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An application of the theory of club goods to capitalization structures and membership investment interests in agricultural cooperatives

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CHAPTER 1. INTRODUCTION

In 1984 the Agricultural Cooperative Service (ACS) of the United States Department of Agriculture (USDA) listed 5782 agricultural cooperatives in the United States. This was approximately 3,000 fewer than existed in 1970 (Kraenzie et al., 1985). The cooperative system that remained was not necessarily in strong financial condition. In 1983, 17 percent of cooperatives had net worth/asset ratios of less than 0.40. These were not the smaller or the weaker cooperatives. They accounted for 53 percent of total cooperative assets, 35 percent of total cooperative net worth, and 28 percent of total cooperative net margins (Kraenzie et al., 1985).

The decline in the number of cooperatives and the relatively weak net worth position do not appear to have been the result of a low farm customer or patronage base for agricultural cooperatives. In 1980, 56 percent of all farm operators in the United States used cooperatives either as members or as non-member customers. Among commercial farmers (those with annual sales of $10,000 or more) 71 percent used cooperatives, and 79 percent of farms with annual sales of $100,000 or more did business with cooperatives in 1980 (Torgeson, 1984). In 1982, U.S. farmers purchased 27 percent of their major farm supplies and marketed 30 percent of their primary output through cooperatives. This was a rise from 23 percent of both supplies and primary output passing through cooperatives in 1973 (Schrader et al. 1985).

Changing situations in the agricultural arena have continued to place pressure on agricultural cooperatives. The period of export growth experienced by U.S. agricultural products in the world market during the 1970s was replaced by export decline for agricultural products

in the 1980s. Government programs instituted in the early and mid 1980s idled significant amounts of agricultural land for prolonged periods. These conditions have increased price-pressure on margins for all agricultural industries and have increased the competition for farm business.

Reductions in both the supply of and demand for raw agricultural products has left the midwestern grain merchandising industry with an oversupply of storage and loading capacity (Ginder, 1985). Federal storage programs in the period from 1986 to 1988 injected cash into the cooperative system and partially covered the excess capacity problem on a temporary basis. The problem remains, however, and the elimination of storage programs between 1989 and 1992 has caused it to resurface in cooperative operating reports.

Concerns about the state of the cooperative industry resulted in a significant expenditure of effort by the ACS and others (Cobia et al., 1982; Schrader and Dobson, 1985; Royer, 1987) on the economic theory of agricultural cooperatives during the 1980s. The results of these efforts addressed a variety of issues including game-theoretic models of cooperative initiation and member choice, cooperative efficiency in both a micro and a macro economic context, and speculation concerning the direction of agricultural cooperatives in the future.

Nearly all of these works are similar in that the patronage incentives of the farmer-membership as well as the formation and rotation of member equity are identified as serious and endemic problems in cooperative structure. However, these concerns are addressed in a relatively ad hoc manner. This suggests that:

1. The economic theory of cooperatives accepts cooperative structure as prescribed by tradition and legal restrictions;

2. The traditional economic theory of the firm has been unable to adequately capture the effects of property rights and interests as they exist in the typical midwestern agricultural cooperative;

3. Cooperative theory has failed to adequately identify and address the multiple activities of the cooperative and its membership.

As problems for cooperative theory, these are largely a result of the system of property rights that cooperatives have maintained. Cooperative membership and investment structures have made it difficult to model membership incentives and property rights as these entities are not unambiguously recognizable in the real world. This problem, however, is not restricted to cooperative theory. The same ambiguity that has made cooperatives difficult to model using the traditional techniques of the economic theory of the firm have also made it difficult for the cooperative to maintain farmer-member investment and patronage incentives. These problems were not critical in the postwar period of cooperative expansion that lasted through the 1970s.

However, the recent change in the cooperative environment from one of long-term growth to one of excess capacity has made these issues central to cooperative survival in the 1990s and beyond. It is becoming increasingly important for cooperatives to develop a system of unambiguous property rights and patronage incentives. If the economic theory of cooperatives is to

remain relevant to this undertaking, it will have to assist in illuminating options by which this can be attained.

In a recent work on cooperative theory, Condon (1987) proposed that two general requirements must be addressed for the development of a unified cooperative theory:

1. The motivation of the agents that constitute a cooperative enterprise:
    a. Member-patrons;
    b. Members of the cooperative board of directors;
    c. Cooperative managers;

2. The impact of property rights on cooperative structure and performance.

This contribution does not attempt to create a complete unified theory of cooperatives. Instead, it will focus on the motivations of member-patrons and the effects of property rights on cooperative structure and performance. In turning away from the motivations of cooperative directors and managers, this analysis agrees with Schrader et al. (1985; 3):

> There is no a priori reason to expect a greater disparity between the objectives of owners or members and management in cooperatives than in proprietary firms unless that managers of cooperatives are constrained differently or have more discretion in the use of the firm's resources.

It does appear to be true that cooperative managers are constrained differently than managers of non-

cooperative firms and may be allowed more (or less) discretion in the use of the firm's resources. Cooperative managers face an expanded optimization problem where individual farm operating profits are a consideration. Because cooperative customers are also cooperative owners by definition, customer profits have a direct effect on cooperative management and activities. This results in on-farm assets and cash-flow considerations (which a noncooperative firm could ignore) that must be considered in any cooperative action.

In addition, the cooperative's distribution of operating surplus on a patronage basis restricts management's ability to redirect assets. Resource allocation and pricing decisions in the cooperative are recognized by the membership as income distribution decisions, making them subject to patron review as well as investor review. However, all of these management constraints are a result of the cooperative structure of property rights and their effects on member portfolio decisions. Alternative structures and their resulting property rights will inevitably affect the constraints on cooperative management through this same mechanism.

The focus of this work will be cooperative property rights and membership incentives as they exist in grain marketing and supply cooperatives commonly found in the Midwest region of the United States. This restriction will allow for a more concise comparison of the current and proposed structures of property rights and membership incentives. Many of the ideas included here have been derived from and may be applicable to other agricultural cooperative environments.

The goal of this work is to identify a model of cooperative organization that avoids the farm portfolio pitfalls of current financial structures but maintains

cooperative benefits and membership incentives. The advantages of an explicitly partitioned approach to the practical application of cooperative theory will be discussed. It is hoped that these advantages will be applicable to extension economists in their interaction with cooperative organizations and to academic economists in their pursuit of a more consistent theory of cooperatives.

The remainder of this paper is divided into five chapters. Chapter 2 reviews accepted agricultural cooperative theory with respect to member-cooperative resource allocation. Chapter 3 develops a descriptive model of the member-cooperative relationship in a real-world context and identifies failures of the relationship to account for property rights and patronage incentives in the cooperative organization. Chapter 4 discusses possible causes and consequences of the failure of cooperative theory and practice to account for property rights. Chapter 5 offers the framework of club good theory as a means of restructuring selected cooperative activities to provide meaningful property rights and patronage incentives. Chapter 6 provides a review of results and conclusions.

CHAPTER 2. COOPERATIVE THEORY

An agricultural cooperative is generally defined (Schrader et al., 1985) as a farm supply or marketing business where the following conditions hold true:

1. The business is owned and controlled by the agricultural producers who utilize it;

2. More than half of the business' activity is generated through member patronage;

3. Returns over cost are distributed on the basis of patronage;

4. Returns on capital are limited by legal constraints.

The traditional view of this is that a cooperative consists of a small number of farmers who have personally joined together as a group to improve their well-being as farmers. This may be done by ensuring their access to critical input and output markets, by facilitating access to beneficial services not provided elsewhere, or by coordinating production and marketing activities. In many cases, cooperative formation is a response to either a monopolistic noncooperative firm or a situation in which no market access exists. In these situations the cooperative provides a competitive yardstick for transactions made by both the members and the nonmembers in the cooperative's area.

The traditional view has had two common variants. One variant viewed the cooperative as a vertically integrated extension of the member farms. This work has

generally been identified with work done by Phillips (1953). The other variant, which is often identified with the work of Helmberger and Hoos (1962), has viewed the cooperative as a separate firm which functions as an independent risk-bearer under separate management.

Although much effort was expended in the 1950s and 1960s arguing the merits of each approach, Sexton (1984) has shown that both approaches are compatible in cases where each individual member's patronage level is so small as to be insignificant with respect to the aggregated patronage of the entire membership. Under this conditions the Cournot-Nash behavior that underpins the vertical integration theories and the price-taking behavior that is a basis for independent firm theories lead to the same result. Sexton's result depends upon earlier work by Trifon (1961).

It appears that the choice of theoretical vehicles in this debate has been primarily influenced by the questions asked. Investigations into how farm units financed cooperatives or how cooperatives formed were generally placed in the context of the vertically integrated firm. This facilitated the link between individual farm interests and cooperative capitalization. Questions concerning the operating efficiency of cooperatives have generally been framed in terms of the independent firm. This has allowed theorists to focus on input and output relationships while abstracting away from membership incentives and property rights. Because this research pursues portfolio questions, property rights, and the resulting patronage incentives between the cooperative and its membership, the discussion here will be primarily grounded in terms associated with the vertically integrated firm.

Under the integrated firm approach, farmers

developing a cooperative are primarily attempting to
enhance their own individual farm incomes rather than
creating a profitable independent firm. The cooperative
business is not treated as an entity separate from the
activities of its individual members, each of whom behave
as if the cooperative activity is a direct extension of
their farm business.

A Simple Resource Allocation Model

The first attempt at a detailed presentation of
resource allocations between member farms and the
cooperative was done by Phillips (1953). Phillips viewed
the cooperative as a voluntary federation of independent
farmer-members. He explicitly identified member investment
in a cooperative marketing or supply venture as an input
allocation decision. Individual cooperative members were
assumed to weigh the expected return on investment in
personal farm production enterprises against the expected
return on investment in the cooperative enterprise.
Individual cooperative members, if they behave rationally,
will invest their capital resources in the enterprise that
shows higher expected marginal returns to investment.

In addition, the member has an incentive to transfer
existing investments from an enterprise with relatively
low expected marginal returns to an enterprise with
relatively high expected marginal returns on investment
until the expected marginal returns on both enterprises
are equated. In other words, Phillips assumed that
cooperative members invest resources in their individual
and cooperative enterprises in much the same manner as
speculators invest in stock for a return on equity.

Farm production in the presence of a simple supply
cooperative could be represented by the function

$$m = m(k, x_{ji}) \qquad (1)$$

where

m   is the product marketed by the cooperative
members;

k   is the input supplied by the cooperative;

x_{ji} is a vector of j inputs utilized on i member farms
where $j = (1,2,3,\ldots,z)$ and $i = (1,2,3,\ldots,n)$.

Because farm input k is provided by the cooperative,
it is further characterized by

$$k = k(K, x_{jc}) \qquad (2)$$

where

K   is the source input that the cooperative uses to
produce k;

x_{jc} is the vector of j inputs utilized by the
cooperative in transforming K into k.

The transformation of K into k is not necessarily a
change in form through processing or conditioning. It may
be the process of commodity transfer through time or
space, or of breaking large lots into smaller quantities.
Cooperative transformations in both supply and marketing
functions can be transformations in time, form, and/or
space.

Because the cooperative is viewed as a direct
extension of farm operations, the farm production
function, m, can be generalized as

$$m = m(K, x_{jc}, x_{ji}) \qquad (3)$$

allowing us to construct a net revenue function

$$r = P_m m(K, x_{jc}, x_{ji}) - (P_K K + x_{jc} w_j) - x_{ji} w_j \qquad (4)$$

where

r   is the net revenue received from farm sales of m;

P_m is the market price received by cooperative members for m;

P_K is the market price the cooperative pays for K;

w_j are the market prices for all inputs x_j regardless of where they are utilized.

It is assumed that all prices are fixed and known. Differentiating the net revenue function gives

$$dr = P_m(m_K dK + m_{x_{jc}} dx_{jc} + m_{x_{ji}} dx_{ji}) - (P_K dK + w_j dx_{jc}) - w_j dx_{ji} \qquad (5)$$

Setting the differential equal to zero shows that the marginal revenue of farm production must equal the sum of the marginal cost of cooperative production of k and the marginal cost incurred at the farm level for the equation to be maximized.

