includes how much income an investment will generate over its useful life as well as all aspects of current economic conditions. Nothing is unknown or risky, so the equilibrium interest rate is called the risk-free rate.

Superiority of the Cash Flow Based Net Present Value Analysis--Firm valuation, investment, and finance questions have been analyzed for IOFs by using net present value analysis based on cash flows (Copeland and Weston). Nearly every undergraduate text in finance explains why net present valuation is superior to other investment analysis methods, including internal rate of return and payback. The primary alternative to analysis of cash flows is analysis of reported earnings. The two approaches are sometimes described as measuring economic as opposed to accounting profits (Copeland and Weston, pp. 22-25). Accounting measures of earnings capitalize investment and then write off that amount as depreciation over the life span of the investment. Depreciation is a noncash expense. Cash flow analysis records the receipt of funds from equity holders or other finance sources and the actual payments of cash to equity holders when they occur.

Bodenhorn emphasizes three desirable properties of cash flow analysis for IOFs (p.16). First, cash flow analysis can be used in decisionmaking because maximizing the net present value of cash flow increases the value of the firm and thus is in the best interest of stockholders. Second when profits for an IOF are measured with cash flow techniques, they are identical to income on investment. Third, cash profit for an IOF can be measured from market values, so it is an objective measure. Accounting profits are more susceptible to manipulation by management.

None of these properties hold unequivocably for a cooperative. Maximizing a cooperative's cash flow does not necessarily increase the value of the firm to members. Cooperative net margins, even when measured by cash flow rather than accounting methods, are not necessarily identical to benefits attributable to investment. Finally, measures of cash flow benefits are less subject to manipulation by management than accounting measures, but the cash flow from a cooperative investment can accrue as product price reductions as well year end margins. These points suggest that cooperatives demand more careful examination.

Cooperative Valuation Theorv: A Useful Partition--Cooperatives have not adopted net present value analysis of investment alternatives as rapidly as IOFs (Street, p.1). Perhaps one reason for reticence has been the lack of a clear theoretical exposition of when and how net present value analysis can be applied to cooperatives. The unified product capital market theory developed in this section helps to overcome a major stumbling block--identifying exactly what it is that observed cooperative cash flows measure.

When evaluating investments for an IOF, the primary question is whether the commitment of funds will increase the value of the firm, i.e., increase the value of the stock stockholders own. Let us begin our analysis of the value of a cooperative firm to its members by noting that the value of any firm can be partitioned into two parts, its core value and its global value. The core value of a firm is the value it would command if it were in a competitive industry that is in long-run equilibrium. Industry equilibrium price equals long-run average cost and the firm earns the competitive rate of return.

Global value can be equal to or larger than the core value of a firm. For an IOF, it is defined to be the long-run equilibrium value of its stock as determined by the capital market. It is the total amount investors are willing to pay the for the firm. When an IOF possesses market power, for example, it can increase its net cash flow by charging prices above long-run average cost. The global value of the firm increases as investors bid up the stock price until the rate of return decreases, given the certainty assumption of this section, to the risk-free interest rate. This is the equilibrium adjustment mechanism that Fenwick referred to when pointing out that "no such package" exists for cooperatives.

Turning to the cooperative firm, its global value is similarly defined as the amount its members-owners are willing to pay rather than do without the cooperative. The difference is that, for a cooperative, long-run equilibrium is achieved through adjustments in the product market rather than the capital market. Moreover, how global value is measured depends, among other things, on the market structure of the industry and the membership and pricing practices a cooperative follows. Consider a supply cooperative with an open membership policy in an oligopoly. The analysis of this type of cooperative in the previous section indicated that, in equilibrium, it would charge a price equal to long-run average cost. Long-run average cost includes the cooperative cost of capital as well as other input costs. As a result, the net cash margins that remains after paying for other input costs measures only the cooperative's core value.

Two important corollaries follow. First, the cooperative's reported net margins, on a cash flow basis, can be used to measure the required return on cooperative capital. Given the certainty assumption, the issue is somewhat trivial because the required rate is the risk-free interest rate and can be determined elsewhere. This feature becomes more important when risk is introduced to the analysis in the next section. The cooperative's required rate of return then would include a risk premium and be higher than the risk-free rate. Second, to measure the cooperative's global value, one must add to cooperative cash margins the increased cash flow to members that materializes because they pay lower prices than they would if there were no cooperative in the market. This second component of cooperative benefits is known as the security return. In general, the global value of a cooperative equals its core value plus its security return.[10]

Now consider a second type of cooperative. A closed membership cooperative in an oligopoly. Because IOFs do not fear losing customers to the cooperative, they will continue to charge the shared monopoly price no matter what the cooperative does. If the cooperative charges the same price as they do and refunds all net cash margins to members, those net margins reflect the global value of the cooperative to members.

These two cases make it clear that the observed net cash flows of a cooperative must be interpreted carefully. Exactly what net cash flow measures depends on the structure of the product market as well as the structure and conduct of the cooperative. If a cooperative prices at the industry price level, has no impact on it, and that price level is above long-run average cost, net margins measure the global value of the firm to members. Standard investment analysis procedures are appropriate. A different approach, however, is necessary when a cooperative has a competitive yardstick effect, bringing other firms as well as itself to an equilibrium where industry price equals long-run average cost. Then the observed net cash flows measure only the core value for the cooperative. This latter type of equilibrium is the one that requires a different approach to valuation. Thus attention is focused primarily on its properties in the remainder of this section and the following section.[11]

A Single-Period Supply Cooperative Model

To keep the analysis of cooperative finance and investment behavior under certainty reasonably rigorous, it is necessary to specify the structure of the cooperative and its environment in detail.[12] First, the analysis will be discrete rather than continuous, and it will be for a single period. The future consists of only a single point one period from now. Thus the analysis concerns cooperative activity at time t_0 and at time tl. One might, consider the analysis to be an examination of a cooperative on January first of two successive years with the cooperative dissolving on the second date. When mentioning flow variables at a point in time, they will be for the preceding period. The terms "sales at t_1" and "sales during period t_1" are equivalent. Stock variables such as investment will be at point t_0 or t_1.

The cooperative's financial structure is assumed to be as follows. Investment funds, if supplied by members, are supplied proportional to planned patronage in tl at time t_0. One might regard this as a base capital finance plan. Members provide equity capital in proportion to their planned patronage when they join. Cooperative net margins at t_0 are distributed in proportion to patronage. They are distributed as cash or, if necessary, they are allocated to patrons' equity accounts to bring their investments up to the required amount for planned patronage in period t_1. Equity capital invested by members is assumed to earn no interest. There are no taxes of any sort to be paid by cooperatives or IOFs.

The structure of the cooperative is defined further as follows. It is a supply cooperative that sells one product in an oligopolistic market, and it sells only to members. Finally, its transaction price always is equal to the market price. This last assumption is necessary because the resulting cash flow identifies the spread between the industry price and the cooperative's net, operation-at-cost price. If this magnitude is positive, farmers have an incentive to join the cooperative. This is the adjustment mechanism that produces cooperative equilibrium. The assumptions of this section are listed in table 5 for easy reference.

Examining an open membership cooperative in an oligopoly, how does cooperative equilibrium come about when a new investment is undertaken? One can use valuation and cash flow equations to specify an equilibrium adjustment model. In a one-period model the net present value, V_0 of a cash stream that pays C_0 at time t_0 and C_1 at time t_1 when the risk-free interest rate is i_1 is

$$(2)\ V_0 = C_0 + \frac{C_1}{1 + i_1}.$$

If C_0 and C_1 are cash payments to members of the cooperative, V_0 is the value of the cooperative at t_0.

The cooperative's cash flow equation at t_0 can be written as

$$(3)\ X_0 + F + B = C_0 + I_0.$$

The left side of (3) identifies sources of cash at t_0. X_0 is net cash margins from operations that belong to old members, i.e., those who patronized the cooperative during t_0. F is equity funds paid in by new members who join the cooperative at t_0. B is the amount of funds raised by taking on debt or selling preferred stock.[13] Because certainty is assumed there is no difference in risk level among member equity and all types of funds secured from outside sources. No risk premiums are demanded or offered, so all funds earn the risk-free rate of interest i_1. The right side of (3) identifies the cooperative's uses of funds. C_0 is cash paid to old members-patrons. I_0 is investment made at t_0 that will increase net margins in t_1.

An initial component of the equilibrium adjustment model is an equation that determines the magnitude of cash paid in by new members at t_0. F is the sum of the paid-in capital of M new members. fi in equation (4) is the paid-in capital of the ith new member:

Table 5.--Basic Assumptions for Analysis of Cooperative Price Equilibrium with Investment

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Financial Model Assumptions

1. Certainty.
2. The analysis is discrete rather than continuous in the time dimension.
3. All economic activities occur at two successive points in time t_0 and t_1 (a one-period model).
4. There are no taxes of any sort.

Cooperative Enterprise Assumptions

5. Investment is proportional to patronage.
6. No dividend is paid on equity capital.
7. The cooperatives sells only to members.
8. Patronage refunds may be made in cash at t_0 or allocated to members investment accounts and returned in cash at tl.

$$(4)\quad F = \sum_{i=1}^{m} f_i .$$

As expressed in equation (5), each farmer's investment is a proportion i of total investment I,. Equation (6) indicates that α_i is the proportion of total cooperative sales Sl that the ith member provides. Equation (7) indicates that total investment equals the level of investment prior to t_0, which is I_p, plus current investment IO.

$$(5)\quad fi = \alpha_i I_t \text{ where}$$

$$(6)\quad \alpha_i = \frac{S_i}{S_1} \text{ and}$$

$$(7)\quad It = I_p + IO.$$

Each member will receive at tl a cash refund ci, which is the same proportion α_i of the cooperative's net margins Xl. Because this is a single-period model, the cooperative is dissolving at tl. No cash is allocated to investment at that time because there is no future. Thus total net margins Xl includes liquidation of all investments, and it equals total cash refunds to members Cl. A member's dollar return for investment at t_0 and patronage during t_1 is

$$(8)\quad ci = \alpha_i X_1 .$$

Dividing (8) by (5) gives a member's rate of return on investment,

$$(9)\quad \frac{c_i}{f_i} = \frac{\alpha_i X_1}{\alpha_i I_t} = \frac{X_1}{It}.$$

Equation (9) indicates the rate of return will be the same for all members and it will equal the average rate of return of the cooperative. New members will join the cooperative if the average rate of return is greater than or equal to the risk-free rate of return. This decision rule can be expressed as

$$(10)\quad \text{join if: } \frac{X_1}{It} \geq 1 + il.$$

The investment in the cooperative must earn enough to return the original amount invested plus interest at time tl. Assuming the cooperative is in equilibrium at t_0, i.e., old members have been receiving the risk-free rate of return on I_p, a new investment I_0 that pays a higher rate of return than il will raise the cooperative's average return above il. Unless there is a decrease in the return on the new investment as new members join the cooperative, cooperative equilibrium is indeterminate. An infinite number of new members would join. Recalling the analysis of membership changes on cooperative equilibrium in the previous section, the net margins generated from investment IO is in fact dependent on the quantity of product purchased by old members Q_1^o, the quantity of product purchased by new members Q_1^n, and the market price Pl that prevails during period tl.[14] Because the sum of old and new members' purchases equals total purchases Q_1, net margins at t_1 are

$$(11) \quad X_1 = X_1(Q_1, P_1) \text{ where}$$

$$(12) \quad Q_1 = Q_1^o + Q_1^n.$$

As new members join the cooperative, its output in t_1 increases; this reduces net margins if the cooperative experiences rising average costs of production or if rivals respond to the cooperative's gain in market share by undertaking similar investments and lowering the market price. Either way, once equilibrium is regained, the cooperative's average return on investment will have returned to the risk-free rate i_1. To summarize, this product market adjustment mechanism is the cooperative analogue to stock market adjustments in the value of an IOF's stock for regaining equilibrium in both the product and capital markets.

