ECONOMICS AND GROWTH OF MARKETING AND PURCHASING

COOPERATIVE FIRMS IN THE UNITED STATES

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CHAPTER I

INTRODUCTION

The agricultural sector of the United States has undergone many changes in the past few decades. Along with the technological revolution in production, there have been many changes in the market structure for farm products and inputs. Many of the changes in the market structure have been toward fewer and larger firms and a higher degree of business concentration.

The farming industry is characterized by a large number of individual farm firms which operate independently of one another and market one or more products. In addition, these farm firms purchase production inputs from many sources throughout the nonfarm sector of the economy. The marketing system attempts to perform the functions necessary to make the products available in time, place, and form to the buyers. The training, skill, and capital required for farming operations, along with specialization in production and marketing, makes it impractical, if not impossible, for an individual farmer to perform all of the marketing and purchasing functions necessary for the conduct of his business. Therefore, it is necessary for farmers either to depend upon established marketing firms or to create their own organizations for marketing farm products and purchasing production inputs.

Low Farm Income

The typical agricultural firm is small and the degree of business concentration among such firms is low. Therefore, for all practical purposes, most producers of farm products have virtually no control over prices at which they sell their products or buy their production inputs. As a consequence, farmers are price-takers.

Prices tend to move toward a level that will clear the market under existing conditions of demand. But regardless of whether prices rise or fall, some farmers will continue to produce in the short-run. Farmers have fixed production resources which they will attempt to employ so long as their value in use exceeds their salvage value.[1] Farmers, like other entrepreneurs, attempt to equate the marginal value product of the factor of production with the marginal factor cost to maximize profits or to minimize losses.[2] Since farm labor has a very low salvage value, the return to labor can be less than in nonfarm sectors and still not force laborers out of the farming sector.

Over time the per capita farm income from agriculture has remained far below that of the nonfarm per capita income. The data in Table I indicate that per capita farm income from farm sources was 1,112 dollars in 1965. For the same year, the per capita nonfarm income was 2,466 dollars. Thus, the per capita farm income from agriculture was less than one half as much as nonfarm per capita income.

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[1] Glenn L. Johnson, "The State of Agricultural Supply Analysis," Journal of Farm Economics, Vol. XLII (May, 1960), pp. 435-452.

[2] The marginal value product of factor is the value of the product produced by an additional unit of a factor of production, and the marginal factor cost is the cost of an additional unit of the factor of production.

TABLE I

PER CAPITA PERSONAL INCOME OF FARM AND NONFARM
POPULATION, UNITED STATES, 1946-1965

Year	From Farm Sources	From Nonfarm Sources	Nonfarm
		Dollars	
1946	609	179	1,217
1947	613	205	1,267
1948	733	239	1,365
1949	549	256	1,362
1950	612	272	1,458
1951	740	297	1,548
1952	706	309	1,609
1953	672	324	1,677
1954	658	312	1,678
1955	597	325	1,772
1956	600	352	1,852
1957	625	375	1,902
1958	747	390	1,915
1959	664	425	1,998
1960	733	461	2,014
1961	819	468	2,051
1962	850	490	2,131
1963	899	504	2,198
1964	860	521	2,343
1965	1,112	552	2,466

Source: U.S. Department of Agriculture,
Farm Income Situation, Economic Research Service,
FIS-203 (Washington, July, 1966), p. 44.

Possibilities of Profits in the Nonfarm Sector

The marketing and farm supply industries operate under conditions of imperfect competition, and firms in an imperfectly competitive market structure can regulate prices and output to some extent. The ability to regulate prices and output increases the possibilities of making economic profits.[3]

Average profit rate was used by Bain to compare the profitability of different industries that have different degrees of concentration. Average profit rate on equity, according to Bain, is $\frac{R - C - D - iV}{V}$; where R is sales revenue, C is currently incurred costs, D is depreciation and amortization, i is current interest rate, and V is owners' investment. Using this formula, Bain developed the data in Table II.[4] The agricultural sector, as would be expected, had the lowest return for any industry.

As indicated in Table II, profit rates vary considerably among various sectors of the economy. In 1953, this variation ranged from a low of about 3 percent for agriculture to a high of more than 10 percent for finance. The manufacturing sector, which had an 8 percent return, was categorized into smaller aggregates. The 1953 profit rate after tax was 12.9 percent for motor vehicles and equipment, 10.9 for electrical equipment, 9.5 for chemicals, 8.7 for tobacco manufacture, 9.8 for canned goods and 5.1 for meat packing.[5]

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[3]Economic profits are funds left after paying all factors of production the price they could receive in their best alternative uses.

[4]Joe S. Bain, Industrial Organization (New York, 1959), p. 366.

[5]Bain, p. 385.

TABLE II

AVERAGE PROFIT RATE ON EQUITY FOR SELECTED SECTORS
OF THE ECONOMY, UNITED STATES, 1953

Sector	Average Profit Rate (after tax)
	(percent)
Finance	10.1
Manufacturing	8.1
Construction	7.8
Services	5.9
Wholesale and Retail	5.7
Public Utilities	5.1
Mining	4.5
Agriculture, Fisheries and Forestry	2.9
Average all sectors	7.8

Source: Joe S. Bain, Industrial Organization (New
York, 1959), p. 385.

Farmers may have a greater opportunity to enjoy higher profit rates
on equities by forming cooperative marketing and purchasing firms.
Cooperatives, which are operated efficiently as business institutions
and which adhere strictly to the service at cost principle, may help
farmer-members to realize greater total returns from their farm products.
Although farmer-members of cooperatives operate their farms as independ-
ent businesses, they may coordinate their marketing and purchasing
activities through cooperative associations.

Cooperative firms have played a significant role in marketing farm
products and purchasing farm inputs in the United States. The Farmer
Cooperative Service reported that, in 1964 approximately 9,000 farmer
cooperative firms were engaged in marketing farm products, distributing

farm supplies, and furnishing services.[6] They handled, in dollar terms, about one-fourth of the farm products marketed and one-fifth of the farm inputs purchased by farmers. These cooperatives serve their members by doing business at cost and by providing services not otherwise available.

Objectives of the Study

The major purpose of this study was to evaluate the growth and the potential benefits to farmers of cooperative firms in the marketing of farm products and in the purchasing of farm supplies. Specifically, the objectives were as follow:

1. To determine the potential advantages of cooperative firms for farmer-members;

2. To investigate the effects of horizontal and vertical integration by cooperatives;

3. To review the historical growth and determine the growth rates of cooperative marketing of farm products and purchasing of farm supplies in the United States.

Organization and Procedure

Cooperative firms may have goals and operating procedures which are different from those applicable for noncooperative firms in the United States economy. In Chapter II, the cooperative firm is defined, and principles of organization and operation of cooperative firms are

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[6]B. L. Swanson, _Statistics of Farmer Cooperatives, 1964-65,_ Farmer Cooperative Service, U.S. Department of Agriculture (Washington, 1966) p. 1.

considered. Marginal analysis and market structure theory are used to determine the potential advantages of cooperative firms for their members in marketing farm products and purchasing farm supplies.

Integration may be one means of growth employed by cooperative firms. Marginal analysis is used to investigate the effects of horizontal and vertical integration by cooperatives. Motives, economic firm models, and economic effects of horizontal integration by cooperatives are analyzed in Chapter III. Similar considerations and analysis for vertical integration by cooperative firms are included in Chapter IV.

Chapter V includes a summary of the history of the development of cooperative marketing of farm products as derived from a review of the literature. Detailed consideration is given to the performance of one firm in one industry as an example of integration by cooperative marketing firms. The relative importance of cooperative marketing in the agricultural marketing sector of the United States economy is obtained from secondary data and least squares statistical techniques are used to determine the trend in the growth of cooperative marketing of farm products.

Chapter VI includes the history of the development of cooperative purchasing firms, involved primarily in marketing farm supplies to farmers, an example of integration by such firms, and the growth rate of cooperative purchasing of farm supplies. Finally, Chapter VII is devoted to a summary of the study.