Taking the first order conditions for the individual inputs shows

$$\frac{\partial r}{\partial K} = P_m m_K - P_K = 0 \qquad (6)$$

$$\frac{\partial r}{\partial x_{jc}} = P_m m_{x_{jc}} - w_j = 0 \tag{7}$$

$$\frac{\partial r}{\partial x_{ji}} = P_m m_{x_{ji}} - w_j = 0 \tag{8}$$

From these equations it follows that the ratios of marginal value products of any combination of inputs x_j and K (the marginal rates of technical substitution) must equal the corresponding ratios of input costs w_j and P_K (the marginal rate of transformation) for net farm production revenue to be maximized. This is true regardless of whether the input use is on one of the i individual farms or at the cooperative operation. At the maximum net return, the marginal value products for incremental increases in utilization of any input at any location are equal.

The same results hold for a marketing cooperative that is viewed as a vertically integrated firm. In the marketing context, however, it is cooperative net revenue that is maximized and input k comes to the process in its final form.

$$M = M(m, x_{jc}) \tag{9}$$

where

M   is the product marketed by the cooperative;

m   is the farm output that is now marketed through the cooperative rather than at the farm level.

However, m is still produced under the production

function that appears in equation 1. This allows M to be generalized

$$M = M(k, x_{ji}, x_{jc}) \qquad (10)$$

In this production function, however, input k is purchased from a noncooperative source, so K is no longer a variable in the system.

A net revenue function can again be constructed

$$R = P_M M(k, x_{ji}, x_{jc}) - (P_k k + w_j x_{ji}) - w_j x_{jc} \qquad (11)$$

where
  R   is the net revenue from cooperative marketing;
  P_M is the market price that cooperative receives for its output, M;
  P_k is the market price that individual farm-members pay for input k.

Setting the differential of this net revenue function equal to zero and taking the first order conditions would give similar results to those obtained for the supply cooperative discussed above.

In order for any given member to maximize profits through individual operations and the utilization of the joint plant in this model, it is necessary that all other members' joint plant utilization levels are fixed and known. The individual entrepreneur considers his cost of utilization of the joint plant as the addition to joint operating costs engendered by his added utilization over and above the level of utilization that would exist in his absence. In essence, the Phillips model assumes that each

individual member engages in Cournot-Nash behavior to
maximize total operational profits from the entire
integrated process.

In this simple cooperative portfolio, the
cooperative's capital needs are provided ex ante by the
individual members on the basis of each member's
anticipated activity (patronage level) within the
cooperative. Any discrepancies between anticipated and
actual patronage are accounted for when the proceeds of
the joint undertaking are distributed back to the members
(on a patronage basis). Cooperative operations are
transaction-based. Cooperative investments are relatively
short-term. Cooperative actions are financed and
undertaken on an individual basis. Under this view of
finance, only active members have a capital investment in
the cooperative, as capital is provided up-front in
anticipation of patronage.

Average Cost and Patronage-based Distributions

In this simple exposition of the farm/cooperative
portfolio, the farm incentive and financial commitment to
the cooperative seem relatively clear cut. However, there
is a question of the pricing structure for the
cooperative's output and the resulting patronage
incentives to farmers. Aresvick (1955) pointed out that
cooperative members are faced with average (rather than
marginal) costs and revenues in their transactions with
the joint plant or cooperative in this model. Trifon
(1961) went farther to point out that the individual
member is faced both with the average cost of the marginal
transaction and the change in the average cost caused by
that transaction as it affects all previous transactions.

These arguments proceed from the distribution of all

cooperative returns on a patronage-share rather than on an investment-share basis. If the cooperative operates at the point of minimum average cost this presents no complications; as average cost equals marginal cost at this point. When inefficient markets result in operations where average cost is lower than the margin, there is an incentive for members to over-utilize their joint plant.

The recognition and use of average costs rather than marginal costs as the cooperative decision variable was a sharp break with the accepted theory of the private firm. Some writers have assumed that, over the long run, cooperatives would restrict membership, if necessary, to maintain volumes at optimal average cost (Helmberger and Hoos, 1962; Trifon, 1961).

The average-cost problem at this level can be argued to be a matter of perception. Because capital is provided ex ante in proportion to anticipated patronage, patronage-based distribution of surplus is equivalent to investment-based distributions if patronage levels are accurately forecast. It can also be argued that farmer-members at this level can distinguish between price benefits and investment benefits because they consciously invest in the short-term cooperative activities that result in the surplus.

The Model and Established Cooperatives

The simple portfolio model provides a useful picture during the initial organizational phase of many cooperatives. Frequently, however, it has little in common with the operation and member relationships that exist in the cooperative that has been in business for an extended period of time. Consequently, it does not provide an accurate description of the relationships that

currently characterize midwestern grain marketing and supply cooperatives. These cooperatives are large professionally managed operations with substantial permanent capital investments in grain storage and loading facilities, agricultural supply inventories, and specialized equipment pools. In many cases, these cooperative business enterprises are the major private sector employers in their respective communities.

These factors make portfolio issues, investment, and membership incentives more problematic. Ongoing cooperatives need a continuous system of investment as membership rolls over and the institution grows. In the noncooperative firm this function can be met through the sale of equities in the open market where current owners can transfer shares to future owners or additional stock can be issued by the firm. This is not an option for cooperatives, however, where ownership is legally limited to patrons and stocks are continuously valued at par.

Cooperative members lack incentives to invest in cooperatives because there is no investment-based return. Because cooperative surplus is distributed on a patronage-share rather than an investment-share basis, the individual member has an incentive to maximize cooperative utilization and minimize investment. In addition, the absence of a market for cooperative shares and continuous share valuation at par prevent the individual member from realizing any direct capital gains or suffering any losses from the investment's appreciation or depreciation over time.

The result is an incentive for individual members to become free-riders by minimizing their contributions to the cooperative's capitalization. Cooperatives in the Midwest and elsewhere have addressed this problem by instituting the practice of retaining a portion of the

surplus generated by cooperative operations. This
provides a rudimentary means of accumulating capital on
the basis of current patronage. However, without a set of
mechanisms in place to maintain capital proportional to
patronage, this will result in a set of overinvested
senior members and a set of under-invested junior members
as patronage declines for members who are exiting the
cooperative (generally older members leaving active
farming).

A recent article by Knoeber and Baumer (1983)
attempts to explain the retention of cooperative surplus
(retained earnings) as an active decision on the part of
farmer-members to eliminate the free rider problem.
Knoeber and Baumer develop a mathematical framework which
demonstrates how average income flows and income flow
variances determine the expected investment return to the
cooperative member for both the individual enterprise and
the cooperative unit. These expected returns then
determine a joint decision by the membership to forego the
cash distribution of a portion of the cooperative
operating surplus.

While the Knoeber and Baumer solution provides a
detailed model of portfolio decision making that is
inclusive of risk and variance, it does not directly
address the problem at hand. First, the model seeks to
explain a portfolio investment decision involving two
enterprises in which costs and profits cannot be
separated. By leaving no exit option (avoiding the
inclusion of game theory), the Knoeber and Baumer argument
faces an independence problem that had been pointed out by
Trifon (1961; 226),

No procurement cooperative faces a revenue function
independent of its costs (including payments to

members' capital); and while a marketing cooperative
does face such an independent function, there does not
exist an independent revenue function for the plants
that patronize it. Consequently, it is hard to
conceive a comparison of the marginal value products of
a resource between a cooperative plant and a plant
which patronizes it.

From the farmer-member perspective, the distinction
between farm and cooperative returns does not exist at
this level.

Knoeber and Baumer have also oversimplified the farm-
members' decision-making environment. In assuming that
retained surplus is actively treated as direct cooperative
investment by the individual farmer-members, they
implicitly assume that all surplus (distributed or
undistributed) is directly allocated to the membership;
providing the individual with some claim against the
cooperative in return. In the real world, a significant
proportion of cooperative operating surplus may be
retained and, in many cases, is not allocated to the
membership. Short of cooperative dissolution, the
individual member has no claim upon such surplus. The
Knoeber and Baumer model also depends upon the implicit
assumption that the return of capital (in addition to
return on capital) occurs at some point in the future.
This, too, is untenable in the face of unallocated surplus
retention. Finally, the model requires the assumption
(again implicitly) that member equities are in some way
proportional to patronage at the model's starting point.

In the Midwestern grain cooperative this is not the
case. In nearly all of these institutions, the
memberships are second- or third-generation and have not
provided capital up-front in anticipation of patronage.

Most have established their membership for a nominal fee
(often less than $100) and earn their capital investment
through future patronage (Junge and Ginder, 1986).
Surplus is not entirely credited to individual farmer-
members. Finally, members do have the option of exiting,
reducing patronage levels, or withholding patronage
altogether; and many regularly exercise one or more of
these options.

Summary

This chapter has provided a generally accepted
definition of the agricultural cooperative and a
discussion of the traditional view regarding membership
incentives for cooperative formation. An early resource
allocation model (the Phillips model) is presented and
analyzed, and the average cost problem entailed by
patronage-based surplus distributions is introduced.
Finally, the underlying assumptions of this model are
compared with existing relationships between farmer-
members and their cooperatives in the midwest. It is
concluded that while the traditional model is still a
useful tool for conceptualizing cooperative formation, it
is not sufficient to explain current membership incentives
within the midwestern grain cooperative.

CHAPTER 3. A DESCRIPTIVE COOPERATIVE MODEL

Within actual organizational structures, initial investments and the distribution of surplus in most Midwestern grain cooperatives cannot be simplified to the point where it reasonably fits the portfolio decision models outlined above. It may be instructive to look at the following descriptive model of current cooperative investment and surplus features in order to understand the problems that it presents.

Cooperative Investment

Cooperative investments come from a pool of capital that each potential member allocates to farm production and marketing operations. In this sense, we look at cooperative investment as part and parcel of the farm decision process as an integrated operation. This analysis is not designed to investigate the global portfolio decisions of the potential members. Any capital the potential member allocates to nonfarm uses is not considered here. The model assumes a decision to invest in farm operations as a requirement for our population of potentials.

The make-up of the investment pool that we are considering is outlined here.

$$I = \sum_{i=1}^{n} I_i \tag{12}$$

where

I   is the total farm investment pool aggregated over potential membership;

I_i is the individual farm investment pool of the ith farmer.

$$I_i = I_{Ci} + I_{Fi} \qquad (13)$$

where

I_{Ci} is the ith farmer's allocation of the farm investment pool to the cooperative;

I_{Fi} is the ith farmer's allocation of the farm investment pool to the ith farm.

$$I_C = \sum_{i=1}^{n} I_{Ci} \qquad (14)$$

where

I_C is the total cooperative investment aggregated across the entire membership.

$$I_{Ci} = I_E + \sum_{T=1}^{y} S_{Ti} \qquad (15)$$

where

I_E is the one-time cash-up-front membership commitment required from each cooperative member;

S_{Ti} is the ith farm-member's share of any cooperative operating surplus from a given operating period, T, that is retained by the cooperative.

The implications of equation 15 will become more apparent below where the distribution of cooperative operating

surplus is explained. At this point it is sufficient to note that the cooperative is able to exercise substantial discretion to influence both the absolute and relative sizes of the components of I_{ci}.

Cooperative Returns to the ith Farm

The cooperative provides excludable membership returns in three forms. The first is the accumulation of savings in the event that the cooperative provides any price advantages to its membership relative to prices available from competing noncooperative firms. The second is the accrual to membership of any surplus earnings that the cooperative generates through operations. The third is embodied in access to services or markets that the farm-member would forgo in the absence of the cooperative.

Access to services and markets can be conceived as an extension of price advantages. This is true even where access to goods and services is a major incentive to cooperative membership because noncooperative firms do not exist or are ineffective. There is a price advantage to an accessible service at an affordable price versus the infinite price of an inaccessible service. While this is an extreme, it does allow the reduction of direct advantages to two forms, price advantages and surplus, that are conceptually easier to work with.

In cases where the market provides for prices that exceed average costs, the cooperative has extensive latitude in determining whether membership benefits are in the form of price advantages or surplus. As we will see later, this directly affects the ownership and patronage incentives of the farm-members.