The Core Value of a Cooperative Firm--If a cooperative prices at long-run average cost, as it does when it has a competitive yardstick effect on the market, it is possible to estimate its core value. Returning to the valuation and cash flow equations (2) and (3), the cooperative's cash flow are now clear measures of its core value. Note that subtraction I_0 from both sides of the equation (3) gives

$$(13) \quad C_0 = X_0 + F + B - I_0.$$

Current cash patronage refunds are determined by the difference between cash inflow and current investment. If F and B are not sufficient to cover I_0, some of X_0 will be retained as allocated patronage refunds and cash patronage refunds will be lower.

The cash flow equation for old members at t_1 is

$$(14) \quad C_1^o = X_1(Q_1, P_1) - \sum_{i=1} c_i - (1 + i_1) B.$$

Old members cash flow equals net margins minus cash paid out to m new members minus cash that repays outside capital suppliers plus the interest on that capital. Substituting (13) and (14) into (2) allows an analysis of how the core value of old member investment V_0^o in the cooperative changes when investment I_0 is undertaken:

$$(15)\quad V_0^o = C_0 + C_1^o = X_0 + F + B - I_0 + \frac{X_1}{1 + i_1} - \frac{\sum_{i=1}^{m} c_i - B}{1 + i_1}$$

$$= X_0 - I_0 + F - \frac{\sum_{i=1}^{m} c_i}{1 + i_1} + \frac{X_1}{1 + i_1}.$$

But in equilibrium, the following conditions hold:

$$(16)\quad F = \frac{\sum_{i=1}^{m} c_i}{1 + i_1} \quad \text{and}$$

$$(17)\quad I_t = Ip + I_0 = \frac{Xl}{1 + i_1}.$$

New members join only if they earn the risk-free rate i_1 or more on their investment, and in equilibrium all providers of capital earn i_1. This establishes (16). Similarly, (17) is based on the fact that in equilibrium the cooperative's average return on investment will equal the risk-free rate i_1.

Substituting (16) and (17) into (15) gives

$$(18)\quad V_0^o = I_p + X_0.$$

The core value of the cooperative firm to old members equals the prior investment they have paid in plus the net margins available at t_0. This result is so fundamental to the cooperative enterprise structure that its implications may be overlooked. Any cooperative benefits beyond those necessary to compensate capital at the competitive rate of return are distributed via the product market. Also, the financial decisions of management to go outside for capital, amount B, the decision of m new members to join the cooperative and provide F in capital, and the split of patronage refunds between cash and allocated refunds do not affect the core value of old members' investment. This analysis, however, says nothing about how investment or financing strategies affect the global value of the cooperative members. Investment impacts on global value are addressed in a later part of this section.

A New Insight on the Alleged Tax Advantage of Cooperatives--The fact that cooperatives provide no vehicle for capital gains on cooperative investment sheds new light on the issue of cooperative taxation. Some have decried the tax status of patronage refunds, claiming that because allocated refunds escape the corporate income tax, cooperatives receive a hidden subsidy from the government. This theory can be used to analyze the capital market as well as the product market aspects of this proposition. Examining the capital market aspects brings to the surface the fact that shareholders in investor-owned corporations can receive benefits from their investment as capital gains, which are taxed at the investor level at 40 percent of the ordinary income rate. But in a cooperative, all benefits a member-investor, and any marketwide benefits nonmember farmers receive as a result of the cooperative's impact on price, are ordinary income and taxed accordingly at the patron level. The capital gains treatment investors in an IOF enjoy suggests there is less incentive for a farmer to patronize **and** invest in a cooperative for tax reasons than heretofore thought. With regard to total tax treatment, cooperatives actually may be disadvantaged relative to IOFs.

An example can illustrate this. First consider a farmer who buys an input for $1,000 from a cooperative at t_0. The cooperative solicits $100 at t_0 from the farmer for a new investment project and pays the farmer the competitive rate of return, 10 percent, for use of that money at tl. As a result, the farmer can buy the input for $800 because of the cost-saving investment. Because the input costs on the farm at tl are $200 lower, the before-tax increase in income is $200. If the farmer is in the 40 percent tax bracket the farmer's after-tax gain is $120 at tl. Discounted at 10 percent to t_0, this value is $109.

Compare this result to the net wealth gain if the firm were investor-owned and the farmer purchases $100 dollars of stock at t_0 to finance the new investment. The IOF continues to charge the farmer $1,000 for the input at t_1. However, the value of the farmer's stock appreciates in the stock market until the farmer's investment returns the competitive 10 percent rate of return. That value is computed as follows. The increment to IOF income is $200. Assuming the effective corporate income tax rate after investment tax credits and other write-offs is 20 percent, the new cash flow available to investors is $160 plus the $10 plus the original $100, which equals $270 at t_1. Thus the farmer's stock appreciates to $245 ($270 divided by 1.1) at t_0 and the farmer experiences a capital gain of $145.

Under capital gain taxation rules, 40 percent of this gain is taxed at the farmer's ordinary income tax rate, which is 40 percent in this example. Thus the after-tax income gain for the farmer is $122. The farmer increases income more by patronizing and investing in the IOF than joining the cooperative.

This tax problem can be analyzed in a more general fashion. Space limits that option. However, the relative position of the cooperative improves, ceteris paribus, as the effective corporate tax rate increases and the farmer's personal tax rate decreases. For some tax rates the cooperative is preferred over the IOF. This analysis suggests farmers in higher tax brackets will have less incentive to join a cooperative.

The Case of Unallocated Retained Earnings--How does its retained earnings policy affect the value of a cooperative firm to members? Retained earnings are net margins that cooperative management, with approval of the board of directors, decides to declare as income to the cooperative. Retained earnings are not allocated to patrons' equity accounts. If the cooperative does not dissolve while a person is a member, the cooperative never pays the member a pro rata share of retained earnings. Some very different cooperative groups have advocated the use of retained earnings. **Agway**, a very large and professionally-managed farmer cooperative, makes substantial use of them in its finance mix. Compare this organization to **Lambert**, one of the more visionary social philosophers on cooperatives. He argued for retained earnings financing and for not paying them out to members at dissolution (p. 63). **Lambert** and others who would establish a cooperative commonwealth--an entire economy of cooperatives--have regarded this dissolution caveat as necessary to prevent current members from dividing up the accrued capital of previous cooperative members. They have regarded retained earnings as social capital owned by the group in common. Although farmer cooperatives that use retained earnings do not regard themselves as compatriots of cooperative commonwealth advocates, such financial policies do suggest a community or socialist orientation. A retained earnings program indeed can be described as voluntary socialism. Cooperative members abnegate private ownership of cooperative capital at least until cooperative dissolution, which usually is not a goal of the membership or management. Cooperative capital is owned in common. To analyze retained earnings in the one-period model, one must assume they are not returned to members at time t_1. Otherwise they are identical to allocated patronage refunds. For purposes of analysis, make an additional assumption that will be relaxed later. Assume that the following relationship holds:

$$(19) \quad \frac{X_1 - RE_1}{I_t} = 1 + i_1.$$

The cooperative withholds retained earnings of amount RE_1 at t_1 so that the projected average return on investment equals i_1. As a result, there is no increase in membership and old members do not increase their output. Due to (19), F in the cash flow equation (3) is zero. The old members' cash flow equation at t_1 is as follows:

$$(20) \quad C_1^o = X_1 - RE_1 - (1 + i_1)\, B.$$

Cash flow to old members at t_1 equals cooperative net margins at t_1 minus retained earnings at t_1 minus payments to bondholders at t_1. Substitute equation (13) into (2) for cash flow to old members at t_0, and substitute equation (20) into (2) for cash flow to old members t_1. This gives valuation equation (21) for old cooperative members at t_0:

$$(21) \quad V_0^o = X_0 + B - I_0 + \frac{X_1 - RE_1}{1 + i_1} - B = x0 - 10 + \frac{Xl - RE_1}{1 + i_1}.$$

Solving (19) for I, and substituting the result into (21) gives

$$(22) \quad V_0^o = X_0 - 10 + I_t = x0 + I_{p'}$$

Equation (22) indicates that the value of the cooperative to old members equals their prior investment plus net margins available at t_0. This result differs from the previous valuation analysis because it now represents the global value as well as the core value. Because no members receive retained earnings and because according to (19) the cooperative siphons off all earnings in excess of the amount necessary to pay a competitive return, the global value of the cooperative to a member equals the core value. The retained earnings policy therefore can be used as an alternative adjustment mechanism to attain cooperative equilibrium. When a cooperative retains less than the amount of retained earnings necessary for equation (19) to hold, part of the adjustment to the new equilibrium occurs through price-quantity adjustment and equation (22) measures only the core value of the cooperative to old members at t_0.

Another interesting fact is that if a cooperative decides to retain earnings above opportunity cost payments, as in equation (19), the value of the cooperative, defined as the sum of its value to members plus retained earnings, will vary with investment acumen. Changes in this magnitude reflect how profitable investments have been. Maximizing this measure will lead the cooperative to behave as an IOF. In an oligopoly, for example, it would have no competitive yardstick effect on rival firms, and members would receive no economic benefits above their opportunity cost rate of return from the cooperative. This produces the startling conclusion that voluntary socialism is consistent and can coexist with monopoly capitalism. One wonders if the cooperative commonwealth philosophers realized that their grand strategy would have so little impact on private economic power.

<u>Core Value Analysis of Investments</u>--In many situations, a cooperative's cash flow to members measures only the core value of the firm. Two important cases are a cooperative that performs as a competitive yardstick in an oligopoly, and a cooperative that appropriates all net margins above the amount necessary to pay members the opportunity cost of capital. Appropriated net margins are retained as unallocated earnings. What might one say about cooperative investment analysis in these cases? Consider the competitive yardstick case first. Using equation (15) and (16), one can express the core valuation equation as follows:

$$(23)\quad V_0^o = X_0 - I_0 + \frac{X_1' + \Delta X_1}{1 + i_1}.$$

X_1' in (23) is net cash margins at t_1 without investment I_0, and ΔX_1 is the change in the net cash margins due to the investment.

Rearranging terms gives

$$(24)\quad V_0^o = X_0 + \frac{X_1'}{1 + i_1} + \frac{\Delta X_1}{1 + i_1} - I_0.$$

The change in core value with respect to the investment is the last two terms of (24); and because it was shown earlier that the change in core value is zero, one obtains

$$(25)\quad \Delta V_0^o = \frac{\Delta X_1}{1 + i_1} - I_0 = 0.$$

Stated another way, investment in a competitive yardstick cooperative, as measured by observed cash flows, always will yield a net present value equal to zero.