CHAPTER II

THE COOPERATIVE FIRM: DEFINITIONS AND MODELS

Definitions of Cooperative Firms

The production of economic goods and services usually is an intricate process. Arrangements are made for the assembly of raw materials and supplies; capital, labor, and management are applied in the proper amounts; and finally, through a planned program of operations, the production of goods and services is effected. The unit of organization that performs these functions is the firm.

The firm has been defined in many ways. For example, Boulding says that a firm is an economic organism that buys inputs, performs operations on them, and sells the results with the expectation of making a profit.[1] Penrose views the firm as a pool of resources which are utilized within an administrative framework.[2] Each of these definitions is designed with a specific purpose in mind and, therefore, may not be fully appropriate for other uses.

Boulding is concerned primarily with profit seeking in the business world. He recognizes other economic organisms not primarily concerned with maximizing profits. For example, a wage earner and a hospital

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[1] K. E. Boulding, _Economic Analysis_ (New York, 1955), p. 491.

[2] E. T. Penrose, _The Theory of the Growth of the Firm_ (New York, 1959), p. 24.

would be considered economic organisms under his terminology.

The definition of the firm by Penrose is designed for use in studying the growth of firms and is somewhat less restrictive than Boulding's definition of a firm.

A broad definition of an economic firm would characterize it as an economic organization that exists for the purpose of producing economic goods and services, the maximization of profits, and the growth of the business over time. If this definition is applied to cooperative organizations, it must be concluded that they are firms. Cooperative organizations, which are owned and controlled by member-patrons, are fully recognized under existing laws as legal entities. They are engaged in the production of goods and services, and they attempt to maximize profits for their member-owners. They also attempt to show business growth over time.

In contrast to the conclusion that cooperatives are economic firms, some authors argue that a cooperative organization is merely an extension of farm firms and is not, itself, a firm.[3] However, this position that cooperatives are not economic firms has been accepted by relatively few people. Furthermore, there is an abundance of legal and institutional evidence supporting the theory that cooperatives are legal entities and, therefore, firms in the full sense of the word. Therefore, this study shall treat them as firms.

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[3]Appendix A treats the proposition that a cooperative is not a firm.

Principles of the Cooperative Firm

There are certain principles or fundamental concepts which are
distinct attributes of cooperatives and set them apart from other types
of business organizations. According to Schaars,[4] these basic principles
are, 1) democratic control, 2) limited returns on capital, and 3) service
at cost.

Democratic Control

The principle of democratic control dictates that the control and
ownership of the cooperative firm is vested in the member-patrons.
Democratic control may be interpreted as "one man-one vote" or one vote
per member, or it may be on some other type of a representative basis.
This applies both to individual member-patrons and to local member-firms
in the case of a federated cooperative association. The control of the
cooperative is exercised by the owners who are the patrons of the
business rather than by those who merely supply the capital.

In some cooperative associations, voting may be done on a basis of
the dollar volume of business transacted with the firm. Alternatively,
voting could be on a basis of "one man-one vote" plus additional votes
based on patronage, on shares of stock, or on some other criteria.
These methods of control also are representative in that they recognize
the importance of volume to a cooperative association's effectiveness
as a business firm, and they recognize the differences in economic
interests in the association.

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[4]Marvin A. Schaars, "Basic Principles of Cooperatives: Their
Growth and Development," Agricultural Cooperation (Minneapolis, 1957),
p. 191.

Regardless of how it is accomplished, democratic control is considered as one of the fundamental principles of the cooperative firm. It tends to prevent the concentration of power in the hands of a few members.[5] In no other form of business organization is there a comparable patron-owner relationship. This principle grants all active members equal privileges of participation in the control of their firm.

Limited Returns on Capital

Limited returns on capital is another basic characteristic of a true cooperative. According to this principle, the return on the members' invested capital is restricted to a maximum percentage amount. The capital requirements of a cooperative firm are no different from those of noncooperative businesses engaged in similar services. However, the relationship of the investor to the business is quite different. In the cooperative, the member invests his money primarily so that the firm may provide desired services for him. His decision to enter or remain as a part-owner of the cooperative is made largely on the basis of his opportunity for economic benefit as a patron-user. However, in the noncooperative form of business organization, investor returns are limited only by the profitability of the enterprise and the size of the investment.

The principle of paying a limited amount for the use of capital tends to prevent or minimize any conflict of interest between patrons as users of the business and investors as owners of the business. In the cooperative firm, ownership is related very closely with patronage

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[5] U.S. Department of Agriculture, Farmer Cooperatives in the United States, Farmer Cooperative Service, Bulletin 1 (Washington, 1965) p. 8.

and the danger of ownership becoming concentrated among a few investors
is minimized. Thus, investment in a cooperative business is tied to the
use of its services and is not motivated by expectations of profit from
capital investment. The profit of the cooperative firm is for its
member-patrons and not for its capital. Federal and state laws both
require a limitation by cooperatives on returns to capital. In general,
these laws specify the maximum returns that the cooperative can pay on
invested capital. In most states, the maximum payment is limited to 8
percent, but in some states it is less.[6] In all states cooperatives
may pay any amount less than the maximum.

Service at Cost

A third basic requirement of a true cooperative is service at cost.
This principle often is referred to as operation on a cost-of-doing
business basis. True cooperatives operate on the basis of service at
cost. However, it is not possible to anticipate exact costs; therefore,
adjustments must be made with member-patrons at the close of the fiscal
year. This usually is accomplished through a patronage payment in
which savings (net margins) above costs are returned to patrons on a
basis proportional to their use of the cooperative. However, the methods
of distribution of savings to members vary greatly among cooperative
firms. For example, some cooperative marketing firms pool all proceeds
from sales, deduct all costs, and then distribute the net proceeds.
Under this plan of operation, the cooperative may operate on a cost
basis even though there are no patronage payments, as such, to distribute
to members. In purchasing cooperatives, the products usually are priced

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[6]Ibid., p. 9.

at the going market price. At the close of the fiscal year, net savings are allocated to member-patrons in proportion to their patronage. Most grain marketing cooperatives operate in this manner.

The principle of service at cost recognizes the agency relationship of the cooperative to its member-patrons. Even though the cooperative firm is a legal entity and is separate and distinct from its members, it still is the agent of its members and is designed to serve them at cost. In no sense of the word is it designed to profit on services rendered its members. The true cooperative firm returns all net proceeds either in cash or in some form of equity claim to the member-patrons. The savings realized after deducting total cost belong to the cooperative members, not to the cooperative firm. The cooperative profits or net savings are shared by each member-patron in proportion to the volume of business he has transacted with his cooperative. Thus, service at cost, as one of the fundamental principles, dictates that the cooperative firm as a corporate entity is nonprofit in character.

Classification of Cooperative Firms

Agricultural cooperatives are associated with practically all phases of farming activity. Consequently it is difficult to set forth a classification which would be logical and at the same time broad enough to include all agricultural cooperative activity. For example, cooperatives might be classified by size of firm, type of membership, legal status, commodities or supplies handled, geographic area covered, or functions performed. The two most pertinent classifications of

cooperatives for the purpose of this study are based on (1) membership affiliation and (2) functions performed.[7]

Membership Affiliation

From the standpoint of membership affiliation, cooperative associations may be classified as local, centralized, federated, or mixed.

Local Cooperatives. Local cooperatives are essentially cooperatives providing services in a local area such as a trading center, a county, or some other concentration point. Local marketing cooperatives usually perform a limited number of services in the marketing process, and local purchasing cooperatives usually are operated at the retail level and sell directly to farmers. Regardless of functions performed by local cooperatives, individual farmers are direct members of the associations.

Farmers belong to local cooperative associations to maximize their personal net incomes. They hope to make farming more profitable by supporting and patronizing their cooperative association. The board of directors of a cooperative association is elected by the farmer-members and is restricted to active members of the cooperative. Local cooperatives are autonomous firms and may or may not affiliate with other cooperatives to form federated cooperative associations. Furthermore, the individual member may withdraw his membership from the local

[7]Henry H. Bakken and Marvin A. Schaars, The Economics of Cooperative Marketing (New York, 1937), pp. 204-228, and Richard L. Kohls, Marketing of Agricultural Products (New York, 1967), pp. 222-227.

cooperative if he chooses. Eligibility and procedures for withdrawal, however, are regulated by bylaws governing the cooperative.