The successful cooperative also provides an important public return to both members and nonmembers by forcing

competition and the resulting pricing and behavior on other dominant firms that could otherwise pursue monopolistic or oligopolistic trade practices. This is often referred to as the cooperative yardstick function. Because this benefit is freely available to all, regardless of cooperative membership, the current model does not deal with it as a membership return.

The following equations outline the structure of membership incentives and their sources in each form. Both forms need to account for the differences in flows between marketing and supply activities undertaken by the cooperative.

Price Advantages

Price advantages for cooperative marketing activities are outlined in the following equations.

$$P_m - P_{mo} = A_m \qquad (16)$$

where

P_m is the output price offered to farms by the cooperative;

P_{mo} is the output price offered to farms by competing noncooperative firms;

A_m is the price advantage (if positive) or disadvantage (if negative) from patronizing the cooperative.

$$A_{mi} = A_m m_i \qquad (17)$$

where

A_{mi} is the total benefit to the ith farm from price

advantage A_m;

m_i is the quantity of ith farm's output sold through the cooperative.

Price advantages for the farmer utilizing cooperative supply facilities are outlined below:

$$P_{ko} - P_k = A_k \qquad (18)$$

where

P_{ko} is the supply price offered to farms by noncooperative firms;

P_k is the supply price offered to farms by the cooperative;

A_k is the price advantage (if positive) or disadvantage (if negative) from patronizing the cooperative.

$$A_{ki} = A_k k_i \qquad (19)$$

where

A_{ki} is the total benefit to the ith farm from price advantage A_k;

k_i is the quantity of ith farm's input purchased through the cooperative.

Surplus Generation

Accounting for cooperative surplus accruing to the ith farm is complicated by distribution and property rights as well as by supply and marketing operations. The next section provides a simplified outline of the sources of cooperative surplus. The distribution of this surplus,

as well as notes on this distribution's attendant membership rights, are supplied in the subsequent section.

Surplus generated from marketing activities are derived from

$$m = \sum_{i=1}^{n} m_i \tag{20}$$

where

m is the total member-farm output marketed by the cooperative.

$$M = M(m, x_{jc}) \tag{21}$$

which is identical to equation 9 above. Again, it should be noted that the transformation of commodities by both supply and marketing cooperative activities is not necessarily a change in form. These transformations can be utility enhancing movements through time and space as well as changes in form.

Multiplying the product marketed by the cooperative, M, by its market price, P_M, and subtracting cooperative transformation costs, C_M, and initial raw product payments (if any) made to farmer-members, $P_m m$, results in cooperative operating surplus, S_m.

$$P_M M - (P_m m + C_M) = S_m \tag{22}$$

given

$$C_M = C_M \sum_{j=1}^{z} (x_{jc} w_{x_j}) \qquad\qquad (23)$$

where

    C_M are the costs to the cooperative of transforming m into M and of moving M forward into the market channel from the farm;

    S_m is the total cooperative surplus generated by marketing transactions.

Moving forward into the market channel does not refer to a futures market. In defining forward and backward movements in the market channel from the farm cooperative perspective, we view the agricultural input, production, and output markets as a straight line or channel. Products move forward through the channel as they progress towards the final consumer. The farm stands in this channel and agricultural inputs and supplies flow to it from the rear. The farm sells its output forward into the channel. If the farm belongs to a cooperative, the cooperative acts as the farm's agent in these transactions. As a result, forward into the market channel, for the purposes of this discussion, is the movement of farm output to the first postcooperative stage of processing or consolidation. Backward into the market channel is the final precooperative source of agricultural inputs.

Finally, the individual farmer-member's share of cooperative operating surplus is distributed on a patronage-share basis. Total cooperative operating surplus, S_m, is multiplied by the ratio of the individual farm's raw product deliveries, m_i, to the aggregate raw product deliveries of all farmer-members, m.

$$S_{mi} = S_m\left(\frac{m_i}{m}\right) \qquad (24)$$

where

    S_{mi} is the amount of S_m accruing to the ith farmer.

Surplus generation from cooperative supply operations are similar to those in the marketing context.

$$k = \sum_{i=1}^{n} k_i \qquad (25)$$

where

    k is the total quantity of farm input k purchased from the cooperative.

$$k = k(K, x_{jc}) \qquad (26)$$

which is identical to equation 2, above.

$$P_k k - (P_K K + C_k) = S_k \qquad (27)$$

where

    P_K is the price paid by the cooperative for the input, K, obtained from entities backward in the market channel;

    C_k are the costs to the cooperative of transforming K into k and moving k through the market channel to the farm;

S_k is the total cooperative surplus generated by supply transactions.

$$S_{ki} = S_k \left(\frac{k_i}{k} \right) \tag{28}$$

where

S_{ki} is the amount of S_k accruing to the ith farmer.

Summing the surpluses generated by both the supply and marketing operations gives

$$S = S_k + S_m \tag{29}$$

where

S is the total cooperative operating surplus.

$$S_i = S_{ki} + S_{mi} \tag{30}$$

where

S_i is the amount of total cooperative surplus that accrues to the ith member.

Both of the above equations assume that the cooperative is engaged in both supply and marketing operations. The case for cooperatives engaging in only one operation can easily be represented by setting one of the component parts equal to zero.

In general, cooperative surplus generation is not recognizable to the farm-member at the transaction stage. The assumption that the ith farm-member's patronage level

is insignificant relative to total patronage, which
justifies the assumptions of either price-taking or
Cournot-Nash behavior, results in the ratios m_i/m and k_i/k
(equations 12 and 16, respectively) approaching zero.
These ratios determine the share of cooperative operating
surplus that each member, i, realizes. From this we can
assume that the farmer-member behaves as if S_{mi} and S_{ki}
each equal zero.

This would indicate that farm-members do not directly
recognize their share of cooperative surplus in general.
At the individual transaction level, the lack of surplus
recognition would be even more pronounced. As a result,
it can be expected that farm-members have strong
incentives to be price-motivated at the transaction point.
It is expected that members patronize cooperatives because
of actual and immediate price advantages. These
advantages may exist as actual price differentials on
identical products or as quality or service differentials
on similarly priced products. Where the cooperative
provides a price disadvantage, the farm-member has an
incentive to do business where the lowest immediate
transaction price is available.

Taken together, a zero expectation of surplus and
price-motivation at the point of transaction provide
reasonable support to the found-money argument of Junge
and Ginder (1986). This states that member equity
generated in the form of cooperative surplus is capital
that would not be available to the farm-member had that
farm-member elected to do business with a noncooperative
investor-owned firm.

In the noncooperative firm, surplus would accrue to
the stockholders on an investment-share basis and the
patron would receive no refund. This results in farm-
members treating any cooperative surplus distributions as

found-money. The farm-member recognizes no direct
investment in surplus generation, and surplus retention by
the cooperative entails no on-farm opportunity costs. In
reality, surplus is not predictably available for use in
other on-farm investment; and if the surplus is retained
by the cooperative, farmer-members are no worse off than
they would be if they had patronized noncooperative firms.

By the same reasoning, the loss of retained surplus
by the cooperative also entails no immediately
recognizable on-farm opportunity cost. It was noted
earlier that where the market allows prices that exceed
average cost the cooperative has significant leeway in
determining whether membership returns take the form of
price advantages or operating surplus. In situations
where the cooperative has retained surplus in the form of
member equity or can monetize physical capital through
collateralized debt this is also true. Even where prices
received by the cooperative are below the level of average
costs this option exists in the short run. In these
cases, the cooperative can consume equity (direct
investments or retained surplus from previous periods) in
order to maintain price advantages and membership
patronage levels.

Farm-member incentives in the case of equity
depletion at the transaction point, however, are the same
as in the case of surplus generation. The assumptions of
price-taking or Cournot-Nash behavior result in the farm-
member not recognizing transaction effects on equity. It
would be expected that even in the case that a farm-member
did recognize that cooperative pricing was eroding the
cooperative capital base, the assumed behavior would still
prevent that individual from foregoing immediate,
recognized, and accruable price advantages at the
cooperative's expense.

Surplus Distribution

Cooperative surplus can be split at least four ways for the purposes of distribution. A simplified outline of surplus distribution with observations on attendant property rights is provided below.

$$S = S_D + S_T \qquad (31)$$

where

S_D is the amount of cooperative surplus that is distributed to the membership in cash;

S_T is the amount of cooperative surplus during any operating period that is retained for cooperative use as either allocated equity or as unallocated equity.

In this first division, a portion can be distributed to the farm-member as a qualified cash distribution (S_D). The second portion, S_T, is retained by the cooperative. This retention can take a number of forms which are outlined below. Each form has different implications with respect to the farm-member's current income and cooperative property rights.

$$S_T = S_Q + S_N + S_U \qquad (32)$$

where

S_Q is the amount of qualified cooperative surplus allocations to the membership that is retained by the cooperative;

S_N is the amount of nonqualified cooperative surplus

allocations to the membership that is retained by the cooperative;

S_u is the amount of retained cooperative surplus that is not allocated to the membership.

The distinction between qualified and nonqualified allocations of surplus hinges on the cooperative's legal status as a tax exempt extension of the farmer-member's individual farming operations. The cooperative qualifies for this tax exempt status to the extent that it carries out transactions at cost and promptly refunds operating surpluses on a patronage basis. For an allocation or refund of operating surplus to be qualified and exempt from taxation as cooperative income, three conditions must be met.

First, the distribution must be made within nine months of the end of the cooperative's fiscal year. Second, at least twenty percent of the allocation must be distributed to patrons in the form of cash. Finally, the cooperative must give the farmer-member written notice of the allocation's tax status when the allocation is made.

Under these conditions, surplus allocations qualify as transaction refunds and are not taxed to the cooperative, regardless of whether the cooperative does retain up to eighty percent of the allocation as to the membership's stock of equity. The full value of qualified allocations, regardless of the portion received in cash, is taxable as current income to the farmer-member that receives the allocation.

If these conditions are not met, surplus allocations do not qualify as transaction refunds and are taxed to the cooperative as ordinary business income. At whatever future date these nonqualified allocations are redeemed to the patrons, the cooperative receives a tax credit and the

allocation becomes an income tax liability to the farmer-member.

The total cooperative surplus, regardless of how it is allocated, and its component parts can be represented in the form of individual farmer-member shares.

$$S_i = S_{Di} + S_{Qi} + S_{Ni} + S_{Ui} \tag{33}$$

where

S_{Di} is the amount of qualified surplus received by the ith member in cash;

S_{Qi} is the amount of retained qualified cooperative surplus that is allocated to the ith member;

S_{Ni} is the amount of retained nonqualified cooperative surplus that is allocated to the ith member;

S_{Ui} is the amount of retained and unallocated cooperative surplus corresponding to the ith member's patronage share.

The retention of surplus by the cooperative in the form of qualified allocations of equity shares to the farmer-member (S_Q) results in a current tax liability to the farmer-member. Such surplus also earns no return, is not marketable, and does not fluctuate with asset value. Finally, it is generally redeemable at the cooperative's, rather than the farmer-member's discretion.

Retained surplus allocated to farmer-members as nonqualified allocations (S_N) provides a recognizable claim on the cooperative, but avoids placing an immediate (and, perhaps, partially unfunded) tax liability on the farmer-member. As is the case with S_Q, however, the farmer-member's claim against the cooperative can generally be exercised only at the cooperative's discretion.

The retention of either qualified or nonqualified allocations by the cooperative in the form of member equity shares causes a present value problem for the member. Because the equity is not marketable, pays no return, and is continuously valued at par it creates a present value problem in the portfolio. Its value is continuously eroded during inflationary periods, and its value increases during periods of deflation.

The fourth option for distribution is cooperative retention of surplus without allocation to the membership (S_u). This option, like S_N, places the current tax liability on the cooperative rather than on the farmer-members. However, S_u differs from S_N and S_Q in that it provides the farmer-member with no identifiable future claim against the cooperative. If an identifiable future claim were present, S_u would also result in a present value problem for the member.