Before commenting on this result, let us consider the case for a cooperative that uses unallocated retained earnings and seeks to maximize retained earnings plus the core value of the cooperative to members. Equation (23) still is a good starting point. However, now the subscripts will be removed from V to recognize that this is a different valuation problem. Also, the change in net margins at t_1 due to the investment is now partitioned into two parts--the change in net cash margins that is needed to sustain the competitive rate of return on all cooperative investment $\Delta X_1'$ and retained earnings RE_1. Thus one has

$$(26)\quad \Delta X_1 = \Delta X_1' + RE_1.$$

Substituting (26) into (23), one obtains

$$(27)\quad V = X_0 + \frac{X_1}{1 + i_1} + \frac{\Delta X_1'}{1 + i_1} - I_0 + \frac{RE_1}{1 + i_1}.$$

The analysis without retained earnings indicates that the third and fourth terms on the right side cancel each other, so when management seeks to maximize retained earnings plus the value of the firm to members, the change in the value of the firm due to the investment is

$$(28)\quad AV = \frac{RE_1}{I + i_1}.$$

The increase in value is equal to the net present value of retained earnings.

These results suggest that in competitive yardstick equilibrium, the standard net present value analysis of cooperative cash flows is useless. The computation should produce zero net present value for every investment project. Obviously, what is needed is a measure of global rather than core value. A supply cooperative in an oligopoly that retains earnings in excess of the amount needed to pay members the competitive rate of return on equity capital can use changes in the level of retained earnings to measure the value of a proposed investment.

~--This discussion illustrates how global value analysis of cooperative investments can be done. The example analyzed here is an investment that reduces the average cost of producing the cooperative's product in all levels of output. Farm product market prices are assumed to remain constant at t_1 so that benefits from an investment can be measured by areas under the input demand curve.[15] Cooperatives must look to benefit measures of this type as well as cooperative net margins when the investment affects the farm supply market price level. This investment's impact on the average cost curve of the cooperative is illustrated in figure 12. The average cost curve prior to the investment AC, accounts for the cost of the cooperative's prior investment I_p as well as other factor costs. The price of that capital is the risk-free rate i_1. Once the investment I_0 has been made, the average cost curve shifts down to AC_1. This curve accounts for the cooperative's new investment level, I, $= I_p + I_0$, as well as other factor costs. Again, the price paid for this capital is the risk-free, opportunity cost rate i_1.

The cooperative is in equilibrium before the investment at point A, charging price P_o and selling Q_o. It has exerted a competitive yardstick effect on oligopolistic rivals, forcing them down the followship demand curve F_1F_1 to price P_o. Net margins are positive only because the cooperative charges the equilibrium price and distributes the competitive rate of return i_1 to its equity holders via patronage refunds.

After investment, the cooperative will move to a new equilibrium. Two possible equilibria are illustrated. They are points B and D. Regardless of where equilibria is attained, the cooperative's cash flow only will be adequate to pay equity holders return i_1 on their capital at time t_1. However, it is fairly obvious that different equilibrium points produce different benefits in the form of lower price and expanded quantity of Q sold. Figure 13 illustrates total benefits to all farmers that use Q, i.e., it measures the social welfare value of the competitive yardstick effect.

Although it is assumed that the cooperative is the innovator, this is not absolutely necessary. Rivals may have adopted the investment and the cooperative may have moved rapidly to imitate it. Here it is assumed that they both adopt the cost-saving innovations at time t_0. Rivals may or may not match cooperative price reductions. If they do, the cooperative moves down followship demand curve F_1F_1 in figure 12 to a new equilibrium at B. Membership remains constant but old members expand their use of Q from Q_o to Q_1. Old members receive benefits over the opportunity cost returns equal to the change in their consumer surplus, which is area P_oABP_1. Consumer surplus discounted to time t_0 is the net present value of the investment to cooperative members. If net present value is greater than zero, i.e., the investment lowers the cost curve, the cooperative should undertake the investment.

Because the cooperative has played a yardstick role and lowered the market price, nonmember farmers also benefit. Figure 13 illustrates the total market demand curve DD for Q. Price has declined from P_o to P_1 so the aggregate consumer surplus of all farmers is the area P_oMOP_1.

Reconsidering the Free-Rider Problem in Cooperative Theory--The fact that total social welfare benefits are greater than the global benefits enjoyed by

Figure 12--Measuring member benefits from a cost-reducing investment for an open membership purchasing cooperative in an oligopolistic industry

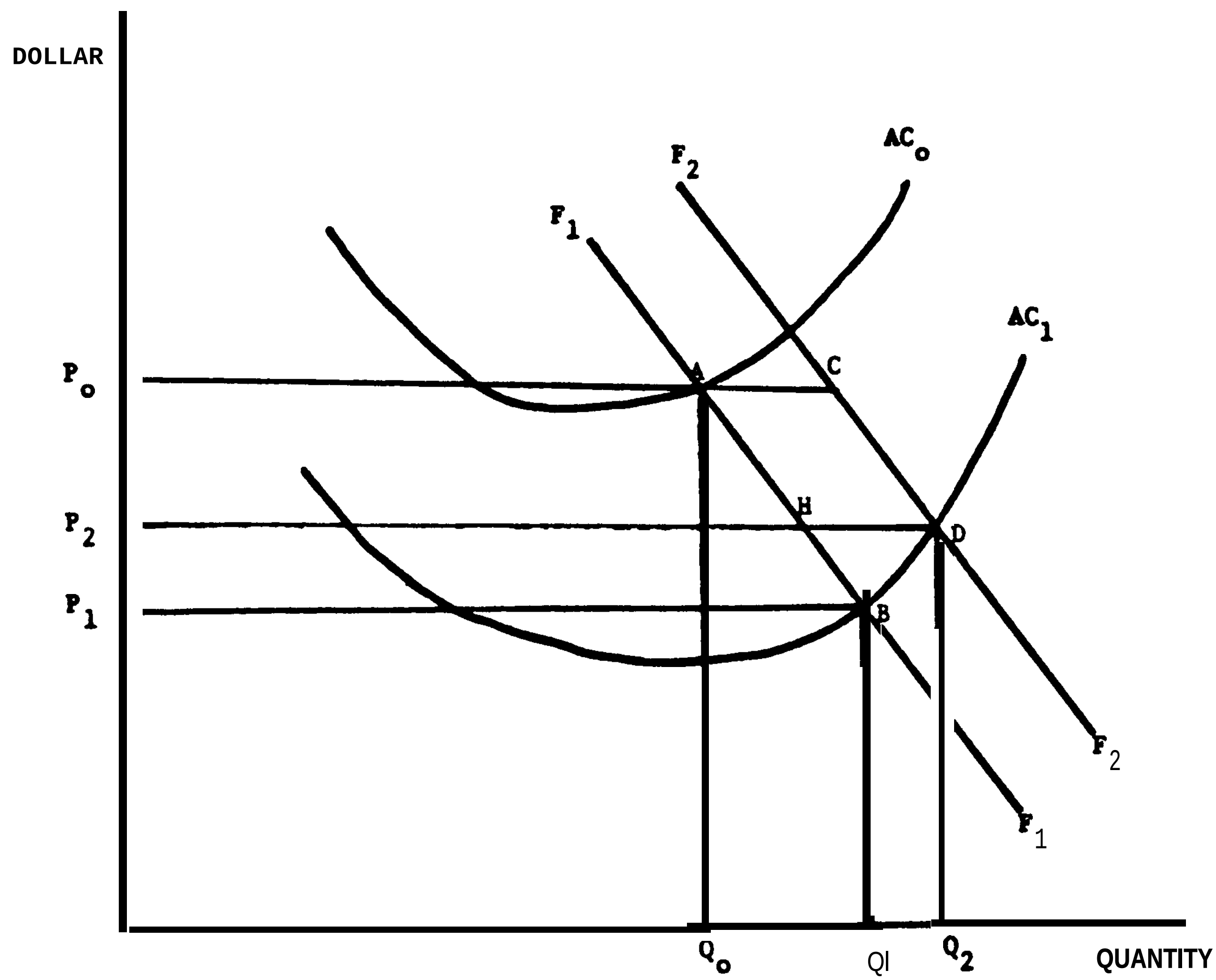
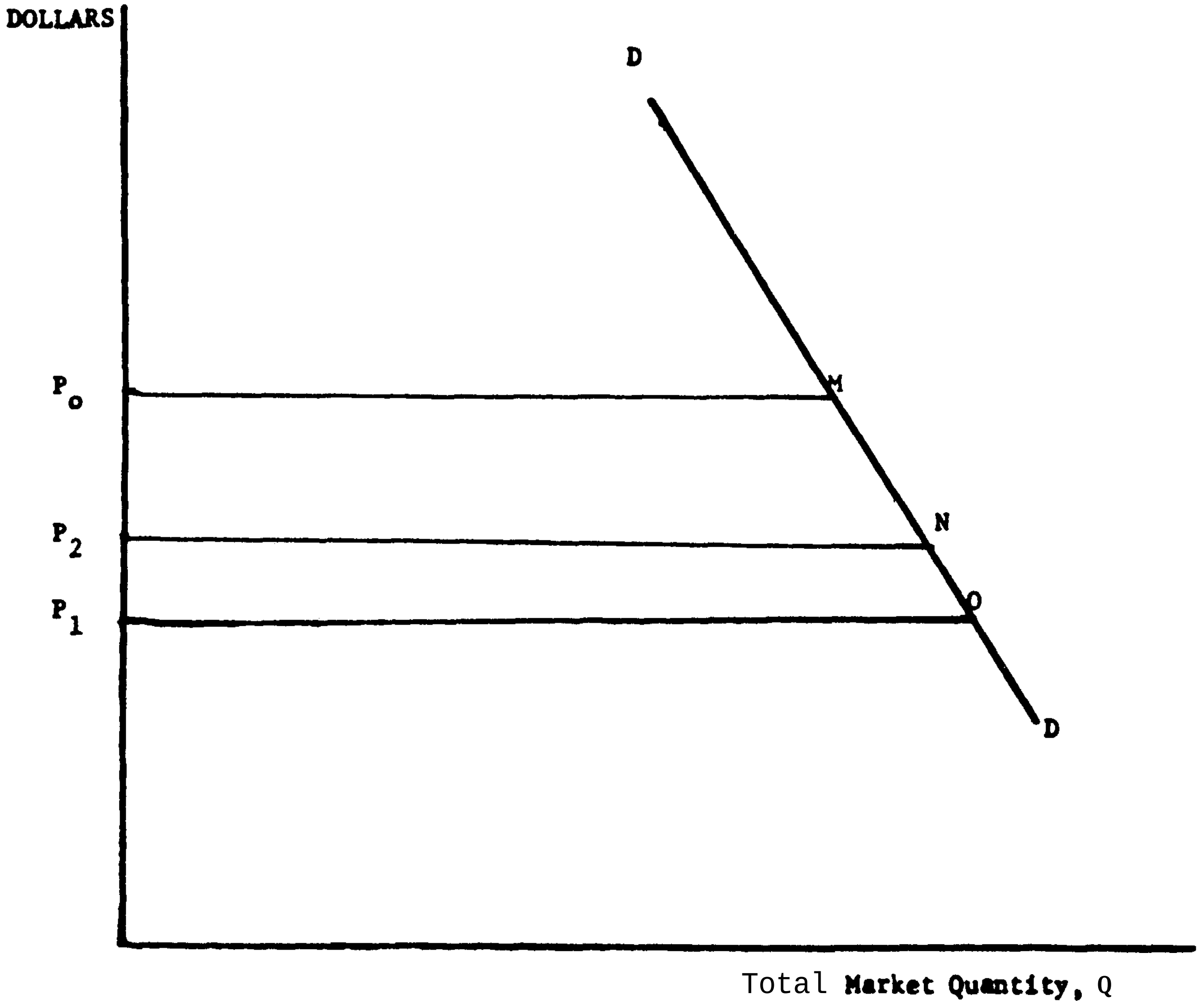