Federated Cooperative. A federated cooperative, often referred to as a cooperative of cooperatives or as a regional cooperative[8], is a business structure formed through the horizontal integration of local cooperative associations. Thus, the members of a federated cooperative are local cooperatives, and farmer-members of local cooperatives are indirectly members of the federated association.

Although joined together to gain efficiency in business operations, and perhaps some degree of market power, the local cooperatives remain as autonomous units operated by local managers who are appointed by and responsible to local boards of directors. The local boards of directors, in turn, are elected by the farmer-members of the local associations. Therefore, each local cooperative in a federated cooperative association is a separate corporate entity, but it is affiliated with the federation and acts under membership regulations.

The federated cooperative is governed by a board of directors which is elected by, and which represents, the local associations. Thus in the federation, control rests with the local associations that constitute its membership. The board for the federation appoints a general manager who directs the business operations of the cooperative.

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[8]A regional cooperative is one which, regardless of functions performed, serves a large area such as a state or a number of states. Federations often are referred to as regional cooperatives. Centralized cooperatives also may be regional associations. The classification of regionals is based entirely on the makeup of their membership.

Any gross revenue of the federation which is in excess of costs (net savings or profit) is returned to the local member cooperatives on a basis proportional to their volume of business transacted through the federation.

Centralized Cooperatives. A centralized cooperative is one which serves a large area. Like federated cooperatives, centralized cooperatives often are referred to as regional associations. Some centralized regionals serve areas which encompass an entire state or perhaps several states.

Structurally, a centralized association is very similar to a local cooperative. In fact, it is an elaboration of the independent local. In both instances, individual persons comprise the membership. Patrons are direct members of the centralized association in the same way that they are direct members of a local cooperative. Thus, farmer-members control the centralized association through a board of directors which appoints a general manager who supervises the entire operation of the centralized cooperative.

In some respects centralized cooperatives are similar to federated associations. For example, both types encompass a large geographic area, and they may perform essentially the same functions. They differ greatly, however, with respect to membership and control. In the centralized association, patrons are direct members; there are no autonomous local associations. But in the federation, autonomous local associations comprise the membership. Therefore, in a centralized association, control and authority are centralized in the headquarters' organization, but in a federated association control is decentralized and lodges in the autonomous local association. Furthermore, if the

centralized association operates local units (which it may own outright), these local units are subject to control directly through the board of directors and manager of the centralized association and not by the patrons of each local association. Thus, local units have very limited functions in a centralized association.

Mixed Cooperatives. Large regional cooperatives may have a dual structure which involves both federated and centralized types of associations. Such a combination of structures usually is referred to as a mixed-type cooperative. The mixed-type association may operate through local affiliated units which represent a federated structure. But in addition, it may have a centralized structure in which individuals are direct members of the cooperative. In some instances, although the members are the local cooperatives, the farmers sign a contract directly with the central association.

Voting rights constitute one of the major problems in this type of cooperative association. Where local cooperatives and individuals both are members of the overhead cooperative, that is the mixed association, there is a question of what constitutes democratic control. For example, in this case who has a vote? Some mixed-type cooperatives have solved this problem by allowing one vote for each local cooperative plus additional votes based on the volume of business conducted with the overhead association and one vote for each individual plus additional votes based on volume of business conducted.

Functions Performed

Cooperative firms, classified on the basis of functions performed, may be grouped as marketing, purchasing, and service cooperatives.

Marketing Cooperatives. Marketing cooperatives are associations through which farmers may sell their products. They may perform some or all marketing services for their members. These services could include selling, wholesaling, processing, grading, packing, and other marketing functions. The objective of a marketing cooperative is to obtain the highest farm price for the products farmers have to sell and thus maximize gross farm receipts. Most of the marketing cooperatives are single commodity organizations, but some are multiple commodity organizations. Some marketing cooperatives, especially those which are integrated both horizontally and vertically, perform complete marketing functions. These associations usually operate at a regional or national level.

Purchasing Cooperatives. Purchasing cooperatives are those through which members may purchase many of their farm inputs such as fertilizer, feed, seeds, farm machinery, insecticides, and petroleum products. Purchasing cooperatives attempt to provide their members with high quality production supplies at the lowest possible cost, and thus effect savings for the farmer-member. Although the principal source of savings on farm inputs usually will come from lower prices, savings also may be obtained by providing higher quality products, better and more services, and supplies and equipment which are better adapted to the farming operations.

Many purchasing cooperatives are integrated horizontally and vertically. They may manufacture, process, wholesale, and retail the farm inputs, and they may acquire the sources of raw materials. In most states there are state-wide or regional purchasing cooperative associations. These associations often are structured on a federated basis, but they may be centralized cooperatives.

Service Cooperatives. Service cooperatives usually are formed to provide farmer-members with services, some of which may not otherwise be available. These services might include, for example, electrical service, insurance, credit, irrigation and drainage, and transportation. Service cooperatives attempt to provide farmer-members with services at the lowest possible cost and thus increase net returns from farming operations. Service cooperatives, however, are not limited to persons engaged in farming operations. Nonfarm people are members of service cooperatives which provide services for both urban and rural people.

Monopsony and the Cooperative Marketing Firm

The most extreme form of imperfect competition in purchasing is monopsony.[9] A monopsonist is the sole buyer of a resource.[10] In buying farm products as production inputs, the monopsonist faces a near purely competitive resource market. The monopsonist determines the quantity

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[9]Oligopsony may exist in buying farm products. Oligopsony means a few buyers of the resource and there may or may not be interdependence between buyers to set the resource price in the market.

[10]It is assumed that the farm product is a resource of the buying firms, either cooperative or noncooperative.

of the resource taken, and the market will set the price. Thus, resource exploitation exists.[11]

Monopsony in buying farm products results in monopsonistic exploitation of farmers as resource sellers. The monopsonist will employ resources up to the point where marginal revenue product of the resource is equal to its marginal resource cost. This is shown in Figure 1(a), where S_y is the market supply curve for resource Y; MRC_y[12] is the marginal resource cost curve and lies above the supply curve; MRP_y[13] is the marginal revenue product of the resource Y; and VMP_y[14] is the value of marginal product curve of the resource Y.

The profit-maximizing level of resource employment is that at which $MRP_y = MRC_y$. Since the point where marginal revenue product equates with marginal resource cost exceeds the resource (farm product) price, units of the resource are paid less than the value which they add to the firm's revenue. The resource owner (farmer) is paid OP_y; the resource adds OV to the firm. The monopsonistic exploitation of the resource is P_yv per unit of the product Y as shown in Figure 1(a). This is an example of how farmers may be monopsonistically exploited as owners of the resources.

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[11]Resource exploitation as used in this study is defined to mean that units of resource are paid less than the value of the product they add to the economy's output as a result of applying the marginalist maximization principles under imperfectly competitive market structure, and is not intended to connote any ethical judgments.

[12]MRC_y is the change in the firm's total cost resulting from a one unit change in the purchase of the resource per unit of time.

[13]MRP_y is the change in the firm's total revenue resulting from a one unit change in resource Y used per unit of time.