The preceding equations show that while surplus generation is a straight-forward derivation of costs and prices, its distribution is complex. Typically, the division of surplus among these categories is not placed before farmer-members as an option to approve or deny. There is no continuum of choices by which to mediate individual preferences as is assumed by Knoeber and Baumer (1983). In fact, most cooperative by-laws require that the board select a surplus allocation alternative and present the result to the membership after the fact. Membership claims on cooperative surplus and the resulting patronage incentive structure are clearly not the foundation for strong farmer-member interest in affecting surplus distribution.

The assumptions of price-taking and Cournot-Nash behavior again lead to the conclusion that the size of the individual farmer-member's operation relative to the group

as a whole makes the individual's impact on group decisions negligible. Even where farmer-member control is on a one-member-one vote basis rather than on an investment or patronage basis, the size of the membership group leads to this result. It should be assumed that the conclusions of Mancur Olson's large-group analysis (Olson, 1965) are applicable in this situation. The representative farmer-member views cooperative decisions and voting outcomes as public goods. The benefits that result from any individual effort to affect these outcomes accrue primarily to non-participants. Each member has an incentive to minimize individual effort at affecting joint outcomes.

In cases where individual farmer-members do have enough patronage to influence cooperative operations, strategic action by individuals may indirectly affect cooperative management decisions. Such decisions may be swayed by threats or perceived threats to either exit or withhold patronage. Farmer-members with relatively large patronage shares have incentives to influence cooperative decisions in this manner as pointed out by Trifon (1961).

It may also be worthwhile to point out the difference between the incentives of a representative farmer-member and a farmer-member with aspirations towards the cooperative's board of directors. Election to the board of directors may result in status or value apart from the decision making process for certain individuals. This, again, results in a group of members that have an atypical interest in cooperative decision making. It may be that the median-voter behavior of Knoeber and Baumer (1983) is relevant in situations where every member wants a board seat. This situation may also, however, lead directly back to Olson's small-group analysis, where all members are associated closely enough to recognize direct returns

from group participation and individual attempts to influence the decision-making process.

Notwithstanding these caveats, observation indicates that in the usual cooperative context the representative farmer-member does not directly influence cooperative decision making. Coupled with controlled choice and the found-money nature of the assets involved, this reinforces the conclusion that the individual farmer-member is not actively involved in the surplus distribution decision.

In order to complete the investment circuit, it is useful to examine where surplus returned to the farmer-member's portfolio goes. Equations 34 through 37 show the destinations of the various surplus categories at the close of the cooperative accounting period. There is very little incentive for the individual farmer to redirect surplus distributions to destinations other than those shown here.

$$S_{Di} \rightarrow I_{Fi} \tag{34}$$

All distributed surplus either goes out of the farm investment portfolio or remains invested at the individual farm level. There is no investment incentive for the farmer-member to unilaterally provide capital to the cooperative.

$$S_{Qi} \rightarrow I_{Ci} \tag{35}$$

$$S_{Ni} \rightarrow I_{Ci} \tag{36}$$

$$S_{Ui} \rightarrow I_{Ci} \qquad\qquad (37)$$

All retained surplus increases the farmer-member's cooperative investment whether or not it is allocated to the farm-member.

Allocated retained surplus becomes an immediate farm-member tax liability if it meets the rules for qualified refunds listed previously. It does not become a tax liability if it is allocated as a non-qualified refund (in which case it is an immediate tax liability for the cooperative). While allocated retained surplus provides the farm-member with a claim against the cooperative, this claim can only be exercised at the discretion of the cooperative. Unallocated retained surplus provides the farm-member with no direct claim on the cooperative and bestows no ownership rights short of the dissolution of the institution.

Given the found-money nature of cooperative surplus, the retention of operating surplus by the cooperative cannot be equated with farm-member investment. This is the case even when a portion of the retained surplus is allocated to the farm-member. While the farm-member will receive payment at a future date, the decision to invest is strictly out of the farm-member's hands. It is a passive rather than an active investment. Recall that

$$I_{Ci} = I_E + \sum_{T=1}^{y} S_{Ti}$$

and

$$S_{Ti} = S_{Qi} + S_{Ni} + S_{Ui}$$

This results in

$$I_{Ci} = g(I_E, S_{Qi}, S_{N1}, S_{Ui}) \tag{38}$$

To the extent that the cooperative successfully skews the components of farmer-member investment away from I_E, this allows it to finance its operations without imposing a recognizable opportunity cost on its farmer-members; assuming that any current tax liabilities accruing to the farmer-member as a result of qualified surplus allocations are covered by sufficient cash distributions.

A short-term capital rotation cycle in which all cooperative capital is continuously adjusted to membership patronage levels would limit this ability. In the extreme, instantaneous capital rotation would require new members to fully fund their memberships in order to finance either the out-rotation of exiting members or the expansion required by increased patronage.

The reality, however, is that most cooperatives have no strict adherence to any instantaneous or short-term capital rotation plan that is geared towards patronage-capital equity. In those cases where such plans exist, the appreciation of assets and the retention of unallocated retained surplus prevents the complete rotation of capital in any event.

A short-term capital rotation also results in two disadvantages for the cooperative. Retention of operating surplus is arguably the cheapest source of capital available to the cooperative. A restrictive rotation of this capital would increase the capital costs of operation and expansion. Instantaneous capital rotation leaves no one with an incentive for the maintenance of capital or to hold investments between transactions.

The appreciation of assets that is not accounted for by the value of capital stock (either up-front investments or allocated retained surplus) and the retention of unallocated capital support the statement that the cooperative member "... likely does not even know how much he or she has invested in the cooperative system." (Ratchford, 1985; 133). It also provides the cooperative a means to generate an endowment that is available to relatively under-invested members while they build their investment through patronage. This endowment, as opposed to a conscious decision by the membership to let the cooperative to retain surplus, has allowed the typical midwestern cooperative to reduce the free-riding problem caused by the patronage-based distribution of surplus.

In moving away from I_E and towards S_Q, S_N, and S_U for financing the cooperative, the farmer-member's decision to invest becomes a relatively automatic consequence of patronage decisions. Initial cooperative investments generally require less than $1000 and, in many instances, are possible for $100 or less. Even these nominal values can often be covered with retained patronage refunds in many grain cooperatives.

All other cooperative equity is generated from surplus, found money. In effect, I_E has become an access fee to the farmer-member. Its small value relative to total farm production expenses, coupled with any positive level of risk aversion on the farmer-member's part, result in I_E being inelastic with respect to the potential farmer-member's expectations of cooperative price advantages.

Although the endowment is the result of passive investment and gives the farmer-member no immediately actionable claims, it provides several advantages to the cooperative which are generally in the farmer-members'

interests. First, it allows the cooperative to solicit farmer-memberships without requiring large recognizable equity investments. This allows the cooperative to maximize its pool of patrons and its market penetration, and reduce average costs. Lower average costs are important to the representative grain cooperative because of the relatively large capital investment required for such an operation. Major fixed costs make grain marketing, handling, and storage facilities decreasing average cost operations. The bulk commodity nature of grain puts spatial limits on the cooperative's market area. As a result, the cooperative is very sensitive to developing a concentrated patronage pool within this area.

Second, the endowment provides the cooperative with a degree of operational independence. This independence results from three factors, all of which are a direct result of eliminating an active farmer-member choice from the investment decision.

Operating independence is immediately enhanced by reducing the conservative attitude that results from the farm-member consciously deepening their investment commitment to primary agriculture. It must be remembered that direct investment in the cooperative is not an act of diversification on the part of the farmer-member. The lack of independent cost and revenue functions between the farm and cooperative plants result in an increasing variance in the total return of any individual farmer-member's global portfolio as cooperative investments are increased. By making the cooperative investment process a passive act on part of the farmer-member, the cooperative reduces the conservatism that such capital deepening can be expected to generate. This movement to a passive found money investment frees the cooperative to engage in more innovative or risky activities on the farmer-members'

behalf.

It should be noted that this alleviation of member conservatism is not the result of increasing the diversity of the farmer-member portfolio. Rather, it is the result of the farmer-members not actively considering the depth of their commitment to the cooperative. The farmer-member has generally made a passive investment as a consequence of a price-motivated patronage decision. The member would have been no better off doing business at similar prices with a noncooperative firm that kept any business profits. The cooperative surplus provides a finite possibility that surplus distributions will be received by the farmer-member at some future date.

The accumulation of unallocated surplus by the cooperative also partially alleviates the truncated investment horizon of individual farmer-members. Because cooperative equity shares have no market, the expected current value of future cooperative earning capacity is not embodied in the redemption value of those shares. As such, the investment horizon of the membership is limited to their periods of active patronage. This tendency towards a near-sighted temporary capitalization is again alleviated by making farmer-member investment a passive act.

Finally, by making investment and capitalization primarily a function of retaining surplus, much as a non-cooperative firm retains earnings, the cooperative has eased its problem of capital access. While the cooperative continues to lack the ability to generate capital by issuing new equity shares to the public, it does not require an ex ante "passing of the hat" to increase its capital base. The same is true of maintaining the capital base in the event of an operating loss. In the absence of an endowment, operating losses

would have to be made up through assessments against the membership. An endowment makes it easier for the cooperative and the farmer-members to manage finances in the face of ordinary business fluctuations.

Capital access is also increased to the extent that the endowment makes it easier for the cooperative to attract debt capital for long-term projects. While the cooperative does have a fixed future commitment to pay out allocated retained surplus (which noncooperatives do not), its ability to retain surplus increases its debt-carrying capacity beyond what would exist in the absence of surplus retention. The extent to which the cooperative is able to retain unallocated surplus improves this position even further. In this case, potential lenders can count on cooperative revenue flows and surpluses as a source of repayment, much as they would view the revenue and profits from a non-cooperative firm.

Cooperative dependency upon the endowment, however, also creates one major disadvantage. By making investment a passive act, the cooperative does not provide its farm-members with an active ownership interest. Cooperative membership is, effectively, a free good. At no cost to the prospective member, that member obtains rights to utilize all of the facilities of the cooperative.

The assertion that the cooperative farmer-member does not actively recognize property interests in the cooperative should not lead one to conclude that there are no membership incentives for joining or remaining in a cooperative. The cooperative may provide market competition or access to services that a trade area would otherwise lack. Price advantages may exist for the member of a cooperative. Finally, there is a finite possibility that the found money that makes up the bulk of the member's equity will be returned at a future date. All

three factors insure that the farmer-member has reason to participate. These incentives notwithstanding, the nature of the investment path does not provide the farmer-member with an active interest in the investment.

The lack of a recognizable opportunity cost in cooperative investment makes each member free to exit from the cooperative or to patronize other entities without considering the effects of these actions on their own cooperative investments and the investments of other cooperators. Members are also free to compete directly against their cooperative by marketing input supplies and custom services or by building private on-farm storage. In all of these cases, the farmer-member does not recognize a significant participation in cooperative losses resulting from individual action. The member is thus encouraged to utilize cooperative facilities and equity as a common property resource.

It is somewhat ironic that the very system that makes cooperative investment a direct consequence of the patronage decision has separated the patronage decision from its effect on investment and property interests in the mind of the farmer-member. This is directly due to the passive nature of the investment relationship between the farmer-member and the cooperative. The cooperative has become, in effect, an independent entity that the farmer-members treat as they would any other supplier of inputs or services. The endowment and the near elimination of up-front membership capitalization have created an environment where the vertically integrated firm and portfolio theory add very little to the understanding to farmer-member incentives and actions with respect to the cooperative.

Summary

Chapter 3 has presented a descriptive model of financial relationships between the cooperative and the farmer-member as they currently exist in most midwestern grain cooperatives. It has been shown that these relationships provide incentives for the farmer-member to be primarily motivated by immediate transaction prices in making patronage decisions. This is due, in the first instance, to the distribution of cooperative operating surplus on a patronage basis. The problem is magnified, however, by the somewhat arbitrary distribution of claims to surplus that result from cooperative allocation decisions.

The farmer-member has very little control over cooperative surplus distributions and has no incentives to individually invest in the cooperative. The farmer does, however, have incentives to be a cooperative member. This paradox results from a cooperative structure that does not require the individual farmer-member to consciously hold a significant stake in the cooperative. As a result, the cooperative treats the member as a customer rather than an investor, and the farmer-member treats the cooperative as an independent supplier rather than as an investment.