Figure 13--Measuring total benefits from a cost-reducing investment in an industry



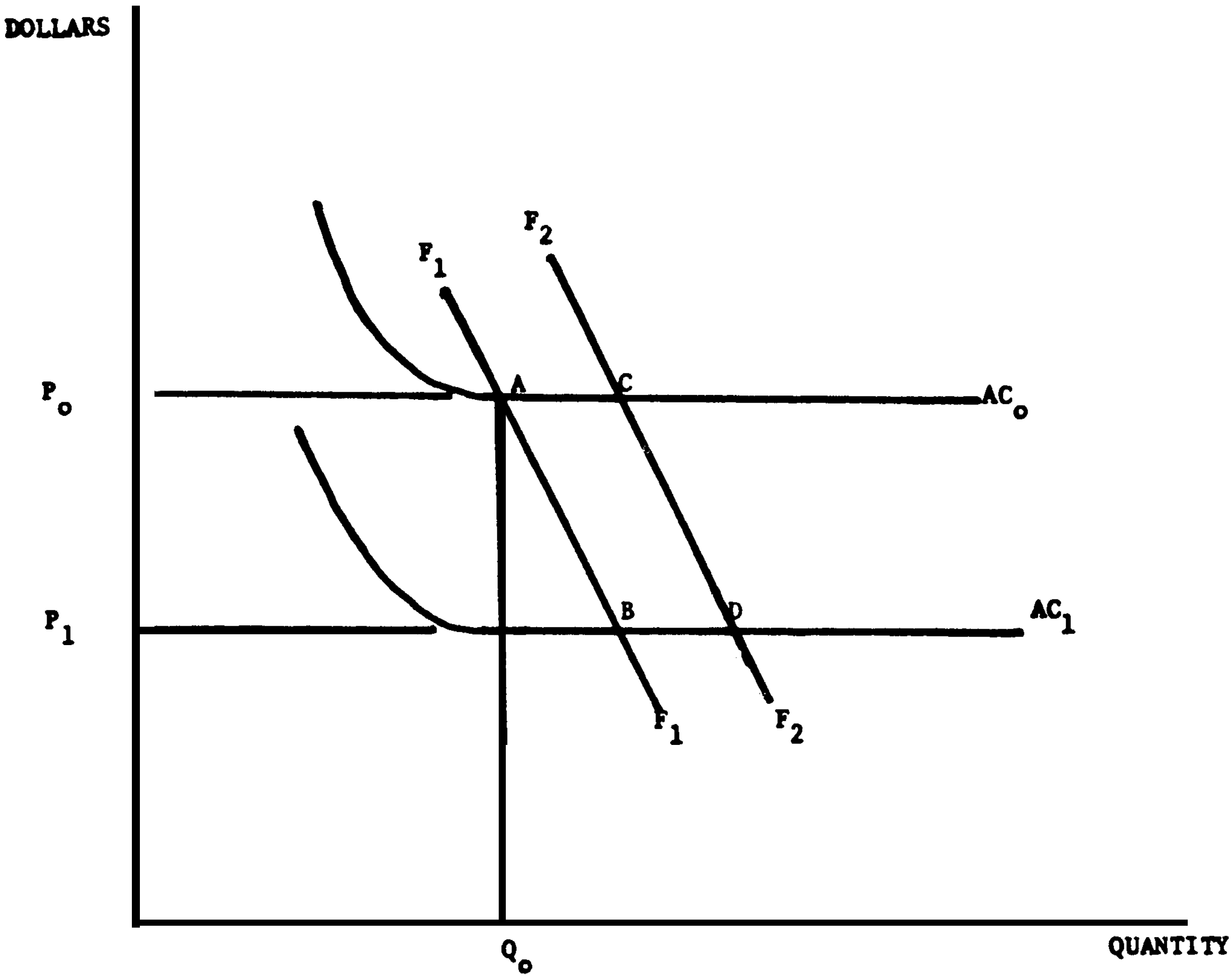
members has led some analysts to suggest that there is a free-rider problem. This contention needs to be analyzed carefully. A free rider is an individual who benefits from a collective action but does not pay his or her share of its costs. Free-rider behavior materializes when benefits are nonappropriable. The competitive yardstick effect of a cooperative on market price is an example of a nonappropriable benefit. All farmers who use the product sold by the cooperative enjoy it--members and nonmembers alike. Does the fact some farmers are free riders, i.e., not members of the cooperative, result in economic inefficiencies? Does it mean members somehow are unfairly shouldering the cost of ensuring desirable performance? The ghost of Sapiro, the advocate of industry-wide cooperation, reappears on the scene when these questions are raised.

Although in specific situations the free-rider problem may lead to inefficiencies or inequities, in general this is not true. Consider how the benefits and costs of a cooperative that has a competitive yardstick effect on the market are distributed. Members and nonmembers receive benefits from market price reductions.[16] For members, this is the security value component of their global value. Members, of course, must provide the equity capital for the cooperative. This is a cost they bear, but they are compensated at the market rate of interest. A member would be no better off if he or she exited the cooperative and invested his or her money elsewhere. Conversely, a nonmember would be no better off if he or she disinvested elsewhere in the economy and joined the cooperative.

The example illustrated in figure 12 proves that the free-rider problem is not a general tenet of cooperative theory. If some farmers join the cooperative, possibly because of a belief in Sapiroism, the followship demand curve shifts out to F_2F_2. The cooperative's market share expands--rivals react and follow the cooperative to equilibrium at point D. The cooperative and other firms now charge P_2 in equilibrium, which is higher than Pl. Old member benefits are less, amounting only to area P_oAHP_2. Total member benefits are area P_oCDP_2, which may be greater or less than member benefits when equilibrium was established at B. Total benefits for all farmers in figure 13 are measured by area P_oMNP_2, which is clearly less than before. Therefore, there is no free-rider problem. In fact, the cooperative would enhance member and nonmembers alike if it aided another firm, preferably a cooperative, to enter and serve approximately one half of its members.

If the cooperative's cost curve is L-shaped, expanded membership does not raise the price and the cooperative still does not encounter a free-rider problem. This situation is illustrated in figure 14. Without expanded membership, equilibrium occurs at B, and member benefits are area P_oABP_1. Total marketwide benefits still are P_oMOP_1 in figure 13. Now, if the cooperative's membership expands to followship demand curve F_2F_2 before rivals respond, equilibrium is attained at point D. Note the old member benefits and total market benefits are the same as before. Increasing cooperative membership does not increase total benefits, although it does internalize more of them in the cooperative. Do these increased internal benefits mean that the cooperative would now undertake the investment, whereas it would not have before the membership expanded? The

Figure 14--L-shaped cost curve case for measuring benefits from a cost-reducing investment for an open membership purchasing cooperative in an oligopolistic industry



answer is no because the cooperative would logically undertake any investment that has positive net present value to old members. Because the cost curves contain the cash flow necessary to cover the opportunity cost interest expense of capital, old members will benefit as long as the project reduces the equilibrium market price of Q. The project has positive net present value, and it will be undertaken. No free-rider problem exists.

The Public Interest and Public Support of Comoetitive Yardstick Cooperatives--The results of this section point toward a fundamental difference between competitive yardstick cooperatives and IOFs. That difference argues for public policies supportive of such cooperatives if increased economic efficiency and a more equal distribution of wealth are desirable. Farming is, on the whole, a competitive industry. Over the long run, the constant farm market price assumption used in the global value analysis may not hold. As farm output increases, the prices of farm products, assuming no government price support programs, will decline. Benefits will be passed on to downstream firms in the food system. If downstream industries are competitive and all other factors are inelastic supply so no rents accrue, consumers ultimately receive all of the benefits measured by this method. Of course, both of these assumptions often do not hold in an absolute fashion. Consumers then receive only part of the total benefit. Nonetheless, compare this result to the performance of an oligopolistic industry without a cooperative. Most, but not all, of the benefits of such a cost-reducing investment would flow to stockholders as increased rents from the shared monopoly. Therefore, cooperatives not only increase economic efficiency, but they tend to redistribute wealth toward lower income persons. This may be a desirable result and, if it is, public support for competitive yardstick cooperatives would help attain it.

Conclusions

To conclude this section, perhaps it is useful to stress that ex post, or after the fact of investment, one often cannot use the observed cash flows of the cooperative to evaluate whether cooperative management has made wise investment decisions. If the cooperative is performing its historic role, prices and quantities, and possibly membership, will change to ensure that ex post the net present value of a desirable investment will be zero. Any positive result would be due to rigidities in the adjustment process to the new long-run equilibrium. Cooperatives must look to changes in consumer surplus under the demand curve for its product to evaluate the ex post impact of investment. Even then, they cannot be certain that all benefits flow to their members if farm prices change or factors of production are in limited supply and not owned by members.

Cooperative managers who wish to evaluate investment decisions ex ante, (before the fact) must forecast where the new cooperative equilibrium will occur and estimate the resulting benefit streams. As figures 12 and 13 suggest, this is a complex measurement problem for cooperatives. Nonetheless the problem of forecasting benefits may be nearly as complex for IOFs in oligopolistic industries. An investment may destabilize the market and cause prices to decline. Like cooperatives, IOFs must consider these price effects when measuring cash flows in such industries.

In figures 12 and 13, the benefit areas have been made very large. Under actual conditions, they may be very small and certainly they will be negative in some areas. These latter investments have negative net present values, and should not be undertaken. Such borderline cases take an added importance when risk is introduced to the theory. A cooperative may choose an investment with positive expected net present value and large variance, including significant chances of not returning to members the opportunity cost rate of interest. If a cooperative's investments are this risky, members will require a return on their equity capital that includes a large risk premium as well as the risk-free interest rate. This is the issue addressed in the next section.

Coonerative Eauilibrium with Risky Investment

> What if economics as a theory of efficiency opens up problems requiring evidence not amenable to academic canons of accurate and absolute demonstration? What does scientific procedure demand. Scientific tactics says: "limit the study to evidence about which absolute and accurate statements can be made." But scientific strategy says "It is unscientific to exclude any evidence relevant to the problem in hand. This comprehensiveness is scientific even if it involves some sacrifice of other qualities for which science likes to strive. (Clark, pp. 74-75)

Introduction

Expanding the theory of the previous section to encompass investments for which returns are not known with certainty is challenging. Considerable controversy has been generated concerning the empirical measurement and testing of the capital asset pricing model which is the starting point for the theory elaborated here (Roll; Drymes). This section does not intend to test as well as develop a cooperative capital asset pricing theory, but the question of the testability and the empirical validity of the approach taken here undoubtedly is an issue. Clark's admonition on scientific method is thus appropriate. The focus here is developing a theory. It is admittedly an exploratory effort.

In an economy where investment income streams are known with certainty, the required rate of return in equilibrium is the risk-free rate of return. How does one generalize the concept of a required rate of return to an economy where investment income streams are not known with certainty?