[14]VMP_y is the market value of a firm's increment in product when it increases the employment level of resource Y by one unit per unit of time.
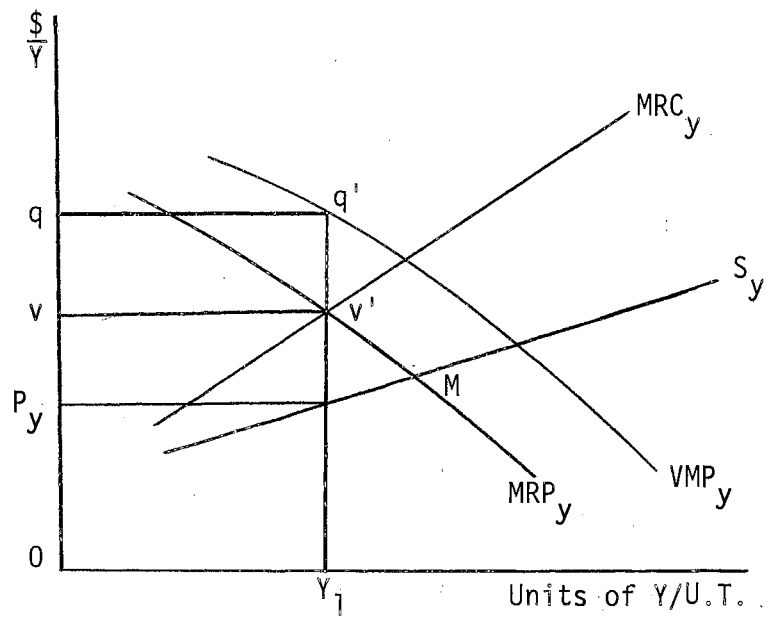
(a)
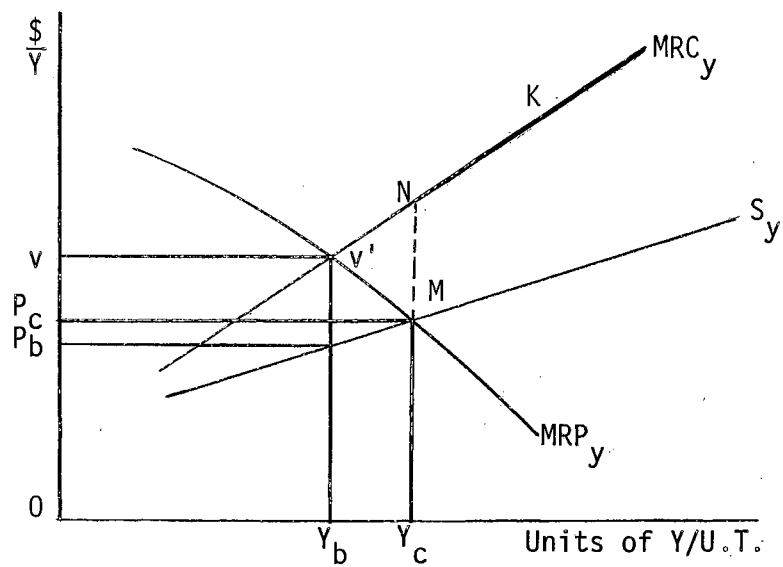
(b)

Figure 1.   Resource Supply and Cost Curves
for a Monopsonist.

Farmers through their cooperative can minimize monopsonistic exploitation by noncooperative marketing firms. Figure 1(b) represents the monopsonist situation before and after the entry of a cooperative firm. The monopsonist employs the level Y_b of resource Y before the cooperative sets prices. The price is OP_b per unit of resource Y. Resource Y is being exploited because OP_b is less than its marginal revenue product, Ov.

Assume that all farmers in the community form a bargaining cooperative.[15] Then the cooperative could bargain with the monopsonist to establish the price of the resource. Assume that the cooperative can reach OP_c price per unit for all units purchased or OY_c of resource Y. The supply curve facing the monopsonist will be P_cMS_y. The marginal resource cost will be altered to P_cMNK, and it is discontinuous between M and N.[16]

The monopsonist maximizes profit by using the quantity Y_c, at which the new marginal resource cost equals to marginal revenue product of Y. Thus, the price set by the cooperative could eliminate or reduce monopsonistic exploitation of farmers as owners of the resource and increase the quantity of farm products marketed.

Monopoly and the Cooperative Marketing Firm

Monopoly profits may exist if the resource buying firm faces a downward sloping demand curve for its product. Again, as shown in

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[15]In this situation, bilateral monopoly exists (i.e. monopsony in buying and monopoly in selling).

[16]Richard H. Leftwich, The Price System and Resource Allocation (New York, 1966), p. 286.

Figure 1(a), a unit of the resource, Y, adds VMP_y to the economy's output and MRP_y to the firm's output. Since the resource buying firm maximizes profits where $MRC_y = MRP_y$, the resource is paid OP_y. The unit of the resource adds Ov to the firm's revenue, but consumers value the resultant product at Oq. The difference, vq, represents an element of monopoly profit obtained from the consumers of the product.

Cooperative marketing firms could capture such monopoly elements by purchasing the farmers products and competing directly with the non-cooperative firm. The monopoly profits could then be distributed to farmers on a patronage basis.

Figure 2(a) shows cost and revenue curves of a noncooperative imperfectly competitive firm. AC_1 is the firm's average cost, MC_1 is its respective marginal cost, DD_1 is the demand curve for the firm's product, and MR_1 is its respective marginal revenue. The firm produces at the profit-maximizing amount of output, where its marginal cost is equal to marginal revenue; it sells its product for price OP per unit. Its profit per unit is C_1P, and the total economic profit is PC_1LK.

Assume that some farmers in the area form a cooperative firm to market their product. It would pay the going market price to farmer-members according to the aggregate supply of and the aggregate demand for the product. The cooperative would share the resource market and the product market with the noncooperative firm. Figure 2(b) shows the cost and revenue conditions of the noncooperative firm after the entry of the cooperative firm. No change in aggregate output is assumed. Figure 2(c) shows the possible cost and revenue curves of the cooperative firm.
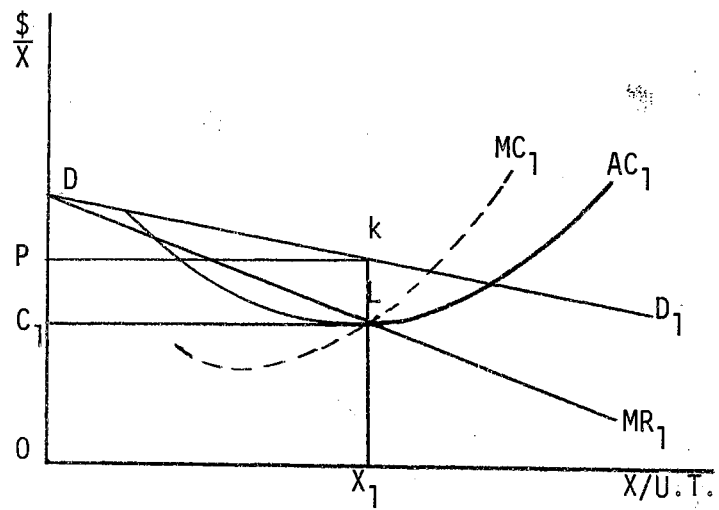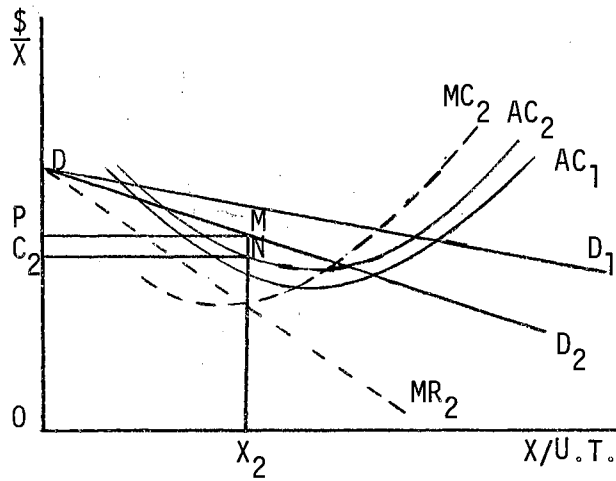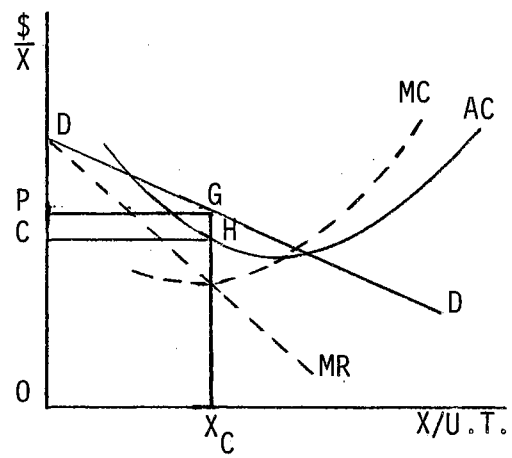
Figure 2. Cost and Revenue Curves for a Cooperative and Noncooperative Firm in Marketing Farm Products.