CHAPTER 4. THE COOPERATIVE AS A CAPITAL POOL

Vertical integration models and portfolio theory do not adequately explain farmer-member incentives and actions with respect to the cooperative. This does not necessarily imply, however, that the early vertical integration theorists were wrong in their analyses of the cooperatives of the time. The early theories of vertically integrated cooperatives were developed to explain cooperatives that were far different than the cooperatives that exist today. Cooperatives have changed because the farm operations that they serve have changed.

Phillips' integrated cooperative model was characterized as either a joint marketing or purchasing agreement. The costs of the joint operation were primarily operating or variable costs associated with an individual transaction. When the transaction was complete accounts were cleared, costs were added to or subtracted from prices, and no cooperative investment remained. All benefits from cooperation were recognizable in the form of immediate price advantages.

This simple cooperative served farms where production costs were largely variable operating costs. The farm production function was labor intensive. As long as labor was freely available in easily divisible units, production cost sharing was not a cooperative function. Cooperative activities in the production cycle were limited to group purchasing of bulk inputs. Likewise; the technology of grain marketing and transfer limited cooperative marketing needs to the development of a united bargaining front and consolidated sales. In both production and marketing activities, the cooperative's farmer-member was explicitly interested in immediate price advantages rather than long-term cost sharing.

The most immediately necessary expansion to this view results from the addition of grain storage facilities. Traditionally, grain marketing systems have required physical storage facilities in order to consolidate commodity lots of sufficient size to enter the market. To the extent that grain marketing and transfer technology requires permanent facilities for grain consolidation, the cooperative cost function expands beyond variable costs.

This is not a major break, however, as long as the facilities are technologically inseparable from the marketing activity itself. Facility size and costs, determined by shipping lot sizes, could be amortized across time and applied to patronage. Patronage is still based on price advantages as long as the technology required for marketing makes this service unavailable to the farmer-member individually. This was long the case with respect to rail shipment facilities, given the grain transfer capacity of the individual farmer-member.

The major breaking point in a cooperative model dependent upon pure price advantages began to exist as farm production technology became capital intensive, and as grain transfer and marketing technologies began to separate storage facilities from marketing functions. At this point, the potential for production capital sharing provided a further cost reduction incentive to the farmer-member that was not immediately recoverable in price advantages during a single production period. In addition, grain storage needs began to be defined in terms of production lots rather than shipping lots, storage took on a speculative aspect, and transfer technology made on-farm and cooperative storage relatively interchangeable from the member perspective.

The cooperative was no longer primarily transaction-based. It also became a capital pool. Mainstream

cooperative finance and the economic theory of cooperatives, however, both continued to be based on a transaction-based paradigm.

The transaction paradigm results in all benefits being defined in terms of patronage. A consequence of this is that there are no direct returns to investment. Combining this with the democratic control (one member, one vote) of cooperatives results in a situation where there are generally no specific rights attached to investment. Participation in cooperatives usually provides only general access to cooperative facilities and services.

From the capital pool perspective, this lack of access rights becomes a serious problem for the cooperative organization (even in the face of its ability to retain surplus and hold an endowment). The basic grain cooperative is not a risk pool in any real sense of the term. Marketing is done on a buy-sell basis that leaves the risk of market timing largely with the farmer-member. Storage and production services are generally provided on a first-come, first-serve basis.

Pooled capital stock with no access guarantees leave farmer-members holding significant access risks; particularly in periods of unusually high demand. These periods are particularly likely for storage facilities during bumper crop and\or low market price years. Unusually cold or wet planting seasons create these situations for production services.

Midwestern grain producers have generally avoided shielding themselves from market risk by shunning attempts to create market pools. They tend to look at cooperative marketing expertise as a means of maximizing their returns to risk rather than a means of risk reduction. However, they typically attempt to shield themselves from the

access risks involved in capital pools. In order to shield themselves from these risks, farmer-members can either insure themselves against the losses that these risks may entail or protect themselves by reducing the risk involved (e.g., building more capacity). In either case the farmer-member can chose to act individually or collectively through the cooperative.

Recent work by Shogren (1990) in the field of experimental risk reduction suggests that individuals will generally opt for private self-protection unless private actions are too expensive or too complicated to be economically feasible. The operability of both of these constraints imply economies of scale in provision. Application of Shogren's results to cooperative members leads to the expectation that farmer-members will opt for private capacity where economies of scale permit private provision. As a result, one would expect that relatively large and/or financially well-established members will more likely to opt for private self-protection than will smaller members.

If established members also perceive that insufficient rotation of retained patronage dividends have left them overinvested relative to other members, the perception that they are subsidizing the free riding of other members may further discourage participation in cooperative self-protection. Shogren's work suggests that an individual's valuation of cooperative and private action is sensitive to the perceived productivity of the payment made. The perception that payments made for cooperative action are diluted by benefits received by free riders increases the preference for private action.

These factors suggest that in the face of immediate recognizable access risks, at least some farmer-members can be expected to build private capacities in the face of

the pooled facilities maintained by their cooperative.

Once established and paid for, private capital stock can be used by the farmer-member at marginal cost. In the case of many cooperative facilities in the capital pool, decreasing average cost structures require that user fees be equated with average cost if the provision of facilities is to be self financing. This gives reason to believe that private stock, once established, will be utilized before the cooperative capital pool in individual instances. The marginal cost advantage of using private facilities overrides the scale economies of constructing cooperative facilities because the member can separate fixed from marginal costs in the on-farm utilization decision but cannot separate fixed from marginal costs in the utilization of the cooperative facility.

The tendency to utilize private facilities is further strengthened if we assume that the use or potential use of private stock provides the member with bidding advantages with respect to other farm and market activities. If we assume that private capacity, once established, is utilized prior to collective capacity, this will directly affect both the volume and the consistency of utilization of services within the capital pool.

Shogren's results are consistent with several previous works (Kahneman and Tversky, 1982; Tversky and Kahneman, 1988; Slovic, Fischhoff, and Lichenstein, 1988). These works in the field of psychological response to risk indicate that individuals overestimate the impact of low-probability events (particularly in the face of high potential losses) and are oversensitive to changes in the probabilities of low-probability events. In addition, these researchers have shown that response to risk is affected by the context in which an event is framed by the risk bearer.

It is reasonable to assume that the farmer-member's decision to provide the largest of the cooperative capital pool investments, grain storage, is framed differently with respect to cooperative and private action. The decision to provide cooperative storage is most likely framed in a long-term context where facility access risk is perceived to be low, potential impacts of access risk are over-estimated, and the farmer-member's opportunity cost of constructing storage is covered with cooperative surplus (found money).

One would expect a tendency to over-build cooperative storage under these conditions. However, over-building does not necessarily eliminate the occurrence of individual events that significantly increase access risk in the short term. Individual events that temporarily increase short-term access risks are likely to frame the decision to provide on-farm storage. In the short-term, lack of access to storage results in immediate and significant losses to the farmer-member that is forced to sell grain at the point of harvest. The farmer-member can compare potential marketing losses that may result from unsuccessful visits (failure to gain access) to the cooperative facility with the provision costs of acquiring private storage (self protection) and directly reduce access risk through private storage construction. The individual benefits from reduced transaction costs because coalition-building is avoided. Finally, private provision provides a level of certainty against highly correlated needs that is not possible with cooperative provision.

Both of these decision frames suggest the dedication of more resources to risk reduction than are economically optimal in environments where consistent market experience in risk reduction is not present. This is generally the environment that exists when farmer-members anticipate

excess demand for services from the cooperative's capital
pool. The infrequent expectation of increase in demand
and the long-term nature of investments required for self-
protection combine to increase the dedication of resources
to self-protection over an optimal long-term level. This
is because both of the conditions present tend to limit
the repeated market risk-reduction experience that is
available.

Shogren's work in experimental risk reduction
suggests that the development of private capital stock
will take place if the capital pool carries no specific
access rights. This expectation is reinforced by a number
of other factors in the case of grain storage. First, the
construction of on-farm grain storage was encouraged by
government programs that subsidized construction costs in
the 1970s. Government grain storage programs of the 1980s
also provided incentives for developing on-farm storage.
In addition, on-farm storage increases a farmer-member's
ability to seek alternative bids in marketing grain. On-
farm storage of sufficient quantities may allow the member
to influence bids, or bargain on delivery terms, in some
instances.

Regardless of the instigating incentives, it is
apparent that private on-farm capital stock is developing
in the face of the cooperative capital pool. The
assumption that, once obtained, private resources will be
utilized before cooperative resources creates the
possibility that the cooperative will become a reservoir
of excess capacity. This should have the effect of
driving up unit costs within the cooperative; forcing
either the consumption of the endowment or a loss of
patronage as price-motivated members take their business
elsewhere, or both. This effect is clearly seen in a
recent analysis of high-volume, low-margin competition in

the grain marketing arena (Ginder, 1985).

Under the present structure of investment and ownership rights, this situation is hard for the cooperative to combat within the existing membership. Attempts to increase capital stock utilization through increased membership (lower entry fees) or subsidized access costs have the effect of expanding access rights and increasing access risk. This has the unintended effect of exacerbating the problem of existing member self provision.

To overcome this problem a cooperative finance structure that will unambiguously provide investment incentives and property rights to the membership is required. It is also necessary to demonstrate that existing cooperative management and legal structures make it possible to simplify and rationalize the farm portfolio decision with respect to cooperative membership and patronage.

Existing work in the theory of agricultural cooperatives has focussed on solutions that provide farmer-members with more consistent and recognizable claims on cooperative surplus (Cobia et al., 1982). These solutions are based on two cooperative management plans that institutionalize the return of retained surplus (endowment) equity to the farmer-member on a regular basis.

The first of these plans involves a capital rotation system. Under this system the cooperative continuously rotates its oldest capital (valued at par) back to the members that provided it. This requires that the cooperative continuously acquire new capital through the retention of surplus or some other method. A rotation period is often fixed under this system. If the primary source of cooperative capital is retained surpluses, the

shorter the rotation period, the more closely member shares of cooperative capital mirror member shares of patronage.

The second plan is referred to as a base capital plan. Under this system the cooperative regularly makes an appraisal of capital needs for maintaining and improving facilities and operations. These capital needs are then apportioned among the membership with regards to their current period's patronage shares. Members whose accumulated equity falls below their base capital requirements must ante up (generally through increased retention of patronage-based returns). Members with excess accumulated equity (valued at par) have capital returned to them by the cooperative.

Both of these systems and their variants provide the farmer-member with a more consistent and realizable claim on individual shares of the cooperative endowment. Each recognizes the importance of the return of equity capital to retired members or to long-term members that may be over-invested. Each, however, remains completely dependent upon patronage shares for all surplus retention and rotation.

While each of these plans addresses problems of the return of capital, neither provides for return on capital. While the surplus pool that is allocated and paid out is equivalent to profits that represent return on capital to a non-cooperative firm, it is paid on a patronage-share basis rather than on an investment-share basis. It is this pay-out trigger that makes these distributions returns to patronage (even if unrecognized) rather than returns to investment. The source of the pay-out pool is not important from an incentive standpoint. As a result, neither the base capital plan or the capital rotation plan provides for any reduction of the price-dominance in the

cooperative-member relationship. To accomplish this, the cooperative must set up explicit capitalization relationships with the membership that formalize utilization rights and credit functions.

This does not suggest that the cooperative cease to provide assistance to under-invested members. It does require that assistance in meeting capitalization requirements become explicit. This provides a direct link between cooperative investment and the farmer-member portfolio; moving credit relationships, collateral values, and capital claims back to the farm level.

This chapter has pointed out that cooperatives are currently structured on a transaction-based paradigm. It is suggested that the cooperative's marketing and input supply operations fit into this framework. Grain storage and custom application services, however, are better understood as capital pools.

The decisions of farmer-members to acquire capacity within these capital pools are strongly influenced by estimations of access risk. A review of risk-framing theory indicates that, in the absence of defined access rights, cooperative capital pool goods will be over-provided on both a cooperative and an individual basis. Additionally, there is reason to assume that private capacity will generally be utilized first; leaving the cooperative as a reservoir of excess capacity.