Knight in his classic book completed in 1927, Risk. Uncertainty and Profit, was the first economist to focus on the relationship between the competitive rate of return and two general states of knowledge about the future. In a risky situation, future outcomes are not known but the probability that each particular outcome will occur is known. Gambling on one's ability to pull an ace from a deck of cards, for example, is a risky situation. Assuming the dealer has not stacked the cards, one has 4 out of 52 chances of winning.

The odds are known. Knight's other general state of knowledge, uncertainty, exists when it is not possible to compute the probability of particular outcomes. The probability of a total nuclear war is a good example. One reason for this is the structure of the problem is not known. Using the deck of cards analogy, we do not know how many cards and how many aces are in the deck. Another reason is that, fortunately, we have no prior occurrences of the event on which to base an estimate of its occurrence. The theory developed below deals with risk.[17]

The Market Eauilibrium Approach

It seems plausible that if the level of risk varies among cooperatives, the required rate of return for capital also would vary. A cooperative with large swings in net cash flow is a riskier investment. Members would require a larger risk premium, and this would establish a higher required rate of return than required from a firm with smaller swings in net cash flow. Cooperative members that seek to maximize their welfare now maximize expected utility because cash flows from risky assets are random variables. The variance as well as the expected (average) return on investment now matter. Stated another way that is more operational for many analytical queries, the opportunity cost of member equity investment in a cooperative now consists of the risk-free rate of return plus a risk premium.

The market equilibrium approach to cooperative finance requires that the total cash income (net cash flow) for a member farm be partitioned into two components: cash income from farm operations and cash income from cooperative membership. Separate degrees of risk usually will exist for each of these economic activities. Cash income from cooperative membership must be further partitioned. The total or global income a farmer receives from cooperative membership is the cash flow he or she would lose if there were no cooperative in the market place. The core income that the farmer receives is the actual cash flow he or she would receive from the cooperative if it were in a competitive industry that is in long-run equilibrium. Therefore, from the member farmer's viewpoint, his or her cash income has two major components: income from farming and global income from cooperative membership. The latter component is further subdivided into core income and security income just as global value was subdivided into the core value and the security return in the last section.

Basic Assumntions--The task at hand is to provide a theory that predicts the required rate of return for cooperative firms and investments in those firms when they have different levels of risk. To keep the analysis manageable and consistent with the method of the preceding section, the same assumptions will be maintained. They are listed in table 5. In addition, it is assumed the cooperative is an open membership organization.

Assumntions Underlying Asset Pricing Models--The fundamental insight into risk management was made by Markowitz. An individual, including a cooperative member, can avoid a certain amount of risk without any loss in return by holding a portfolio of diversified assets. Using this insight, finance theorists have developed two theories to measure the required rate of return or price for a risky asset: the arbitrage pricing theory (APT) and the capital asset pricing model (CAPM). The assumptions underlying these theories are listed in table 6. Each will be explained with special concern for the fact that some of the firms are now cooperatives and some of the investors are now cooperative members. APT, the most general theory, was developed by Ross in 1976. Both APT and CAPM rely on the first eight assumptions in table 6. First, all individuals, now including cooperative members, maximize expected utility of their wealth or income (changes in wealth). Second, all individuals, including cooperative members, are assumed to be risk-averse. Third, all individuals, including cooperative members, are assumed to have homogenous expectations with regard to the occurrence of future events.

Fourth, it is assumed, as it has been throughout this paper, that capital markets are perfect or efficient.[18] In real markets, this assumption does not hold because there is a need for financial intermediaries. Banks and brokers, for example, introduce transactions costs. To cover such costs, these intermediaries lend funds at a higher rate than the rate at which they borrow them. When rates multiply because of transactions costs, the capital market no longer is an efficient mechanism an individual can use to borrow or lend funds to maximize utility over time. The separation theorem proved later no longer holds.

Corporate finance theorists commonly recognize that the efficient market assumption is often violated.

> The theory of finance is greatly simplified if we assume that capital markets are perfect. Obviously they are not. The relevant question then is whether the theories which assume frictionless markets fit reality well enough to be useful or whether they need to be refined in order to provide greater insights into reality. This is an empirical question. (Copeland and Weston, p. 14)

At this stage, theorists in this area obviously espouse a positive approach to theory.

The fifth assumption is straightforward for IOFs, given there are no taxes, as assumed earlier. This assumption is not relevant for cooperatives, because cooperatives do not generate capital gains.

The sixth assumption, a homogeneous planning horizon, is equally straightforward. Adding cooperatives and cooperative members to the problem creates no need for modification in the one-period model. Over a longer period, the planning horizons of cooperative members may differ. However, the length of an individual's planning horizon should not be confused with a member's decision to exit the cooperative. Such decisions may be made at any time during the planning period. When members exit the cooperative, it is assumed they receive all monies due them at that time. In fact, many cooperatives do not redeem equities this promptly.

The seventh assumption, that everyone in the market has the same opportunity to invest, also requires extra consideration when agricultural cooperatives are added. Its purpose is to ensure no one can corner the market by

Table 6.--Assumptions Necessary for Estimating the Required Rate of Return for a Risky Asset: The Abritrage Pricing Theory and Capital Asset Pricing Model Approaches[a]

APT and CAPM

1. Individuals maximize expected utility.

2. Individuals are risk-averse.

3. Individuals have homogenous expectations with regard to the probability distributions of future returns to assets.

4. The capital market is efficient.

5. Individuals are indifferent between equal dollar amounts of dividend or capital gains income (because they can always their shares or bonds).

6. All individuals have the same horizon period; in this paper it is assumed to be one period.

7. Everyone in the market has the same opportunities to invest although the amounts invested may differ from person to person.

8. The stock of risky securities in the market is given, all securities that were to be issued for the coming period have been issued, and all firm financial decisions have been made.

Additional Assumption for CAPM

9. Individual utility functions are quadratic or the distribution of assets' returns is joint-normal.

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[a] These have been assembled from Haley and Schall, p. 144, and Copeland and Weston, chap. 7.

excluding investors. As such, it is an extension of the efficient market assumption. One might think that agricultural cooperatives, and especially closed membership ones, would violate this assumption. They do limit membership to farmers who use their product or services. Nonetheless, as long as the membership can expand or as long as members can expand output, i.e., there are no quotas or other output restrictions, the investment necessary to ensure equilibrium at the capital market's level of return for firms of the cooperatives risk level will be forthcoming.

Assumption eight ensures the problem's boundaries are defined. It does this by fixing the stock of securities and the financial decisions of the firms. For a cooperative, financial decisions also include farmer decisions to join or leave the cooperative, the decision to allocate patronage refunds to members' investment accounts, and the decision to use unallocated retained earnings. Given such decisions have been made, the theory analyzes their impact on the required rate of return and other performance variables.

Assumption nine is required only for the CAPM approach. If utility functions are quadratic, investors are concerned only about expected value and standard deviation or variance of their portfolio performance. This means that the theory can be reduced for trade-offs in these two dimensions. One can obtain the same attractive feature by assuming that the distribution of asset returns is joint-normal. The multivariate normal distribution can be described completely by its first two moments, the expected value vector and the variance vector. Because all higher moment vectors are zero, it does not matter whether individuals actually consider them in their utility functions. They do no vary. Adding cooperatives to the problem requires no changes to this assumption.

The following analysis focuses on a market economy with two types of firms, cooperatives and IOFs. Individuals differ in their attitudes toward risk and the amounts they will be investing, but they agree on the characteristics of securities available. All individuals are averse to risk and agree on what constitutes risk. Except for the restrictions imposed by agricultural cooperative membership policies, individuals can freely invest in any combination of securities desired and can borrow and lend at the same risk-free rate of interest.

Comnaring the Arbitrage Pricing Theorv and Capital Asset Pricing Model--The essential concept of the arbitrage pricing theory is the market is not in equilibrium if a portfolio holder can for a given risk level increase his or her return by redeploying wealth. In equilibrium, no arbitrage opportunities exist in the market. From this equilibrium condition, one can derive the required rate of return for each asset as a function of several risk factors (Copeland and Weston, pp. 211-20).

CAPM is a special case of the more general APT. Under CAPM, the required return is a function only of risk defined as a single factor that shifts the value of the market portfolio up and down over time. This is termed systematic risk. Risk that can be avoided through diversification is called unsystematic risk. The APT model decomposes the single risk measure of CAPM into several statistically independent subcomponent risk variables. It then analyzes how asset prices vary as each of these specific risk levels vary.

Empirical studies have found that APT explains observed returns on equities more accurately than CAPM (Copeland and Weston, chap. 7). From an econometric standpoint this should not be surprising. A theory that admits multiple explanatory factors usually will explain more variation than a theory that relies on a single explanatory variable. However, for the expository purposes of this section, the focus will be on the single-risk-factor CAPM.

The Capital Asset Pricing Model--Applying a capital asset pricing model to a cooperative may seem useless. If the asset is equity investment in a cooperative, its market value does not change over time. Its market value is its face value. Thus it may seem odd to develop a pricing model for cooperative equity. The purpose, however, is not to determine the value of equity. It is to use the CAPM theory to determine the risk-adjusted rate of return members require on equity investments in the cooperative. Because of a cooperative's unique business structure, equilibrium is attained through adjustments in price and quantity in the product market rather than adjustments to the value of cooperative equity. This difference in equilibrium adjustment mechanisms does not preclude the measurement of members' required rate of return. For the reader's convenience, table 7 identifies all of the symbols used in the following analysis.

An approprlate place to begin the analysis of the value of an asset, be it a firm or an investment project contemplated by a firm, is the definition of the rate of return r_j for an asset in the one-period model. It is

$$(29)\quad r_j = \frac{Y_1}{V_j} - 1.$$

where Y_1 is the dollar return at t_1 and includes any cash distributions made at that time plus the market value of the asset at t_1. The tilde will be used to designate random variables. In equation (29), dollar return at tl is random so the rate of return also is random. Equation (29) also can represent a set of assets, i.e., a portfolio.

The current value of the investment, V_j, is known with certainty so it is not random. Computing the expected value and standard deviation of $\tilde{r}_j$ gives

$$(30)\quad \bar{r}_j = \frac{Y_1}{V_j} - 1 \text{ and}$$

$$(31)\quad \sigma_j = \frac{\sigma_Y}{V_j}.$$

Throughout this section a bar over a variable denotes its expected value, σ_j denotes the standard deviation of j, and σ_j^2 denotes the variance of j.