Both firms would produce at the profit-maximizing amount of output, X_c and X_2 respectively for the cooperative and the noncooperative firm, and sell their output for OP per unit. This assumes that there are no aggressive price policies between them. The cooperative firm would enjoy an economic profit of PCHG. The cooperative could return its excess profits PCHG to the farmer-members as patronage payments. Thus, the cooperative members would be paid the market price for the product plus patronage payments of CP per unit. The nonmember would be paid only the market price.

The entry of the cooperative firm and its sharing of the resource and product market with the noncooperative firm will have some effects. The cooperative shares the market demand curve for the product. DD_2 is the demand curve that faces the noncooperative firm after the entry of the cooperative, and MR_2 is its respective marginal revenue. Also the noncooperative firm, in order to obtain its necessary resources, would be forced to operate at a lower volume, pay the farmer higher prices, or pay transportation costs to buy the resource from other markets. This would increase its costs. The noncooperative firm's profit-maximizing output is OX_2 in Figure 2(b). It would sell its product at OP per unit but have less economic profit, PC_2NM. These types of price adjustments would continue until the economic profits were eliminated.

If one of these firms operated more efficiently than the other, the less efficient firm would be forced out of business in the long-run. However, if the cooperative were inefficient, the noncooperative firm

could continue enjoying economic profits and might be able to force the cooperative firm out of business.[17]

Imperfect Competition and Cooperative Purchasing Firm

Imperfect competition in selling farm inputs may include oligopoly and monopoly. Oligopoly means that there is a small number of sellers of a particular product, and any one seller can affect the activities of the others. For these types of imperfect competition, the firm's demand curve slopes downward and to the right. Consequently, marginal revenue for the firm will be less than the price. The firm maximizes profit by equating its marginal revenue with marginal cost.[18] The firm can control its output and, indirectly, prices. Thus, the firm has monopoly market power.

Lerner has suggested that the degree of monopoly market power be measured by the extent that marginal cost diverges from the price of the product.[19] Lerner used the formula, $Z_m = \frac{P - MC}{P}$, where Z_m is monopoly market power, P is product price, and MC is the marginal cost of the product.

In the marketing situation where perfect competition exists, price is equal to marginal cost and $Z_m = 0$. Thus, no monopoly power exists in

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[17]William H. Nicholls, _Imperfect Competition within Agricultural Industries_ (Ames, 1941), pp. 224-227.

[18]Marginal revenue (MR) is the revenue derived from an additional unit; and marginal cost (MC) is the cost of producing that additional unit of the product.

[19]Abba P. Lerner, "The Concept of Monopoly and the Measurement of Monopoly Power," _Review of Economic Studies_, Vol. 1 (New York, 1933), pp. 157-175.

perfect competition. The greater the degree of market imperfection, however, the greater will be the monopoly power in the market.

The entry of the cooperative purchasing firm would minimize the noncooperative firm's monopoly power. The cooperative can purchase farm inputs on the wholesale level and may gain some price discounts. The cooperative can also manufacture and process some of the farm inputs. It generally sells these at the going market price. It may gain economic profits which it may return to its members as patronage payments. If some profit is returned, the final farm input price will be less than if inputs are purchased from noncooperative firms. Thus, the cooperative could minimize monopoly power in the market.

Figure 3 depicts the hypothetical cost and revenue curve conditions for a purchasing cooperative and a similar noncooperative firm. Specifically, AC is the average cost of production, MC is the marginal cost, DD' is the demand curve facing the firm, and MR is its marginal revenue curve. The profit-maximizing output is OY_1, where MC equals MR. OP is the price per unit of product Y.

The cooperative and noncooperative firms will set prices at the profit-maximizing level of outputs. Then, the cooperative would return the profits, C_2PLK, to its members as patronage payments. The payment is C_2P per unit of product.

The noncooperative firm could find that its customers were switching to the cooperative and, if so, consider lowering the product price to offset competition. The profit positions of the respective firms would be affected by the degree of patron loyalty that could be maintained. The cooperative could eliminate economic profits of the noncooperative firm. However, if the noncooperative firm has enough patron loyalty,
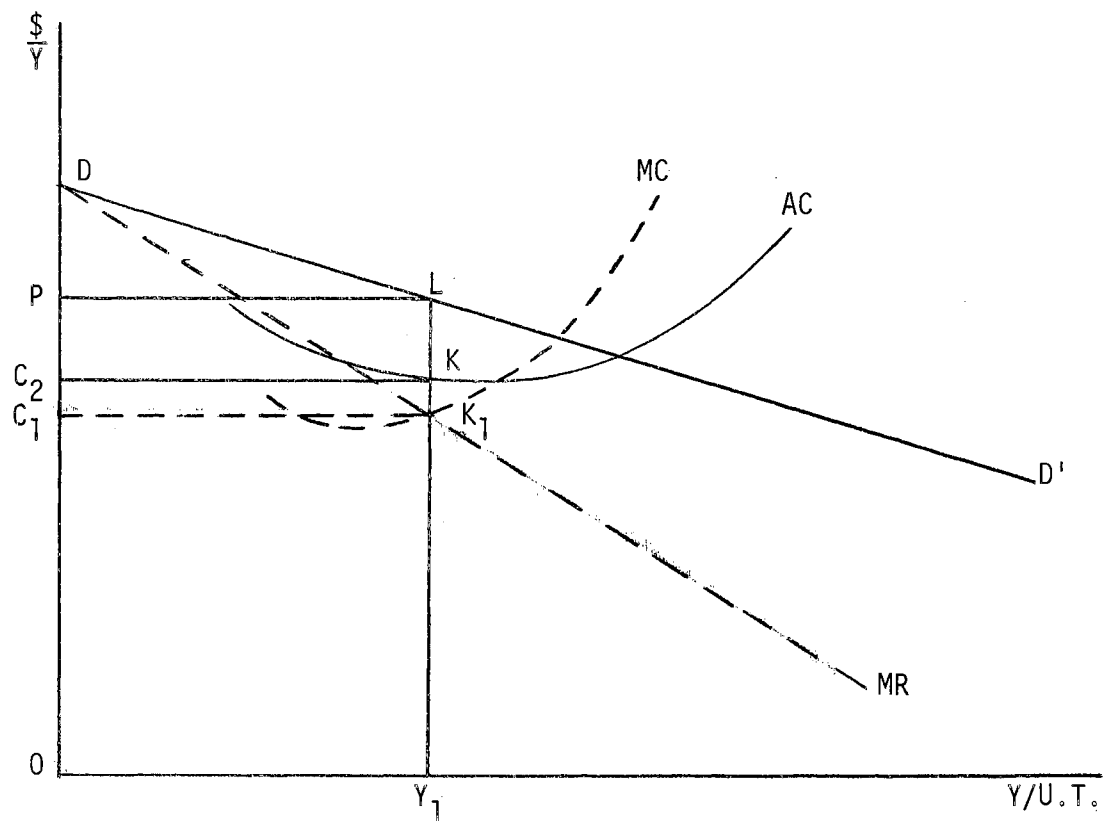
Figure 3. Cost and Revenue Curves for Cooperative and
            Noncooperative Firms in Purchasing Farm
            Products.

it may be able to keep some economic profits. The noncooperative firm's economic profits will also be affected by the relative efficiency of the cooperative firm. Thus, if the cooperative firm is efficient, it would minimize monopoly power.

CHAPTER III

HORIZONTAL INTEGRATION BY COOPERATIVES

In general, the term "integration" is used in the broadest sense
to designate almost any kind of coordination or fusion of business
firms.[1] There are two basic kinds of economic integration, horizontal
and vertical. Integration may be achieved either through ownership or
nonownership. If the situation is such that one firm actually owns
horizontally- or vertically-related marketing or production functions,
it is called ownership integration. Nonownership integration occurs
when various functions are brought under unified control, but ownership
of the firms remains separate. Contracts usually are the legal basis
of nonownership integration.[2]

Integration of like business units under one general administrative
control is called horizontal integration. It is a type of organiza-
tional or structural growth, or an organizational feature, and is not
a form of an organization per se. For the purpose of this study a
horizontally-integrated cooperative firm is a profit-maximizing firm in
which management controls a number of units or plants which operate at

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[1] Edwin G. Mourse and Horace B. Drury, Industrial Price Policies
and Economic Progress (Washington, 1938), pp. 70-79.