Finally, it is noted that current efforts to rationalize farmer-member claims against cooperative operating surplus have been focussed on the return of capital to the farmer rather than a return on the farmer's capital. As a result, these efforts do not address the underlying incentive problems that exist with respect to member utilization of cooperative facilities.

Cooperative structure must reflect both the

transaction-based and the capital-pooling functions of the cooperative. A structure that succeeds at this will also explicitly recognize and treat each member as an owner as well as a patron. This will result in the member treating the cooperative as an asset as well as a resource.

CHAPTER 5. THE COOPERATIVE AS A SYSTEM OF CLUBS

The economic theory of clubs is well-suited to conceptually structure both the transaction-based and capital pooling aspects of the agricultural cooperative. The joint ownership and utilization aspects of club theory also allow us to structure cooperative investment requirements to provide economically rational incentives to cooperative membership.

A club good is an excludable and partially rivalrous good that is characterized by congestible non-exhaustion throughout a significant range of consumption as the number of individuals utilizing it increases. A club is a voluntary group deriving mutual benefits from sharing a club good. Common examples of club goods in the literature include swimming pools and busy commuter thoroughfares. In both cases these goods avail themselves to multiple consumers and cost sharing. In each, however, a point is reached where the cost-sharing advantages of increased utilization are met by disutilities or costs of increased crowding. Similar relationships exist in recreational facilities (golf and racquet clubs, etc.), public services (fire protection), and even military alliances.

A club good is unlike private goods (where additional consumers must have their own units of the good in order to consume) or public goods (where additional consumers can always utilize the benefits of any unit of the good with no loss accruing to other users). A club good is such that an additional consumer causes a reduction in the cost per consumer of providing the good (a benefit to other consumers) and an increase in the congestion of the good due to use (a cost to other consumers). As a result, individuals that are allowed the possibility of acquiring

a club good and one or more non-club goods are faced with deciding both how much of each good to acquire and how many other individuals to share the acquisition of the club good with.

Club theory was independently developed by both Buchanan (1965) and Olson (1965) to study goods that fall into the gap between pure public goods and pure private goods. The theory of clubs is a recent entry into the field of cooperative analysis. The theory has been directly applied to investigate factor usage and optimal membership in consumer cooperatives (Anderson, Porter, and Maurice, 1979 and 1980), to determine conditions pertaining to the optimal number of cooperatives from an economy-wide perspective (Sandler and Tschirhart, 1981), and technological incentives for cooperative formation (McGuire, 1972). In a broader sense club good theory generally applies to cooperative analysis in addressing the incentive structure necessary to sustain voluntary efforts to collectively solve the economic problems of shared provision. General surveys of club theory have been written by Sandler and Tschirhart (1980), Cornes and Sandler (1986), and Sandler (1992).

Several agricultural economists (Sapiro, 1923; Trifon, 1961; Staatz, 1987) have investigated club-related aspects of the cooperative. In general, however, they have not recognized that these aspects fit into the broader theory of club goods. Perhaps this is due to the variety of cooperative operating and financial structures. Perhaps it is due to the lingering division between the vertical integration and independent firm perspectives; which tends to separate provision and finance questions from questions of membership. As the situation remains, agricultural economists have not successfully approached the problems of organization, finance, and patronage

incentives within agricultural supply and marketing cooperatives from the perspective of the theory of club goods.

In the cooperative context, we could envision a number of farmer-members, each facing a production function

$$M_i = M(x_{Fi}, x_C, n) \tag{39}$$

where
- M_i is the ith farm's marketed output of joint farm-cooperative production activity;
- x_{Fi} is a consolidated farm-level input;
- x_C is a consolidated cooperative-level input;
- n is the number of cooperative members sharing x_C.

This production function can be visualized as an example of either a marketing cooperative or an input supply cooperative. M_i, for the marketing cooperative, can be viewed as the farm output marketed through the cooperative with x_C representing cooperative marketing services. For the input supply scenario, M_i can represent the output marketed by the farm with x_C being an input supplied by the cooperative.

Assume that at any point in time the market price of M, P_M, is fixed and that the factor price of x_{Fi} is one. Finally, assume that the cost of x_C to the individual farmer-member is

$$\frac{C(x_C, n)}{n} \tag{40}$$

or the average cost of the club facility or resources.

The number of cooperative members, n, appears in the production function as a variable cause of congestion. It is assumed that increasing the number of members sharing a particular amount of club resource will cause a decline in output per member due to congestion which might manifest itself in increased queuing time, longer processing times for transactions, or a less pleasant or safe operating environment. The cost function of x_c also contains n due to the assumption that increased membership will increase maintenance, paperwork, etc. Finally, the cost resulting from the combination of a given level of x_c and a given level of membership is shared equally by the membership.

In this simple case, the farmer-member attempts to maximize profits

$$\pi = P_M M(x_{Fi}, x_c, n) - (x_{Fi} + \frac{C(x_c, n)}{n}) \qquad (41)$$

where

$$I_i = (x_{Fi} + \frac{C(x_c, n)}{n}) \qquad (42)$$

is the farmer-member's resource constraint.

The first order conditions for profit maximization are

$$\frac{\partial \pi}{\partial x_{Fi}} = P_M M_{x_{Fi}} - 1 = 0 \qquad (43)$$

$$\frac{\partial \pi}{\partial x_C} = P_M M_{x_C} - \frac{C_{x_C}}{n} = 0 \qquad (44)$$

$$\frac{\partial \pi}{\partial n} = P_M M_n - \frac{C_n}{n} + \frac{C(x_C, n)}{n^2} = 0 \qquad (45)$$

From these equations we can see that the marginal value product of increasing farm input, x_{Fi}, must equal the factor price of x_{Fi}, or 1. The marginal value product to the farmer-member of increasing the cooperative input, x_C, must be equal to the farmer-member's share of the marginal cost of x_C. Finally, the decrease in marginal value product for a given level of x_C due to increases in membership, n, plus the increase in cost associated with the increasing membership must be equaled by the corresponding reduction in the farmer-member's cost share

$$P_M M_n - \frac{C_n}{n} = -\frac{C(x_C, n)}{n^2} \qquad (46)$$

The first order conditions also provide us with the marginal rates of technical substitution and transformation between x_C and x_{Fi} and between n and x_{Fi}

$$MRTS_{x_C, x_{Fi}} = \frac{M_{x_C}}{M_{x_{Fi}}} = \frac{C_{x_C}/n}{1} = MRT_{x_C, x_{Fi}} \qquad (47)$$

$$MRTS_{n, x_{Fi}} = \frac{M_n}{M_{x_{Fi}}} = [\frac{C_n}{n} - \frac{C(x_C, n)}{n^2}] / 1 = MRT_{n, x_{Fi}} \qquad (48)$$

Equation 47 provides the provision condition for the cooperative input relative to farm input. The provision decision requires the equation of the marginal rates of technical substitution between the club and private goods for the entire membership and the marginal rate of transformation for the club and private goods in the marketplace.

Equation 48 provides the membership condition. The membership condition illustrates that trade off between the marginal benefits that result from additional memberships (the reductions in club good cost per member that translate into an enhanced ability to consume the non-club good) and the costs that result from the marginal memberships (increased congestion or decreased production; and increased maintenance, depreciation, transaction, and uncertainty costs that accrue to existing members as memberships are increased).

The provision and membership decisions must be made simultaneously because they are determined by a common set of variables.

In this simple model we have assumed that membership is equated with the uniform utilization of the entire cooperative input, x_c, by each individual member. In reality, the member of a cooperative or club must determine the rate at which to utilize the good acquired. Being the member of a typical grain cooperative does not require continuous utilization. Club membership allows the member the option of utilization.

The utilization decision requires that the marginal value of actual utilization of the club good by a member be equated with the marginal costs of each utilization. The marginal costs of a visit include the congestion costs that the visit imposes upon other members, the increased maintenance or depreciation costs that the actual

utilization of the good entails, and the transaction costs
of monitoring the usage incurred by the visit. These
costs are actually incurred by the use of the good, and
are not the same as the costs of acquiring it. The
utilization of the good, once it has been acquired, is
essentially a private act.

In general, a club characterized by identical members
and constant utilization (as described in the equations
above) is financed by a user fee or toll that captures the
marginal costs that an individual member's utilization
imposes upon others. This toll can be collected up-front
as a membership fee or can be paid on an individual visit
basis. In the case where members are constrained to
constant utilization, this fee is most efficiently
collected as a one-time membership fee, as per visit fees
impose an unnecessary transaction cost upon both the
member and the club.

In the case of variable utilization, the toll must be
at least partially made up of a per visit fee, as future
usage cannot be foreseen with certainty. Even if perfect
foresight on the part of all parties can be assumed,
Berglas (1976) has demonstrated that per visit fees are
necessary for setting optimal visitation rates if
visitation is variable. If visitation is fixed, the costs
of visitation can be represented as fixed costs and
charging a uniform one-time membership fee does not affect
the member's decision to utilize the club. Where
visitation is variable the member's decision to visit the
club is independent of the initial membership decision and
each visitation entails a separate cost-benefit analysis.
In this environment it is necessary that the actual costs
of each visit be evaluated in each visitation decision. A
single up-front membership fee in this instance results in
the marginal cost of each visit being recognized by the

member as zero, resulting in over utilization of the facility.

Where the cost structure of x_c provides increasing marginal costs and demand is sufficient to allow a toll to be set at or above average cost, a per visit toll will be sufficient for the club to finance itself. In instances where the cost structure of x_c results in decreasing marginal costs throughout the relevant utilization range, a toll set at marginal cost will not be sufficient to finance the club. In this case, a toll set equal to average cost (which restricts utilization to levels below the optimum), a two-part tariff (to offset fixed procurement costs), or an outside subsidy (which is, basically, a two part tariff where the parts are paid by separate entities) of the club is needed in order to guarantee sufficient funding.

The case of the grain cooperative described in chapters 3 and 4 loosely fits the description of a club facing decreasing marginal costs throughout the range of utilization. Decreasing costs are assumed due to the large investment in fixed grain and bulk commodity storage that generally characterizes a grain cooperative.

The cooperative described makes use of both the two-part tariff and what amounts to an outside subsidy in order to fund itself. The two-part tariff is encountered through the fixed membership fee (I_E) coupled with transaction prices at market or near-market levels. To the extent that the sum of an individual's membership fee and transaction charges is insufficient to cover that member's share of cooperative fixed and operating costs, a subsidy is needed. The cooperative endowment of retained operating surpluses acts as an outside subsidy with respect to its effects on patronage incentives. To the extent that the endowment is made up of unallocated

surpluses retained from past cooperative members, the endowment can be viewed as a true subsidy to existing members. Even that portion of the endowment made up of surpluses allocated to current members has the effect of an outside subsidy because it is found money and carries no opportunity costs in the eyes of the farmer member.

Specifications for the Cooperative

Up to this point, the discussion of cooperative structure and property interests has been restricted to a one dimensional entity. The cooperative has either provided input supplies to the farmer-members or marketed their output. This vantage point has been sufficient to demonstrate that the current structure results in no direct returns on cooperative investment. It has also been sufficient for providing a brief overview of clubs from the perspective of the agricultural cooperative.

A demonstration of the applicability of club good theory to the workings of a midwestern grain cooperative, however, would be a simplistic exercise if it did not account for the multiple functions that such an organization serves. This section will describe how a midwestern grain cooperative can be viewed as a collection of structures serving specific member interests.

Organizing the cooperative as separate units is not a new idea. It was addressed by Sapiro (1923;90) in describing the California model for perishable produce cooperatives:

The association without capital stock is ideal for the marketing association. If a building, a warehouse, or packing plant is needed, no matter how cheap or expensive, we organize a subsidiary organization.