Table 7.--A Key to Symbols Used in the Analysis of Cooperative Equilibrium with Risky Investment (Equations (29) Through (53))

Equation where first introduced	Symbol	Definition
(29)	r_j	rate of return on jth asset
	Y_1	dollar return of jth asset at time t_1
	V_j	value of jth asset at time t_0
(31)	σ_j	standard deviation of jth asset's rate of return
	σ_Y	standard deviation of dollar return of jth asset
(32)	i	risk-free interest rate
	λ'	slope of capital market line (CML)
	σ_m	standard deviation of market portfolio rate of return
	r_m	market portfolio's rate of return
(33)	β_j	beta volatility coefficient for jth asset
	σ_m^2	variance of market portfolio rate of return
(39)	λ	risk parameter (slope of capital market line λ' divided by standard deviation of market portfolio σ_m.
(40)	V_1^o	expected net present core value of cooperative activity during t_1
(41)	V_0^o	expected net present core value of cooperative at time t_0
	C_0	cash patronage refunds at time t_0

(Continued)

Table 7.--A Key to Symbols Used in the Analysis of Cooperative Equilibrium with Risky Investment (Equations (29) Through (53)) (Continued)

Equation where first introduced	Symbol	Definition
(42)	I_t	total equity investment in cooperative at time t_0
	I_p	equity investment in cooperative prior to time t_0
	I_0	equity investment in cooperative at time t_0
(43)	α_n	nth member's share of cooperative sales at time t_1
	r_c	required rate of return for an investment with cooperative's riskiness
(44)	X_1	cooperative's net cash flow at time t_1
	Q_1	sales volume of cooperative at time t_1
	P_1	transaction price of cooperative at time t_1
(45)	X_0	cooperative's net cash flow at time t_0
	F	amount of equity capital provided by new members at time t_0
	B	amount of outside financing undertaken at time t_0
(46)	C_1	cash flow to old members at time t_1
	Y^F	cash flow to new members at time t_1
	Y^B	cash flow to outside suppliers of funds at time t_1

Given assumption 9 in table 6, the only characteristics of portfolios that matter to the individual are the expected returns and standard deviation (or variances). Thus one can display capital market equilibrium on a two dimensional graph as in figure 15. EE' is the efficient frontier. Portfolios that lie on it are efficient in that they pay the highest expected return for a given level of risk. Alternatively, they have the least risk for a given expected rate of return. Inefficient portfolios are located to the right of EE'.

The risk-free rate of interest i combines with the market portfolio M to produce the capital market line (CML). The construction of the CML will be explained in the proof of the separation theorem. First, however, note that a single portfolio M will be held by all individuals. It may seem counterintuitive that individuals with different risk and income preferences hold the same portfolio of securities. The separation theorem proves that it is not. It states:

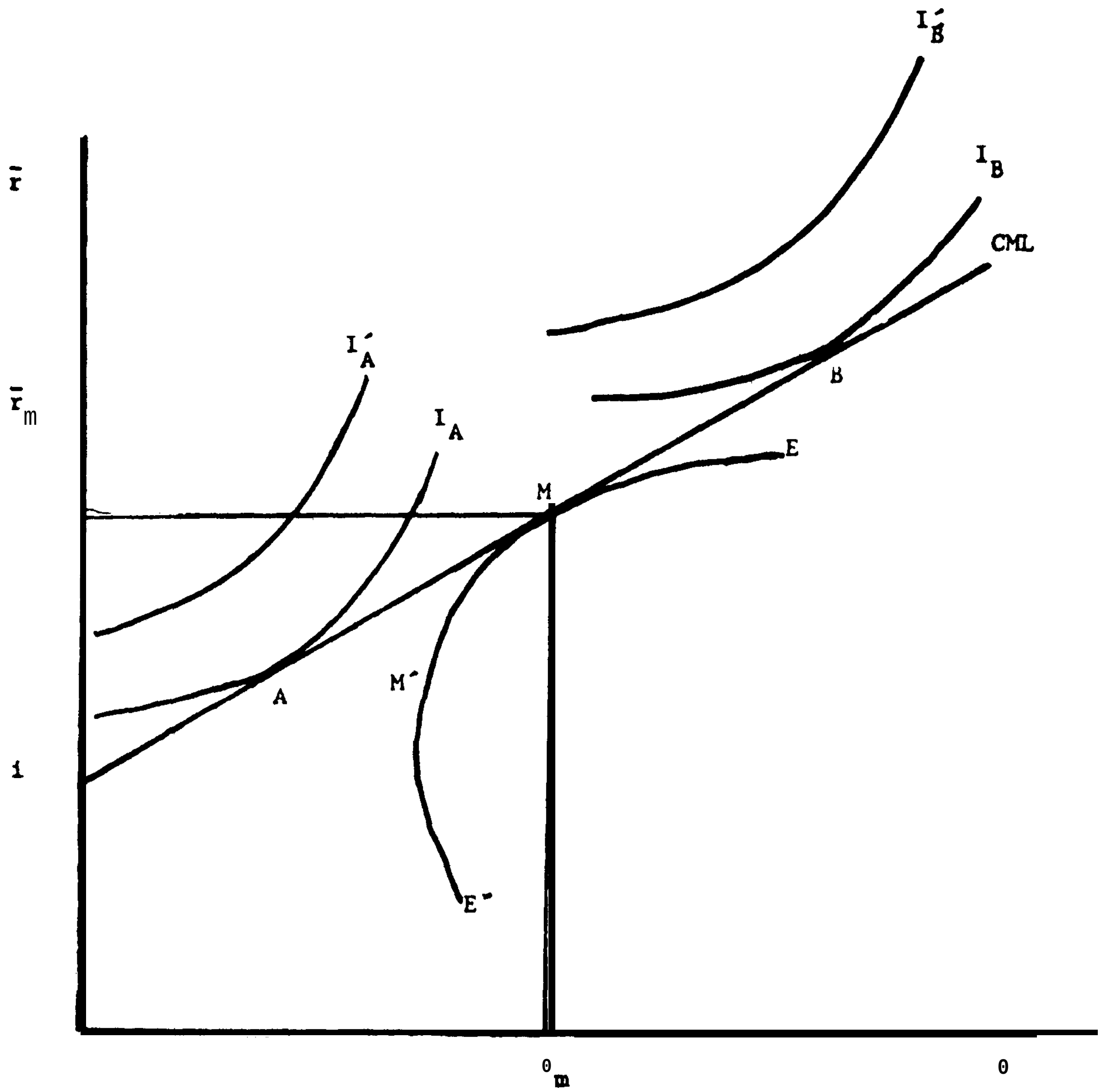
> The individual's choice of a portfolio of risky securities to hold is independent (separate) of the individuals attitude toward risk. (Haley and Schall, p. 132)

To prove this, note the indifference curve sets for two individuals A and B in figure 15. By construction, indifference curves for an individual cannot cross. Moreover, given all individuals are risk-averse, each curve has a concave shape. For individual A, indifference curve I_A' indicates a higher level of expected utility than indifference curve IA' Similarly I_B' provides more expected utility than IB for individual B. Only two indifference curves for each individual have been drawn, however, each has an infinite number of such curves, essentially one for each level of satisfaction. The indifference curve set for each person covers every point in figure 15, and it is the goal of each person to attain the highest indifference curve possible. This expected utility maximization goal, along with the indifference curve set and the boundary of possibilities offered by the capital market, determines each individual's risk-rate of return choice.

Without access to funds at the risk-free rate i, individuals A and B would make two distinctly different portfolio choices because their preferences toward risk differ. The particular portfolio each would choose would be determined by the tangency of the efficiency frontier with their highest attainable indifference curve, The location of their indifference curves in the figure indicate that individual A prefers less risk with corresponding lower expected returns than individual B.

Access to funds at the risk-free rate i establishes the capital market line. Individuals can attain an expected rate of return-risk combination on the CML between i and M by investing a proportion of their assets at the risk-free rate i and the remaining proportion in the market portfolio M. Individuals can move up the CML beyond M by borrowing funds at the risk-free rate i to invest more in the market portfolio M. This financial leverage increases the expected rate of return as well as the risk. In figure 15 individual A maximizes expected utility at point A by investing approximately 50 percent of his or her assets in M and 50 percent in risk-free assets. Individual B

Figure 15--Equilibrium in the capital market



borrows money at interest rate i to leverage his or her funds and attains maximum expected utility at point B. Note that although their attitudes toward risk are different, both in their drive to maximize satisfaction desire to hold only the market portfolio M rather than some other portfolio such as M'. This proves the separation theorem.

For the capital market to be in equilibrium, all securities must be held by someone, i.e., they must be in portfolio M. This requirement implies a pricing process for each security, including equity securities of cooperatives held by members. If the expected return on a security of an IOF is too low given its riskiness, more individuals will wish to sell rather than buy it. The current price (value) of the security will fall until the expected rate of return as computed with equation (30) equals investors' required return for a security of that risk class.

The equilibrium adjustment process for a supply cooperative is different, but it produces the same result. As explained in the previous two sections, when patronage and the associated investment imply an expected return above that earned by investments with similar risk levels, demand for the cooperative's output will expand and the price will fall to reduce the cooperative's competitive advantage until members earn only the rate of return required for assets of that risk class. Thus the equity security's net cash flow rather than its market value changes to reestablish the required rate of return.

The derivation of the asset pricing equation from the capital market equilibrium condition is reasonably complex, but readily available in advanced corporate finance texts (Haley and Schall, chap. 7; Copeland and Weston, chap. 7). The pricing equation, called the security market line (SML), for the jth asset is

$$(32)\quad \bar{r}_j = i + \frac{\lambda'}{\sigma_m}\,\mathrm{cov}(\tilde{r}_j, \tilde{r}_m)$$

where

r_j is the expected price of asset j;

i is the risk-free interest rate;

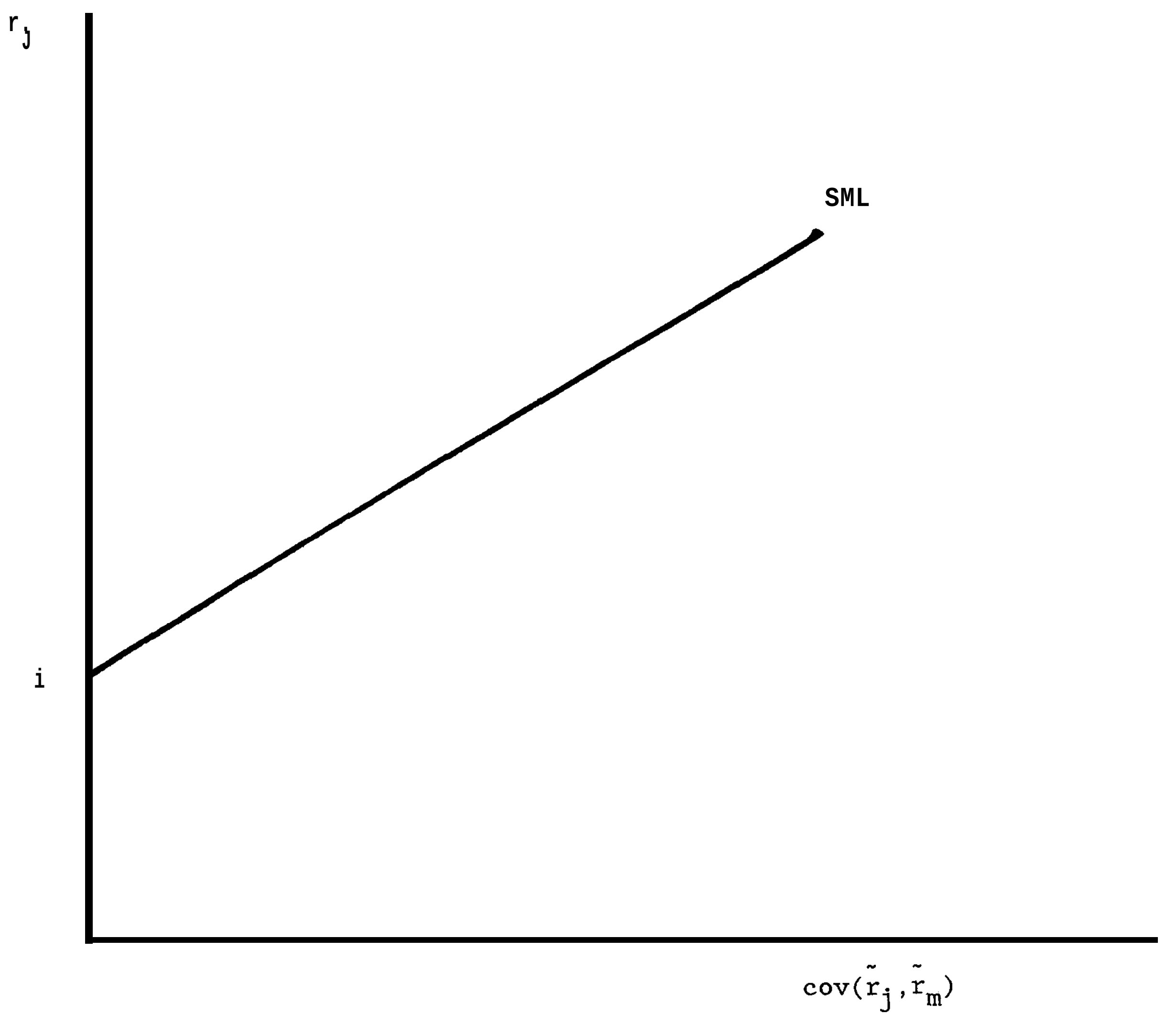
λ' is the slope of the CML;

a, is the standard deviation of the market portfolio M; and

$\mathrm{cov}(\tilde{r}_j, \tilde{r}_m)$ is the covariance of the return on j with the return on the market portfolio M.