[2] For additional discussion of economic integration, see W. F.
Mueller, "The Economics of Vertical Integration," American Cooperation
(Washington, 1958), pp. 715-725.

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the same economic stage of production, processing, marketing or
purchasing.[3] Horizontal integration may be achieved by cooperatives
through the federation or merger of existing cooperatives, or through
internal growth. Horizontal integration in cooperatives most often is
accomplished through the federation of existing units or the addition
of units to a federation. A federation is a group of firms which
voluntarily group themselves for certain purposes under a single
control and administration.

The merger process involves combining two or more previously
independent businesses under a single ownership and control.[4] (While
merger is one way of achieving either horizontal or vertical integration,
one should not equate integration with merger. Integration can be
effected through internal growth of the firm as well as by external
growth, that is, through merger.

Mergers of cooperative firms have been successful in the dairy,
fruits and vegetables, and production supply fields. Many mergers
have been effected to capture economies of scale in production, market-
ing, and purchasing functions. (According to the Farmer Cooperative
Service of the United States Department of Agriculture, during the six-

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[3]Economic stage means any operating process capable of producing
an economic product or service.

[4]The term merger often is used synonymously with consolidation.
Technically, the term merger is properly used to apply to the situation
where one legal entity which continues its legal life, acquires the
assets of one or more other companies which then cease to exist as
legal entities. A consolidation takes place when a new legal entity
is formed to take over the assets of two or more companies. All of
the companies whose assets are acquired no longer exist as legal
entities. For a detailed discussion of mergers and consolidations,
see E. F. Donaldson, Business Organization and Procedure (New York,
1938), pp. 465-478.

year period 1957 through 1962, about 325 cooperative mergers took place in the United States.[5]

In the United States, the Cooperative Grange League Federation Exchange represented an outstanding example of a cooperative merger. The Grange League Federation was formed to coordinate the purchasing operations being performed by farmer cooperatives in the state of New York. It was developed out of several less effective cooperatives to perform a united cooperative purchasing service for its members. Recently, in 1964, the Grange League Federation and Eastern States Farmers Exchange were consolidated to form Agway Incorporated.[6]

Local, regional, and national cooperatives often integrate horizontally through the process of federation. Several national federations of regional supply cooperatives have been formed to process and manufacture farm supplies such as fertilizer, feed, and petroleum products. Federated marketing cooperatives, such as grain elevators, cotton gins, dairy plants, and poultry plants which are commonplace in most sections of the United States, are good examples of horizontally-integrated firms. In many instances additional horizontal integration is achieved by the merger or consolidation of several federations of cooperatives. These federations of federations often are referred to as "super cooperatives" or "super federations".

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[5]U.S. Department of Agriculture, Farmer Cooperatives in the United States, Farmer Cooperative Service, Bulletin No. 1 (Washington, 1965), p. 67.

[6]U.S. Department of Agriculture, Major Regional Cooperatives Handling Supplies, Farmer Cooperative Service, General Report No. 140 (Washington, 1967), p. 5.

Motives for Horizontal Integration by Cooperatives

According to Knapp, " . . . horizontal integration permits cooperatives to enjoy the economies and opportunities which are associated with large-scale enterprise such as (1) the accessibility and use of capital; (2) the selection and use of management; and (3) the application of research techniques."[7] Generally speaking, however, horizontal integration by cooperative firms is motivated by the desire to achieve business concentration, ownership concentration, and economic efficiency. These motives appear to reflect steps which could give the cooperative firm greater economic power in the market. Each motive will be discussed separately.

Business Concentration

One of the characteristics of market structure is the number of firms in the industry. The concentration of firms is indicated not only by the number of firms, but also by the size distribution of the firms in the industry. For example, an industry could have 100 firms with 90 percent of the business handled by one big firm, or an industry could have 10 firms with each firm accounting for an equal amount of the total business transacted. It is difficult to state which industry is more concentrated. A convenient measure has been devised by Bain[8] which combines both measures (absolute numbers and relative size) into a measure of the degree of concentration. He used a description of the

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[7] Joseph G. Knapp, "Cooperative Expansion Through Horizontal Integration," *Agricultural Cooperation* (Minneapolis, 1957), p. 358.

[8] Bain, p. 87.

percentage of business done by the largest four in the industry. This does not solve all problems, but it should be useful in this study.

Ownership Concentration

Business concentration often is achieved by cooperatives through the organizational structure of horizontal integration. Through this structure , cooperatives may achieve a high degree of concentration of both ownership and control in the market place. A high degree of control and ownership may increase the marketing power of cooperatives and consequently could increase their net returns. If there were multiplant, horizontally-integrated cooperatives in the industry and centralized control for buying or selling, it becomes obvious that farmers could exert an extremely powerful influence. Thus, ownership concentration of the firms in the market may increase the individual firm's net revenue for its owners.

Economic Efficiency

Economic efficiency is an important motive for horizontal integration by business firms. Cooperative firms attempt to integrate horizontally, through federation or merger, until they have a plant which, if operated efficiently, will allow them to keep some of the possible economies of size in management, production, selling, and buying. The reverse may very well be the situation if there are diseconomies of size. In some instances, a horizontally-integrated cooperative may not have enough outlets to permit it to expand to an optimum scale of plant. A frequent solution to this problem is

additional horizontal integration through federation, merger, or consolidation. As is explained later, such horizontal expansion usually is accompanied by some vertical integration.

Horizontally Integrated-Single Plant Cooperative Model

Marginal analysis may be used to develop the profit-maximizing model for the horizontally-integrated cooperative firm. Assume that there are a number of local cooperative firms carrying out marketing functions for their farmer-members. Then, further assume that these local firms integrate horizontally to form a larger firm to perform the necessary marketing functions more economically so as to increase net returns to the farmer-members. For ease and clarity of explanation, let us assume that the integrated firm is a federation. The local cooperatives pay the going market price to farmer-members. The federation may perform additional marketing functions such as processing, canning, and wholesaling. The analysis before and after the horizontal integration is considered in the remaining part of this section of the study.[9]

Figure 4 shows the cost and revenue curves for a local cooperative firm and a horizontally-integrated cooperative firm with economies of size assumed. Specifically, AC_B is the average cost of the representative local cooperative firm. MC_B is the respective marginal cost. The demand curve faced by the local cooperative firm is designated DD_1, and MR_1 is its marginal revenue. AC_A is the federated cooperative firm's average cost. MC_A is its respective marginal cost. DD_2 is the demand curve facing the federated cooperative and represents the