For the purposes of this discussion, we assume that the cooperative exists and that it operates in an environment where prices are fixed and known at any point in time. We also assume that at any given point in time it charges, pays, and receives competitive prices for supplies, grain from farmers, and grain sold forward into the market channel, respectively. The cooperative performs four separable operations:

A.   Marketing member output (grain);

B.   Supplying production inputs (fertilizers/chemicals);

C.   Providing storage facilities for uncommitted grain;

D.   Providing a custom application service for inputs.

In terms of the discussion in chapter 4, operations A and B are transaction-based activities. Operations C and D are capital stock pooling activities. This entire group of services can be visualized as a single multiproduct club (Sandler and Tschirhart, 1991; Brueckner and Lee, 1991). For the purposes of this exposition, however, a description of the club aspects of the separate activities is more tractable. In either case, all of these operations can be structured as clubs that maintain cooperative benefits and strengthen property rights.

Each of the clubs is characterized by the increasing returns to scale of joint provision over the levels of provision generally available to a single farmer-member. However, at the joint level both the input supply operation, B, and the custom service operation, D, are

assumed to be characterized by decreasing returns to scale. In operations A and C, marketing and storage, it is assumed that increasing returns to scale are available throughout the relevant production range in both singular and cooperative provision.

Within the context of current cooperative structure, the transaction-based operations, marketing and input supply, are not characterized by access risk. A member is assured of service during each visitation even if crowding or congested conditions reduce the payoff of the visitation. Current cooperative structure results in significant access risk for the storage and production services operations, which are based on pooling capital stock. The risk that access will be denied in these operations results in uncertainty in the utilization of the club. This will significantly affect the proposed structure of these cooperative clubs; particularly definitions of membership.

In the case of each of these operations, it is important to determine whether an alternative club structure shows clear advantages over the current method of cooperative organization from a patronage incentive point of view. In each case, it is also possible for the farmer-member to form an on-farm club to satisfy individual farm needs. These on-farm clubs will be referred to as singular clubs.

It will also be necessary to see if the proposed club structure is superior to these singular clubs. In the real world many cooperative members also have the opportunity to patronize profit maximizing clubs. This is particularly true in the transactions-based activities, input supply and marketing. The following sections will look first at the transaction-based clubs and then the capital stock pooling clubs.

Marketing

The marketing function is generally viewed as the central core of the midwestern cooperative. In most instances, the organization was created to provide better market access and prices to members who viewed themselves as relatively small in relation to other market participants. The marketing operation, from a club perspective, also is the operation most nearly compatible with current cooperative structure and finance.

The marketing function provides price advantages to members as a result of economies of scale. In most cases, a single farm unit does not market enough grain to justify maintaining a professional grain merchandiser. As a result, consolidating the grain merchandising task allows many farmer-members to make use of professional services that are not available to them individually.

As technological advances in communications and grain transfer increase a merchandiser's ability to market grain that is not consolidated, or in-hand, when the transaction is made, the economies of scale available from a pure marketing operation continue to expand. In many cases, the spatial range of a single elevator or grain consolidation point does not produce enough grain to fully utilize a full-time merchandiser.

The decreasing marginal cost of this function suggests that a two part tariff in needed. The fixed portion would include the member's share of actual employment costs for a grain merchandiser and the basic maintenance costs of the merchandiser's office and member accounting structures. The variable portion of the tariff would include the actual transaction costs of merchandising a particular member's grain. Because transactions are the actual measure of utilization, the fixed tariff is unrelated to use.

Input Supply

Like the grain marketing operations of the cooperative, input supply operations are transaction based. However, the input supply operations of the cooperative are not characterized by increasing returns to scale at the cooperative level. Input supply is generally a contestable competitive operation, even in the absence of cooperatives. Privately held farm supply centers are common throughout the midwest. In the cases of specific inputs, particularly seed supply, farmer-members often compete directly against their own cooperatives.

Input supply operations do, however, provide or expand economies of scope within the overall cooperative structure. The operation shares in administrative and maintenance costs, scales and common transfer facilities, and provides diminished transaction costs for members that must connect their supply transactions to credit, application, and marketing transactions. Reduced transaction costs resulting from these linkages at a single site provide the cooperative with important nonprice competitive advantages over single-service enterprises. This makes the input supply operation more cost efficient and also enhances the value of other cooperative services.

As a single entity, the input supply operation can be modelled as a profit maximizing club facing increasing marginal costs. Membership can be inclusive within the population (potential cooperative members), or, if increasing costs result in ceilings on the efficient size of the operation, competitive forces will partition the population into groups that approach pareto optimality. Facility visitation is limited by transaction fees (tolls) sufficient to make the input supply operation sustainable and self-financing.

Grain Storage

Grain storage is characterized by a very high level of fixed costs and is dominated by a component that would seem to be purely private, exhaustible, and excludable. This component is the grain containment facility itself. This structure either has space available or it is full. There is not a question of congestion here.

Construction cost of grain storage per given unit of volume declines over the range relevant for most producers, and even most communities. This provides incentives to form storage coalitions for capturing economies of scale in procurement. The club aspects of this are three.

First there is the declining construction cost of the grain containment facility itself. This provides incentives for common construction and shared use.

Second, congestion is encountered in this case as coalition-building costs escalate in response to the tradeoffs required by an expanding membership. This is, however, congestion of the organization itself and is common to all coalitions. It is better addressed in the context of game theory and cooperative organization (Sorenson, Tschirhart, and Whinston, 1978; Sexton, 1986; Staatz, 1987).

The third club characteristic of shared storage is that head space and grain transfer machinery is congestible as grain turnover increases. The volume of head space and the capacity of grain transfer machinery are important determinants of the level of service and the timeliness of access associated with a given grain storage facility.

Head space is the open storage space or working capacity in a grain storage system that allows grain to be manipulated without leaving the facility. It is

intermediate space where material from two or more storage blocks can be blended or grain can be held in transition stages between processing or consolidation operations. To those unfamiliar with the operations of a grain storage facility, this is often mistakenly identified as empty space. This could not be further from the truth. Head space is a necessary, congestible, and common component of the system.

Transfer machinery includes equipment used in putting grain into the facility (hoppers, conveyors, elevators, distributors, etc.) and load-out machinery for transferring material out of the facility. In the cases of both transfer machinery and head space congestion is encountered as more participants engage in moving and manipulating the grain stored in the system. Also; both head space and transfer capacity are characterized by decreasing unit costs in construction.

A given volume of head space and a given size and capacity rating on transfer machinery defines a given level of club provision. Club membership is measured according to the number of storage blocks available. Visitation is determined by transfers into or out of the storage blocks.

In the context of the basic cooperative club model outlined in equations 39 through 48, current cooperative storage practice would require the inclusion of a visitation parameter. Within the cooperative grain storage facility, membership can not be equated with use.

Current storage practice also requires the inclusion of access risk within the production function. This results from the current practice of lumping storage, head space, and transfer machinery as one good. Access is generally provided on a first-come first-served basis. This results in the potential for unsuccessful visits.

Unlike the representation of club access risk provided by
Sandler, Sterbenz, and Tschirhart (1985), however, this
risk is not randomly distributed. In cooperative storage,
utilization patterns of all members are highly correlated,
and individual members can assume that the utilization
patterns of other members will match their own. The high
positive correlation of use patterns negates the value of
pooled capacity as an insurance or risk pool.

In current practice, access risk is reduced as the
number of members decreases. Access risk is eliminated in
the single-member case. This leads members to create
singular storage clubs on-farm even though economies of
scale in construction costs would favor joint
construction.

In order to conceptualize a storage club that
eliminates this access risk while providing joint
economies of scale, it helps if we can identify members as
uniform blocks of storage volume rather than as
individuals. One could view this as a situation where
each member privately owned a grain storage condominium
and a club is formed to optimize the provision of working
space and transfer machinery; remembering, however, that
the construction or provision of the actual storage
condominium and the club goods is a single act.
Membership is identical in that each member gets an
identical block of storage volume, but a single entity may
hold more than one membership. This provides the farmer-
member the flexibility to determine volume needs and the
security of assured access to storage volume. Use is
determined by grain turnover.

Congestible nonexhaustion remains an access issue as
the correlation of use patterns also affects the members'
queuing time at the point of grain transfer. However, the
correlation of use also ties queuing time directly to the

number of members or storage blocks, so this no longer is an uncertainty issue.

Specifying the grain storage facility in this manner effectively privatizes the storage facility itself into grain condominiums, which are completely exhaustible and when maintained as a common pool are the cause of access risk and uncertainty. This specification also maintains the congestible portions of the facility, the transfer machinery and head space, within the club structure. The common construction of the entire facility allows the owners of the storage condominiums to benefit from economies of scale in provision, a further club benefit.

The cost function associated with such a grain containment club is

$$C = C(x_g, x_c, v) \qquad (49)$$

where

x_g is the number of members or storage blocks;

x_c is the capacity of head space and transfer machinery (the primary club good);

v is the visitation rate (rate of grain transfers into or out of the facility).

In this case the condition for membership in the club, which only includes the provision of head space and transfer capacity, is that a block of private storage capacity exists in conjunction with the club. As a result, membership, x_g, requires significant construction or acquisition costs in addition to club provision costs.

Membership is no longer conceptualized as an individual farmer-member. Membership is a physical storage block and serves a production unit. This makes it

possible to conceptualize alternative multimember clubs serving individual farms, or singular clubs. Essentially, this construction of the problem privatizes the storage containment facility itself, eliminating access risk. We also need to recall that each farmer can be attached to group club storage through the cooperative or to individual club storage through a singular club at the farm level.

Increasing returns to scale in the construction of transfer equipment and head space indicate that a two-part tariff is necessary to promote adequate utilization of the facility. It is assumed that members pay a fixed tariff equal to the fixed cost of building and maintaining the club facility. In addition to the fixed tariff for the club facility, the member also incurs a significant up-front cost in acquiring the storage blocks that are a requisite for membership in the club. A user toll is then applied to the marginal cost of handling grain turnover. Because grain turnover is the congestible attribute of the storage system, the fixed tariff is not related to member use.

If the fixed tariff is sufficient to cover the acquisition and fixed maintenance costs of the facility, visitation tolls (grain transfer charges) are required to cover only the visitation costs. The congestibility of transfer machinery and head space would suggest that tolls set equal to the increasing marginal cost of visitations would be sufficient to cover operating costs.

Members of the storage club can conceivably transfer their rights in the club to any other entity that is eligible for club membership. This creates a market (albeit restricted) for member assets, and provides a means of capital rotation (complete with either appreciating or declining asset values reflecting supply

and demand for storage facilities) for members wishing to exit the club.

The storage club can also be expanded by constructing additional facilities, regardless of whether these expanded facilities are of equal quality to existing structures. This and transferability provides a method for non-members to "bid in" to the club, by taking reduced payoffs. This is a necessity for preventing instability at the core if the storage club is not of sufficient size to include all of the memberships demanded (Sandler and Tschirhart, 1980).

Custom Application Services

The case of providing capital pools for custom application services differs from the storage condominium case in that the shared equipment is beyond the ability of the individual farmer-member to capitalize at the individual level of production, but operates with increasing marginal costs over the range of pooled utilization. On the face of it, this would tend to argue for an open membership club financed by individual utilization tolls.

As with the grain storage club, however, member utilization of custom application services displays highly positive correlations. There is considerable access risk involved in this type of service. A model in which capacity blocks, in terms of utilization time or acreage, are guaranteed and utilization is fixed is appropriate in this case. A membership fee that covers procurement costs plus the present value of future marginal costs is charged. This allows the member to completely internalize the pooled capital into the farm investment structure.

Unlike the case of the grain storage facility the members holding custom application blocks can be

constrained to constant usage. The member holds an
acreage or time allotment in the facility for each
production cycle. This fixed allotment does not imply
that the application facility or equipment is exhausted or
that there is a one-to-one relationship between facility
size and membership (as in the privatized containment
facility of the storage club). A given unit size of
application capacity is congestible in that it can be run
longer hours, in the dark, with less scheduled
maintenance, etc., if that is the level of service that a
given membership finds optimal.

While there is a question of changes in quality that
are based on extreme utilization of capacity, it can be
argued that this is part and parcel to determining the
club's congestion threshold. A more problematic issue,
given the timeliness constraints on the value of
production services, is scheduling within a chosen level
of congestion. However, even this issue can be addressed
through variable time-dependent membership fees (much like
variable rates on time-share resort condominiums), queuing
systems, or bidding clubs (where club membership simply
provides the right to bid on fixed amount of capacity).