Graphically one can represent the SML as in figure 16. Note that the expected rate of return is not a function of the asset's variance. Because the unsystematic or idiosyncratic portion of an asset's variance can be avoided through diversification, only systematic risk as measured by the covariance term matters.

Figure 16--Security market line for jth asset using covariance



An alternative form of the SML often appears in the literature because it suggests a direct empirical method to compute $\tilde{r}_j$.[19] Define the following volatility coefficient:

$$(33) \quad \beta_j = \frac{cov(\tilde{r}_j, \tilde{r}_m)}{\sigma_m^2}.$$

Solving (33) for $cov(\tilde{r}_j, \tilde{r}_m)$, substituting it into (32), and using the point-slope formula fo1 -tRe slope of a straight line to eliminate X', one obtains

$$(34) \quad \bar{r}_j = i + \beta_j(r_m - i).$$

$\bar{r}_j$ is computable from observed data (Copeland and Weston, pp. 204-g). Figure 17 illustrates this second form of the SML. Note when the beta equals one, the asset has the same risk as the market portfolio. As a result, the expected rate of return on j equals the expected market rate of return in equilibrium. If the beta is greater than one, the jth asset is more volatile than the market and its rate of return is higher. The converse holds for a beta less than one.

<u>Deriving the Valuation Eauation</u>--The CAPM enables a parallel examination in a risky world of the valuation, finance, and investment issues covered in the previous section under certainty. The first step is to derive the valuation equation for a risky asset. Equating equations (30) and (32), one obtains

$$(35) \quad \frac{Y_1}{V_j} - 1 = i + \frac{\lambda' cov(\tilde{r}_j, \tilde{r}_m)}{\sigma_m}$$

Substituting equation (29) for $\tilde{r}_j$ into (35) gives

$$(36) \quad \frac{Y_1}{V_j} - 1 = i + \frac{\lambda'}{\sigma_m} cov(\frac{Y_1}{V_j} - 1, \tilde{r}_m).$$

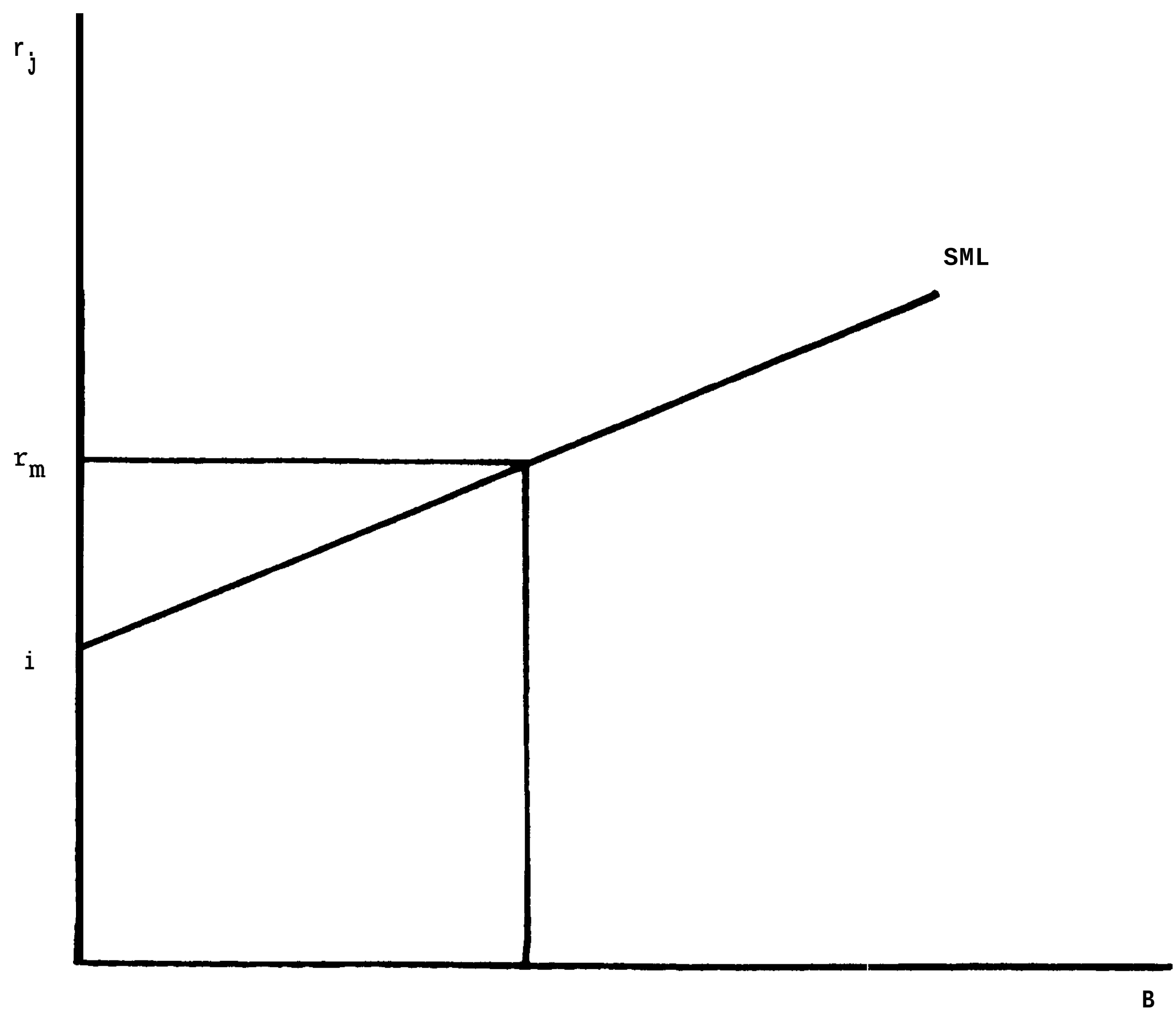
Because V_j and 1 are constants, the covariance term simplifies to

$$(37) \quad cov(\frac{Y_1}{V_j} - 1, \tilde{r}_m) = \frac{cov(\tilde{Y}_1, \tilde{r}_m)}{V_j}.$$

Substituting (37) into (36) and solving for V_j gives

$$(38) \quad V_j = Y_1 \frac{(\lambda'/\sigma_m) \; cov(\tilde{Y}_1, \tilde{r}_m)}{1 + i}.$$

Figure 17--Security market line for jth asset using beta



The standard deviation of the market, σ_m, is a constant in equilibrium. Therefore, one can define a new "price of risk," $\lambda = \lambda' / a$,. Also, dropping the subscript j, one obtains the following general equation valuation equation;

$$(39)\quad V = \frac{Y_1}{1 + i} - \frac{\lambda \operatorname{cov}(\tilde{Y}_1, \tilde{r}_m)}{1 + i}.$$

Note that if the covariance between an asset's period one income $\tilde{Y}_1$ and the market rate of return is zero, the valuation equation reduces to the first term. Such an asset is equivalent over time to a risk-free investment. No risk premium is subtracted from the net present value of its expected return. Alternatively $\tilde{Y}_1 - \lambda \operatorname{cov}(\tilde{Y}_1, \tilde{r}_m)$ is the-cash or certainty equivalent of the random cash payment $\tilde{Y}_1$.

__Applying CAPM to Cooperatives: The Core Value of an Open Membership Cooperative__--The general valuation equation can be used to analyze the core value of a cooperative. As explained in the previous section, if we are examining an open membership cooperative and the cooperative prices at the industry level, the cooperative's observed net cash flow can be used to determine the cooperative's core value. That example is continued here. Assume that at t_1 the cooperative liquidates by paying a cash patronage refund C_1 to old members. It is a random variable. Old members are members who were members during t_0. Also assume that the cash patronage refund at t_0, C_0, is known and has been paid. Then the expected net present core value to old members at t_0 of the cooperative's activity during t_1 and dissolution at t_1, V_1^o, is

$$(40)\quad V_1^o = \frac{Cl}{1 + i} - \lambda \frac{\operatorname{cov}(\tilde{C}_1, \tilde{r}_m)}{1 + i}.$$

The total expected net present core value of the cooperative to old members at t_0 is

$$(41)\quad V_0^o = C_0 + V_1^o.$$

It is the sum of current patronage refunds plus the expected net present core value of period t_1 activity and dissolution.

To establish cooperative equilibrium in a risky environment, recall from the previous section the analysis of potential member's decision to join the cooperative. Briefly, total cooperative investment is the sum of previous investment plus current investment:

$$(42)\quad I_t = I_p + I_0.$$

The nth new member will receive $\alpha_n C_1$ as cash patronage refund for an investment of $\alpha_n I_t$. α_n is the patron's percent of cooperative volume in period one. A potential member will join if the expected return on cooperative investment is greater than or equal to the required rate of return for an investment of the cooperative's risk level $\tilde{r}_C$, that is,

$$(43)\quad \frac{\alpha_n \bar{C}_1}{\alpha_n I_t} = \frac{C_1}{It} \geq 1 + rc.$$

In this example, because there is no investment in tl and the cooperative dissolves at tl, period one cash patronage refunds $\tilde{C}_1$ equal period one net cash margins plus any cash received at dissolution $\tilde{X}_1$. Moreover, the cooperative equilibrium process implies that

$$(44)\quad Xl = X_1(\tilde{Q}_1, \tilde{P}_1).$$

Period t_0 cash flow is known with certainty and can be written as follows:

$$(45)\quad CO = X_0 - IO + F + B.$$

CO is current cash patronage refund. X_0 is current investment. F is the amount of capital provided by members that join at t_0. B is the amount of outside financing undertaken at t_0. Because risk exists, B could be bonds, other long-term debt, or more risky preferred stock.