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[9]There is some degree of vertical integration in this situation, which is discussed in the following chapter.
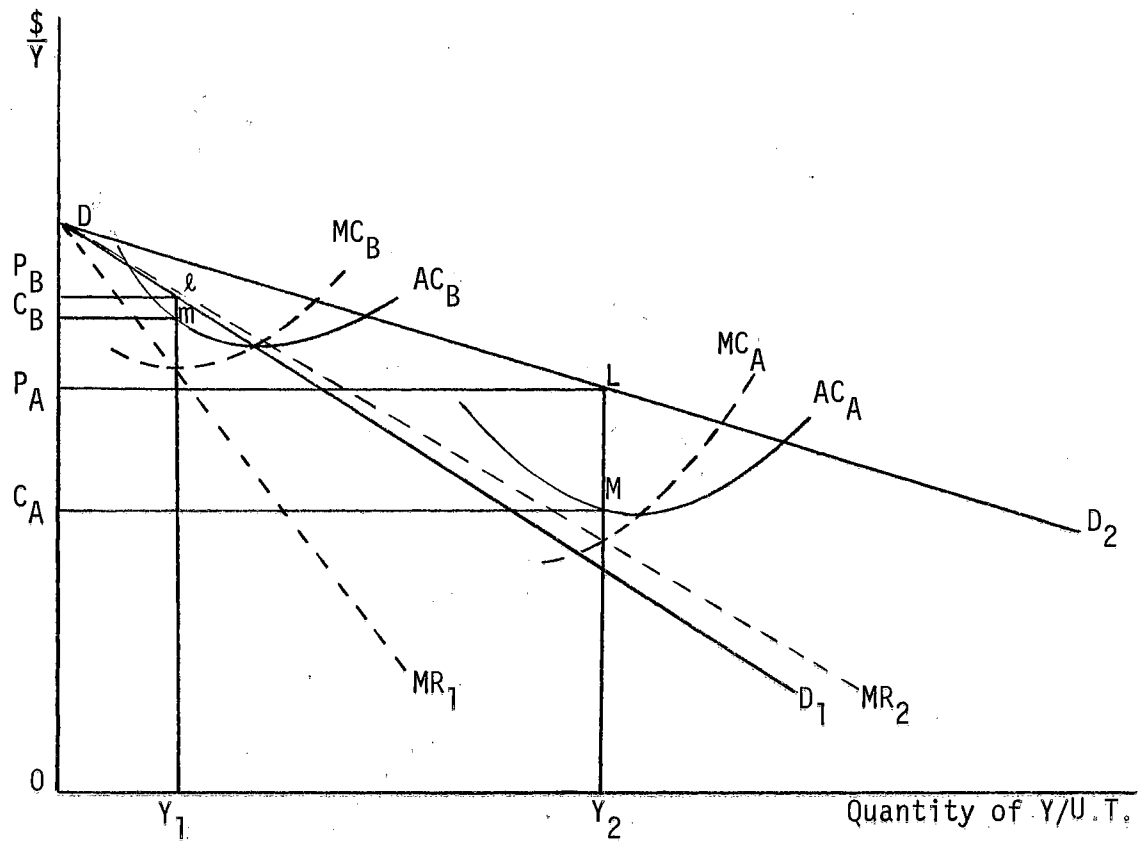
Figure 4. Cost and Revenue Curves for Single Product Firms Under
Horizontal Integration.

aggregate demand faced by all the local firms before integration. MR_2
is the marginal revenue curve for the federated firm.

To maximize net returns, production should be at the point of
intersection of the firm's marginal cost and marginal revenue curves.
Before federation (horizontal integration) of the locals, the local
cooperative would produce OY_1 at OC_B per unit cost and sell at a price
of OP_B. After the horizontal integration was effected, the federated
firm with its larger plant would produce an output equal to OY_2 at a cost
of OC_A per unit and sell this output at OB_A price per unit. Before
integration, the individual local cooperative would have only small
profit of $P_B \ell m C_B$. Consequently there would be a small saving to be
distributed to farmer-members through patronage payments. The federated
cooperative firm would have greater economic profit. These funds would
be distributed to farmer-members on a proportional basis. The patronage
payment of the federated cooperative in Figure 4 is $C_A P_A$ per unit, and
this would be greater than the patronage payment of $C_B P_B$ per unit before
integration.

If economies of size exist in an industry, they could be achieved
through horizontal integration. After integration, both the price and
per unit cost could be decreased, and an increase in profit to the
cooperative farmer-members could be achieved.

The above model was for a firm operating a single plant and
performing a single marketing function.[10] In the next section, a
multiplant, horizontally-integrated cooperative firm is developed,
and its net revenue maximizing situation is analyzed.

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[10]Appendix C will deal with the multiproduct firm model.

Horizontally-Integrated Multiplant Cooperative Model

The horizontally-integrated cooperative firm may own a number of plants to produce its product. For illustration, assume that a cooperative firm produces its output in two separate plants with a geographic separation between plants.[11] Assume further that the output (Y) is sold in a single market.

Figure 5 shows the hypothetical multiplant firm's cost and revenue curves. AC_1 is the average cost of the first plant and MC_1 is its respective marginal cost. AC_2 is the average cost of the second plant, and MC_2 is its respective marginal cost. $\sum_{i=1}^{2} MC_i$ is the summation of marginal costs of the two plants (i=1, 2). DD is the demand curve and MR is the marginal revenue curve. For profit maximization, marginal cost of production in each plant should be equal.[12]

The firm produces the amount OY_3 and allocates this production between the two plants so that OY_1 is produced in the first plant and OY_2 in the second plant. The product is sold at price OP per unit, and profit to the firm is the difference between its total revenue and its total costs for both plants. If marginal cost and average cost were to decrease in one of the plants, a greater part of the total output would be produced in this plant. The other plant would be kept idle or operated at a lower capacity until production levels or costs, or both, again made it economical to utilize both plants.

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[11]Sidney Weintraub, Intermediate Price Theory (Philadelphia, 1964), p. 289.

[12]Appendix B deals with the mathematical approach of multiplant firm model.
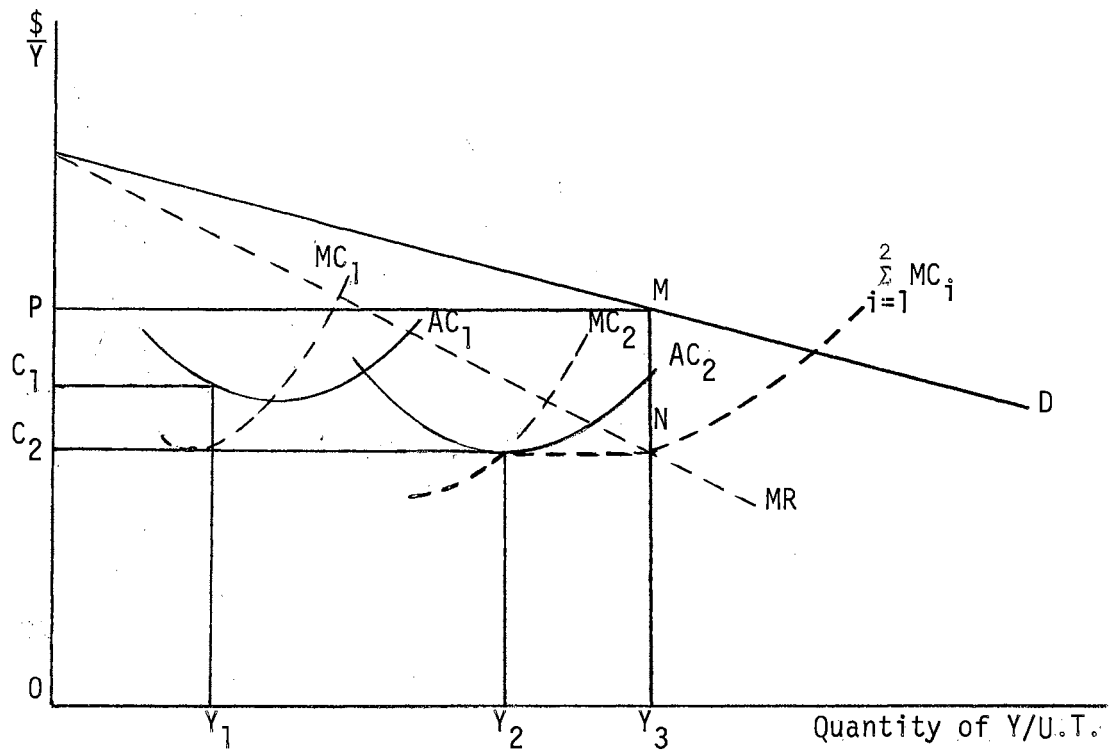
Figure 5. Cost and Revenue Curves for Multiplant Firms Under
Horizontal Integration.

Economic Effects of Horizontal Integration

A horizontally-integrated cooperative firm, like any firm, is economically efficient when it can achieve profit maximization. This assumes the best possible use of resources within the limitations of the existing plants. The following analysis describes some of the aspects of economic efficiency involved in a horizontally-integrated cooperative firm as well as some of the effects of horizontal integration.

Economies

Change in Demand. The nature of demand for the product faced by the individual local cooperative firm may be changed by horizontal integration. The demand curve for the product faced by the horizontally-integrated cooperative firm may be downward sloping because of product differentiation if the firm is large. Therefore, the firm could have some degree of monopoly power in the market.

Extensive advertising of the product may shift the demand curve to the right. For example, fifty years ago in the United States, fruit growers marketed their product individually and each grower faced a highly elastic demand curve for his product. In the 1930's some of the growers formed local cooperatives and the local cooperatives integrated horizontally to form a federated cooperative fruit-marketing firm known as Sunkist Growers, Incorporated. Since then, the demand for the product has shifted to the right, in part because of the extensive advertising and sales promotions implemented by the horizontally-integrated firm. During the past 35 to 40 years, Sunkist has invested

about 68 million dollars for advertising and merchandising fresh oranges, lemons, grapefruit, and processed citrus products.[13] The advertising and promotion have resulted in an increased sales volume for the firm.