In any case, if the member chooses not to utilize the
allotment, it can be sold to other potential club members;
either permanently or for the single cycle. The club can
be expanded in the same manner as the grain condominium
club to allow bidding in by potential members.

Summary of the Club Specification

This description serves to demonstrate how a club
structure can be set up to serve the needs of a midwestern
grain cooperative. In some instances, this is already
happening at the cooperative management level. Grain
storage condominiums are becoming a reality at many

farmers cooperatives. The structures that are outlined
here include one where usage is constant (custom
application services) and one where total costs should be
recoverable through provision at competitive pricing
(input supply). In the cases of grain marketing and
storage two-part tariffs are necessary to cover the high
fixed cost component of a decreasing cost operation and to
privatize a necessary but exhaustible portion of the
facility.

The structure suggested here provides each member
with ownership interests in the essentially private
interests of the cooperative. This will not prevent the
farmer-member from either creating a singular club to
serve individual needs at the farm level or patronizing a
private profit-maximizing club. It will, however, force
the farmer-member to recognize the effects of such actions
on the cooperative investment. It will also minimize the
effect of these actions upon other members.

Privatizing ownership of cooperative capital
structures also provides other benefits. Individual
farmer-members that do not own land are given the
possibility of acquiring guaranteed storage without
incurring the risks and costs inherent in placing
permanent structures upon leased ground. Collateral
values and credit functions for cooperative facilities are
largely moved back to the farm level; allowing the farmer-
member to selectively finance and/or liquidate his
operation as the individual situation dictates. This also
allows the farmer-member the limited ability to utilize
cooperative investments as collateral for other
investments; providing potential creditors with a
marketable position (which current cooperative
organization does not) and an easily verifiable analysis
of collateral condition (which is difficult to obtain for

individual on-farm equipment).

Within this structure, the farmer-member continues to benefit from the economies of scale that make cooperative activity attractive. Nothing in the club formulation violates purely cooperative benefits to the farm.

The club arrangement does require explicit financing arrangements, however. This is a sharp split from the current practice of financing cooperative facilities through use of the endowment. The endowment can generally be viewed as an appropriation of capital from senior members of the cooperative. Its use in subsidizing facilities and membership costs is an implicit form of financing junior memberships.

Under the club framework described here, senior members would have the option of providing credit to junior members on a private basis or through an explicit cooperative arrangement. Senior members would benefit from the option of removing capital from the cooperative by selling their capacities to other members. Junior members would benefit from an expanded collateral base at the farm level and access guarantees for their cooperative capacity.

Issues in the Literature of Club Goods

While this description of the cooperative as club good has been greatly simplified in terms of both the cooperative and the theory of club goods, several important topics in club good theory have direct implications for midwestern cooperatives. The discussion below identifies some of these issues and places them in the perspective of the club formulation of the farmer's cooperative.

Homogeneous and Heterogeneous Memberships

Club theorists have put forth a number of models dealing with the efficiency of mixed clubs (heterogeneous membership) as opposed to clubs with homogeneous memberships. In looking at this distinction from the farmer cooperative perspective, we must look at members and memberships as being attached to production units rather than to individuals. The cooperative enhances returns to production rather than increasing individual utility.

The homogeneous/heterogeneous distinction is not particularly at issue in the transaction-based operations in the cooperative club described above. It is assumed that the member either markets grain or does not. If grain is marketed the same cost/price issues are relevant to all production units. Identical input supplies are available from several sources at competitive prices. Both operations reduce directly to identical transactions where an assumption of homogeneity is easily justified.

This distinction does become relevant to the capital pooling operations of the cooperative, however. Grain storage can be built for several purposes; including speculation on market prices, holding grain for feed, or maximizing harvest speed by removing transportation bottlenecks. Because each of these needs may imply different time frames and service levels, homogeneity can not necessarily be assumed.

The importance of this to the cooperative lies in the debate over whether mixed clubs can be optimal. Several club theorists (see the evaluative survey by Sandler and Tschirhart, 1980; Berglas, 1976; Berglas and Pines, 1981 and 1984) have suggested that mixed clubs will not be optimal and that heterogeneous groups should be partitioned into smaller homogeneous clubs. If this is

the case, different storage uses could reasonably result in separate storage clubs. If the singular storage or application clubs that exist on-farm result from the heterogeneity of storage purposes, a club formulation of the cooperative might be expected to change the property relationships within cooperatives. In this case, however, the club formulation would not be expected to change the pattern in which all club facilities, singular and cooperative, are distributed.

On the other hand, the analysis of Sandler and Tschirhart (1980 and 1984) indicates that segregation is only required where members are constrained to financing the club equally. Where this constraint is not invoked, mixed clubs can be optimal. If mixed clubs can be optimal, access risks can be removed, and economies of scale in provision exist; we would expect the formulation of the cooperative on a club basis to alter both the property interests within the cooperative and the pattern in which all club facilities, singular and cooperative, are distributed. More specifically, the formulation of the cooperative facility as a club should tend to concentrate future facility development within the cooperative club rather than in singular on-farm facilities.

Private For-profit Clubs

The existence of profit-maximizing clubs has been investigated by Berglas (1976), Boadway (1980), and Scotchmer (1985). Each concludes that private profit-maximizing firms can provide club goods at an optimal level where competitive price structures exist and the population can be partitioned into homogeneous groups of sufficient size for club maintenance.

The cooperative club described above faces

competition from private profit-maximizing clubs in the
input supply operation. As noted above, this is a
transaction-based operation within the cooperative, and an
assumption of homogeneity is easily justifiable. In fact,
the cooperative often faces this competition from its own
members. The privately owned farm supply store is not
rare in the midwest. The farmer, often a cooperative
member, that markets seed to other farmers, cooperative
members and non-members alike, is also not uncommon. It
is likely that the cooperative is able to maintain its
position in this activity due to the reduced transaction
costs available to members that are able to consolidate
production activities at the cooperative.

One might also expect to see private goods clubs
competing with the cooperative in the provision of custom
application services. This, however, is becoming more the
exception than the rule as the so-called "Custom Farmer"
becomes a rarity in the midwest. The demise of the Custom
Farmer may be due to the over provision of on-farm capital
stock as a farmer response to access risk (as in the
cooperative case), or it could be due to the ability of a
farmer to purchase inputs and make application
arrangements in a single transaction at a cooperative.

Surprisingly, cooperatives are seeing continually
more intense competition from profit-maximizing clubs
(private limited-service grain marketing firms) in the
area of their marketing operations (Ginder, 1985). This
is not to be expected, as the marketing activity is a
decreasing cost operation. A partial explanation for this
may be found in the analysis of multiproduct clubs.

Multiproduct Clubs

As pointed out in the initial description of the
cooperative as a club, the description could have been

presented as a multiproduct club rather than as four separate clubs. The existence of multiproduct clubs has recently been investigated by Brueckner and Lee (1991) and Sandler and Tschirhart (1992). Staatz (1987) has provided a game theoretic analysis of the agricultural cooperative from a transaction cost perspective that closely approaches many of the aspects of a multiproduct club.

The viability of multiproduct clubs depends upon the existence of economies of scope, or the ability to produce the multiple products in a single organization for less than the same products can be produced independently. This requires that there be some common element of cost shared by the multiple products that cannot be unarbitrarily assigned.

In the cooperative described above such unassignable costs are the result of common transaction and accounting systems, scales and transfer equipment, rolling stock, and the site of operations. These economies of scope are instrumental in justifying the cooperative position in the input supply operations, and were used above as a partial explanation for the demise of competition for the cooperative's custom application services.

The Sandler and Tschirhart (1992) analysis also provides some insight in the increasing private competition for cooperative market operations. In a competitive price-setting environment, it is possible for a least-cost multiproduct club to be unsustainable against collection of single product clubs or clubs that provide a subset of the least-cost club's products and services. This may be the case even when the single multiproduct club can provide the most efficient production of the complete bundle of goods relative to any combination of alternative clubs. This result does not depend upon the presence of cross-subsidization across the memberships of

the different activities, but it is shown that if cross-subsidization occurs in otherwise sustainable multiproduct clubs the resulting fee structure will likely be unsustainable.

The current method of financing cooperative facilities through use of an endowment makes the existence of cross-subsidization across activities very probable. The cooperative marketing activity is characterized by decreasing costs. As technology continues to separate the marketing function from the storage function, the capitalization needs of the marketing activity continually decrease. These conditions indicate that the cooperative could utilize a dominant market position in grain marketing with its ability to retain operating surplus in order to cross-subsidize its other activities.

The possibility exists that single product profit maximizing clubs involved in grain marketing are able to compete with the cooperative in a decreasing cost activity as a result of cooperative cross-subsidization through the endowment. The ironic prospect of private grain marketers acting as competitive yardsticks relative to cooperative marketing organizations may justify further research on sustainable pricing in the cooperative context.

CHAPTER 6. CONCLUSIONS

This work has addressed two major topics relative to the application of economic theory to the midwestern grain cooperative. The current structure of the economic theory of agricultural cooperatives was reviewed with respect to the actual operating structure of a cooperative. The application of the economic theory of clubs was presented as an alternative to the current firm analysis applied to these cooperative.

It was shown that accepted portfolio theory, as applied to agricultural cooperatives, fails to adequately explain the relationship between farm-level investments and cooperative investments. This is due to the absence of any investment-based return on cooperative investments under the current structure of cooperative property rights.

Member investments in the cooperative are primarily in the form of found money. The member often recognizes no on-farm opportunity costs with respect to a large proportion of cooperative investments or losses. As a result, the member has an incentive to be price-motivated in all patronage decisions. The representative member cannot be expected to behave as an active participant in cooperative decisions under the current structure of cooperative property rights.

Current property rights were designed for a cooperative that fulfilled primarily the transaction-based needs of the farmer-member. These rights are structured to promote ease of entrance into the cooperative, and do not address the access risk problems that become increasingly important as the cooperative becomes a capital pool for sharing long-term investments in production equipment. The lack of access rights in the

capital pool environment are shown to provide incentives for private provision and duplication of investments in the cooperative capital pool.

A model based on the theory of clubs is presented as the basic building block for structuring cooperative ownership interests to correct the current shortfalls in membership incentives. It is shown that the cooperative can be partitioned into functional units within a multiproduct club framework.

Memberships are recognized as being tied to productive units rather than to individuals. This is an important point in that it allows individual participants to hold more than one membership block while maintaining the justifiable possibility of a homogeneous membership. This membership formulation also allows the consistent representation of on-farm provision as singular clubs.

The ability of the structures of club theory to handle provision and membership decisions simultaneously while also determining utilization costs and tolls separately is shown to be very useful in structuring the cooperative to privatize exhaustible components. This analysis also argued that cooperative goals and benefits do not have to be foregone in order to define property rights under the structure of club theory.

In moving acquisition costs into an explicit membership fee, the club structure defined here rationalizes credit functions by opening up what had been the subsidization of credit for new members with resources withheld from an identifiable class of cooperative members. Recognizing this transfer explicitly allows members to retain the cooperative benefits of collective action while more accurately accounting for investment and cost trade offs in the production function.

This work also brings the economic theory of

cooperatives more into line with actual practice among progressive cooperatives. In many instances, these cooperatives are already treating storage facilities as pooled capital goods and are parcelling out blocks of capacity on a long-term condominium basis.

Finally, several issues within the theory of clubs are discussed relative to the agricultural cooperative. Several of these issues have direct bearing on current cooperative problems.

While this analysis has only scratched the surface of the potential for the use of club goods in the theory of agricultural cooperatives, it has begun the process. It is hoped that this work will lead to questions on the aspects of intergenerational clubs and clubs with marketable or quasi-marketable memberships. From a public policy standpoint, investigation into the optimal provision of cooperative and singular clubs would be useful.

In addition, more detailed technical work needs to be done to attempt to tie the individual cooperative club structures detailed here into a single hierarchy or multiproduct club. The unity of multiple clubs is a given. The clubs outlined here benefit from economies of scope in the real world. Scales and maintenance brigades are maintained in common. The very site displays economies of scope in that members can combine business activities without additional travel-related transaction costs.

Much remains to be done.

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