Cash flow at tl is a random variable and given there is no investment, it can be written as

$$(46)\quad \tilde{X}_1 = Cl + \tilde{Y}^F + \tilde{Y}^B.$$

$\tilde{C}_1$ is the random cash flow to old members, $\tilde{Y}^F$ is the random cash flow to new members, and $\tilde{Y}^B$ is the random cash flow to outside suppliers of funds. A random cash flow to outside suppliers of capital is appropriate because most cooperatives borrow at floating interest rates. Solving for period tl cash patronage refunds gives

$$(47)\quad Cl = Xl - \tilde{Y}^F - YB.$$

The expected cash flow at t_1 is

$$(48)\quad \bar{C}_1 = Xl - \bar{Y}^F - \bar{Y}^B.$$

Substituting (48) and (47) into the general valuation equation (40) and simplifying, using the additive property of covariance, gives

$$(49)\quad V_1^o = \frac{X_1 - \lambda\ \mathrm{cov}(\tilde{X}_1, \tilde{r}_m)}{1 + i} \quad \frac{\bar{Y}^F + \mathrm{cov}(\tilde{Y}^F, \tilde{r}_m)}{1 + i} - \frac{\bar{Y}^B + \mathrm{cov}(\tilde{Y}^B, \tilde{r}_m)}{l+i}.$$

The expected net present core value at t_0 of the cooperative activity in period tl and its dissolution at t_1 to old members is composed of three parts: the net present value of the certainty equivalent of cash income, minus the present value of the certainty equivalent of payments to new members, minus the net present value of the certainty equivalent of payments to outside suppliers of capital.

Equation (49) can be further simplified by noting that the raising of outside funds and new decisions to join occur in markets that are in equilibrium. Thus the net present value of expected bond repayment plus interest equals the amount of outside funds raised, B. Market equilibrium also combines with equation (43) to establish that the net present value of expected cash patronage refunds to new members equals the amount of capital provided by new members, F. Therefore, equation (49) can be rewritten as

$$(50)\quad V_1^o = \frac{Xl - \text{cov}(\tilde{X}_1, \tilde{r}_m) - F - B}{1 + i}$$

The total expected net present core value of the cooperative to old members at t_0 is now obtained by substituting (45) and (50) into (41) to obtain

$$(51)\quad V_0^o = C_0 + V_1^o = X_0 - I_0 + \frac{X_1 - \lambda\ \text{cov}(\tilde{X}_1, \tilde{r}_m)}{1+i}.$$

In cooperative equilibrium, another relationship holds:

$$(52)\quad I, = I_p + IO = \frac{X_1 - \lambda\ \text{cov}(\tilde{X}_1, \tilde{r}_m)}{1 + i}.$$

Total investment in the cooperative earns only the competitive rate of return for assets of that risk level. Therefore, the old member core valuation equation reduces to

$$(53)\quad V_0^o = I_p + X_0.$$

The expected net present core value of the cooperative to old members equals the sum of prior investments I_p made by old members plus the current net margins X_0 of the cooperative. This result corresponds to the result obtained in the certainty case analyzed in the previous section. There the actual value of the cooperative to old members was equal to prior investment plus current net margins.

<u>Risk-Adiusted Discount Factors for Cooperative Investmont Analvsis</u>--The analysis of changes in global value arising from a cooperative investment given risk also corresponds to that of the certainty case presented in the previous section. It will not be generalized here because it adds little new insight. The CAPM approach does, however, provide a measure of the appropriate discount factor for a proposed investment. It also can be used to measure members' required rate of return on cooperative equity. The security market line identified in equation (34) and figure 17 provides answers. If the jth asset is a proposed cooperative investment, one would proceed as follows. First, estimate the investment's beta. Then estimate

the SML of figure 17 and employ it to determine the required rate of return on an investment of the proposed investment's risk level. If the jth asset is the equity capital of the cooperative firm, this procedure gives the members' required rate of return.

An important result of this approach is that two investment projects with different levels of risk will have different risk-adjusted discount rates. The traditional weighted average cost of capital (WACC) approach does not adjust for different levels of risk associated with projects. It computes one discount rate for a firm by weighting the required return for each type of security by the proportion of total assets. If 75 percent of the firm is financed with debt bearing an interest rate of 10 percent and equity capital which requires a 20 percent return accounts for the remaining 25 percent of assets, the weighted average cost of capital is

$$(54)\ WACC = .75(10) + .25(10) = 12.5\%.$$

This discount rate is then used to evaluate all investment projects. This approach is only acceptable if the proposed investments have the same risk level and that risk level equals the current risk of the cooperative firm (Haley and Schall, p. 177). In general, WACC is no longer considered to be an appropriate method for adjusting investment analysis for risk.

<u>Unallocated Retained Earnings Given Risky Investment</u>--The analysis of unallocated retained earnings in a risky environment produces results that correspond closely to those derived under certainty in the previous section. A cooperative that retains all net margins in excess of the amount necessary to meet the required return of security holders will provide members an expected net present core value equal to prior investment I_p plus current net margins X_0. As in the prior analysis, this also will be the members' expected net present global value. The cooperative can evaluate investment performance by noting how the amount in the retained earnings account changes.

Under risk there is, however, one additional possibility for the cooperative. If one assumes in the one-period model that the cooperative had unallocated retained earnings at t_0, it has an extra degree of flexibility when determining cash flow to members at t_1. It can manage the benefit flow to members, but because unallocated retained earnings are finite, the cooperative cannot raise the cash flow to members permanently in a multiperiod model. This suggests three testable hypotheses. First, a retained earnings cooperative might use a buffer stock approach, drawing down retained earnings in bad years, and adding to them in good ones, to reduce the riskiness of the cooperative's payments to members for equity capital furnished. The member's required rate of return on equity capital could thus be lowered. A retained earnings cooperative could conceivably reduce beta to zero so members would be satisfied receiving the risk-free rate of return. In a multi-asset, efficient capital market, however, this type of manipulation of the required rate of return may not increase members' expected utility.

A second hypothesis is: Cooperatives that have accumulated a pool of unallocated retained earnings would have more stable patronage refund streams with, on average, a lower cash refund value than comparable cooperatives that do not have and use retained earnings as a buffer stock. Lowering the required rate of return also suggests these cooperatives would find more investment projects with positive net present values. Retained earnings cooperatives that buffer refunds may expand more rapidly than other cooperatives.

Future Research

The theory presented in this paper is very abstract. Some may reject it out of hand because its assumptions strip away many of the "real" world features of cooperative pricing and finance methods. Yet for progress in the theory of cooperative enterprise activity, perhaps more research on specific pricing and finance methods should be conceptualized within the context of the linked product and capital market equilibrium theory developed in this paper. In fact, this paper suggests several fruitful avenues for research. The price output models of the second section can be seen as the core of a set of strategic planning models. They can be expanded by incorporating other internal organization and policy features to complement the pricing membership and retained earning features analyzed here (Cotterill 1987). Specific cooperative finance plans such as the revolving fund or base capital plans could be incorporated to produce a more detailed model of price and finance. This would require a more complex multiple-period model. Adding corporate and personal income taxes also would produce more refined results. Ultimately this work could lead to empirical testing and measurement of the parameters in these models.

Applied research along this avenue could provide cooperatives with operational strategic planning and investment analysis models that incorporate risk. Members' required rates of return could be estimated. Managers and directors as a result should be able to improve cooperatives performance.

The theory suggests several ways to evaluate the performance of cooperatives that use tax-paid surpluses such as retained earnings or income from nonpatronage business units. Comparing their performance to cooperatives that use other types of financial strategies might provide useful insights. The theory also generates insights that can serve as the basis for antitrust analysis of cooperative activity and for member education on strategic pricing and financial issues. Certainly this type of information would be useful.

Notes

1. The work of Helmberger, and Helmberger and Youde on market impacts, especially the relationship between cooperative membership policies and the ability of marketing cooperatives to raise price to members is a notable exception, as is the 1977 NC-117 monograph *Agricultural Cooperatives and the Public Interest*.

2. Except for the first principle, which is curiously omitted, these are from Abrahamsen, p. 48.

3. See Berle and Means for a classic discussion and Cotterill (1987) for a recent analysis of this subject in IOFs. For a discussion of the same concerns for cooperatives, see Vitaliano and Condon.

4. It is worth noting that there is a difference between the political process in an organization such as a cooperative and a country. A member can exit a cooperative, but a citizen cannot exit a country very easily. Citizens essentially have only the voice option.

5. Later Robotka (1957) retrenched toward Emelianoff's view of cooperation. This revision was in response to Phillips's rigorous theory of a cooperative as a "joint economic plant" operated by members of a cooperative association without a central coordinating agent.

6. See Ladd for an example of this approach. His bargaining cooperative seeks to provide services including political representation of farmers' interests as well as to raise the prices that farmers receive.

7. Royer's criterion is the same as Enke's, which is the sum of producer surplus and cooperative net margins, because producer surplus and profits from farm operation are identical.

a. Recall that for the interim we are assuming that members purchasing behavior is not a function of patronage refunds. When this assumption is later relaxed, this pricing rule no longer produces maximum welfare.

9. If the long-run average cost curve is flat at the point of intersection with the demand curve, price also equals long-run marginal cost and we have an exact duplication of the properties of long-run competitive equilibrium.

10. One also can measure the total social welfare value of the cooperative by including the net gains in consumer and producer surplus throughout the economy. One component of this is gains that nonmember farmers enjoy because of the yardstick effect of the cooperative rival IOFs. Core and global value are critical for cooperative investment decisions; total social welfare value is not.

11. One may be able to view these two approaches as valid for the end points of a price-cost spectrum that has the shared monopoly margin as one end and the competitive price-cost margin (zero) as the other extreme. When the equilibrium price-cost margin settles between these two values, the cooperative has had a partial competitive yardstick effect and the resulting net cash flow measures neither the global nor core value. Cooperative investment analysis is even more challenging if this is the case.

12. This specification and the related mathematical analysis follows Haley and Schall. I also have tried to follow their notation. Reading

chapters 1 and 2 of that book may be helpful for readers who are unversed in mathematical finance models.

13. F and B are stock variables that occur at t_0. They could have zero subscripts, but because this is a one-period model, no new member equity or new debt is contemplated at time t_1. As a result, there is no need to distinguish between transactions at t_0 and t_1, so no subscripts are used on F and B. Also, it is assumed, without loss of generality, that prior investment is net of any prior bond financing. Only current financing decisions are analyzed.

14. Changes in the cooperative's unit cost structure are implicitly included because they occur as purchase volume Q_1 changes.

15. Cases where farm product prices remain unchanged after a cooperative lowers an input price may not be uncommon. If the cooperative operates in one of several production areas, the production response to lower the cooperative input price may not affect the national market price of the farm product. On the other hand, if farm product prices adjust immediately to the input price, benefits over the opportunity cost of capital are passed on to others in the food system. If all downstream industries are competitive then consumers and the owners of productive factors in less than perfectly elastic supply are the ultimate beneficiaries. High quality farmland, for example, is not in elastic supply so returns to it would be higher in equilibrium and its owners would benefit.

16. Recall it is assumed that members purchase at the cooperative and nonmembers purchase from IOFs.

17. See Vickers for an iconoclastic attempt to develop a theory of profit that deals with uncertainty.

18. See Copeland and Weston, chaps. 1, 9, and 10, and Haley and Schall, chap. 14, for further explanations of what an efficient capital market is and evidence as to how lack of efficiency can be controlled in these models.

19. Using the model to compute required rates of return is different than testing the model to establish its validity.

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