Decreasing Per Unit Cost. One of the most important potential economic effects of horizontal integration is lower per unit costs which result from an increase in the size of the firm's plant. Economies of size arise because a firm with larger resources has a greater range of technological possibilities than a small local firm.[14] For example, many items of capital equipment are available only in very large sizes. Hence, the large plants may be composed of qualitatively different and technologically more efficient equipment items than small plants. Also as the plant becomes larger, the firm usually can benefit from specialization of labor and management. Exploitation of these opportunities by firms able to develop larger plants results in lower per unit costs. Larger plants usually are more efficient than small plants up to the optimal scale of plant. While a large firm may have lower costs up to some critical scale of plant, further increases in size beyond this minimum-optimum scale do not lead to further increases in efficiency.[15]

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[13]Irwin W. Rust and Kelsey B. Gardner, Sunkist Growers, Inc., Farmer Cooperative Service, U.S. Department of Agriculture, Circular 27 (Washington, 1960), p. 47.

[14]E. H. Chamberlin, "Proportionality, Divisibility, and Economies of Scale," The Quarterly Journal of Economics, Vol. LXII (February, 1948), pp. 229-257.

[15]Minimum-optimum scale of plant means that scale of plant which gives the lowest per unit cost of production and distribution. It indicates the highest degree of economic efficiency of the firm. For a detailed discussion, see Joe S. Bain, Industrial Organization, (New York, 1959), pp. 145-186.

In some industries, the minimum-optimum scale of plant may be very large in terms of volume of output. In other industries, the maximum technological efficiency may occur at a relatively small scale of plant. When the size of plant and output volume are large, additional efficiency in terms of reduced costs may occur because of economies effected through large volume of distribution and buying.[16] For example, a number of studies by the Farm Credit Administration showed how local cooperatives could integrate to reduce operating costs and increase efficiency. One of these studies indicated that four local packing houses could reduce average packing expense from $.95 to $.85 per box if all the fruit were handled by one large packing house.[17] This economic gain may be attributed to economies of size made possible through horizontal integration.

Diseconomies

Change in Supply. Since horizontal integration could lower per unit costs, the supply of the product could increase which could lead to a decrease in the product price. The cooperative firm might avoid the increase in supply by contracts and other limitations with the producers. It also might reduce the amount of business it did for members through the medium of a closed membership policy. Thus, the firm could initiate preventive measures so as to operate on the optimum scale of plant and increase the net savings for its members.

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[16]G. J. Stigler and Kenneth E. Boulding, Reading in Price Theory (Chicago, 1952), pp. 198-232.

[17]J. K. Samuels and George L. Capel, Citrus Packinghouse Costs in California, Farm Credit Administration, U.S. Department of Agriculture, Circular C-138 (Washington, 1951), p. 12.

Increasing Per Unit Cost. According to economic theory, certain
diseconomies may begin to develop as the size of the firm expands. For
one reason, the firm may become so large that the costs of maintaining
the organization in operation, such as executive costs, rise sharply.
Also the prices of the factors of production, the inputs of the firm,
may increase as a consequence of the increased demand for them on the
part of the horizontally-integrated firm. These diseconomies could
lead to increasing per unit costs at some size of plant.

The discussion thus far has dealt with the horizontal integration
by cooperative firms, the motives for that integration, and its
economies and diseconomies. In the following chapter, the economies of
vertical integration by cooperative firms is discussed and some
illustrations of the United States cooperative experience in this field
are presented. The possibility of expansion to increase the net income
for farmer-members also is discussed.

CHAPTER IV

VERTICAL INTEGRATION BY COOPERATIVES

The purpose of this chapter is to evaluate vertical economic
integration by cooperative firms. Cooperatives integrate vertically
so as to be in a better position to serve their members. This may be
in the form of additional services, better services, lower prices for
farm supplies, higher net prices for farm products, or some combination
of these factors. Through vertically integrated activities cooperatives
may gain some degree of market power and, if marketing economies result,
make it possible for farmers to share in these economies.

Concepts and Definitions

A vertically-integrated firm controls the administrative operations
of two or more economic stages of production, marketing, or purchasing.
The term vertical indicates the direction taken by the succession of
stages in production, processing and marketing farm products or purchas-
ing farm inputs. Thus, vertical integration applies to vertical
structures associated with internal coordination, and it occurs when a
firm combines activities which are unlike those it currently is
performing.[1]

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[1]Edwin G. Nourse and Horace B. Drury, Industrial Price Policies
and Economic Progress (Washington, 1938), p. 70.

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Vertical integration can be backward or forward. Forward vertical integration exists when it is initiated near the raw material stage of production and is extended toward the finished product and the ultimate consumer. Backward vertical integration exists when it is initiated near the consumer level and is extended toward the raw material stage.

As a working definition, an economic stage in production is any operating process capable of producing a product or a service which can be sold. Such a process may be a part of a longer production sequence within a firm. But so long as there is a possibility of separate sale associated with a sequence of stages that may be divided among firms, each process may be considered as a separate stage.

Motives for Vertical Integration

Maximizing Net Return

One of the most important motives for vertical integration through cooperative firms is that of maximizing net returns for farmer-members. Profit maximization is based on integration through farmer-owned cooperative firms to obtain the greatest economic efficiency.

The significance of vertical structuring in the economic sectors and the relationship between the farming sector and non-farming sectors has become more important with the increasing interdependence of agriculture and other industries. Expenditures for machinery, fertilizer, formula feeds, pesticides, and petroleum products from nonfarm sectors are expanding with the result that farmers are becoming increasingly more dependent on the marketing and purchasing sector of the economy. The relatively high prices paid by farmers for farm inputs and the

relatively low prices received for their products have reduced net revenue from farming operations.

Farmers continue to seek methods of increasing the prices they receive for their products and of decreasing the prices they pay for their inputs. Vertically-integrated cooperatives which are operated properly can help farmers in this respect. Through the development and use of both forward and backward vertically-integrated cooperative firms, it may be possible to organize, coordinate, and control marketing and production processes so as to obtain increased operating efficiency and more power over the buying and selling processes. This could be beneficial to farmers.

Gaining Market Power

Gaining market power is an important motive for integrating vertically. Market power may be considered as the ability of a firm involved in a particular structural environment to influence price for its own benefit. Individually, farmers do not have any significant amount of market power in product and resource markets because of the competitive market structure for firms handling farm products and supplies. Agricultural marketing firms have some degree of market power in non-atomistic situation. Vertical integration through cooperatives and the development of differentiated products through processing, grading, and special brand names may enable the cooperative firms to

gain some market power.[2] This approach has been used by several cooperative firms in the United States and will be discussed later in this study.

Vertically-Integrated Cooperative Firm Models

The theoretical model for a profit-maximizing vertically-integrated cooperative firm can be developed through the use of marginal analysis. In the following analysis, the assumption is made that a firm is integrated through the three stages of buying raw material, processing, and wholesaling.

Short-run Model

Figure 6 depicts the cost and corresponding revenue curves for the three successive stages. Specifically, AC_1 represents the average cost of the raw material plus services necessary to move the product in an acceptable form to processors. MC_1 is the marginal cost associated with AC_1. AC_2 is the average of the combined costs of the first marketing stage and the costs involved in the processing stage; MC_2 is the marginal cost associated with the combined stages. AC_3 is the average of the combined costs of the first two stages plus the wholesaling stages; MC_3 is the marginal cost for the aggregate of the three stages.

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[2]Discussing how farmers fare under vertical integration, Mueller states: ". . . This is largely a matter of relative bargaining power among the integrating participants. We should always remember that vertical integration alone need not affect this bargaining power. Vertical integration per se is neutral with respect to market power. Rather, the terms of integration arrangements reflect the relative bargaining power of the participants rather than cause it." W. F. Mueller, "The Economics of Vertical Integration," American Cooperation, 1958 (Washington, 1958), p. 724.
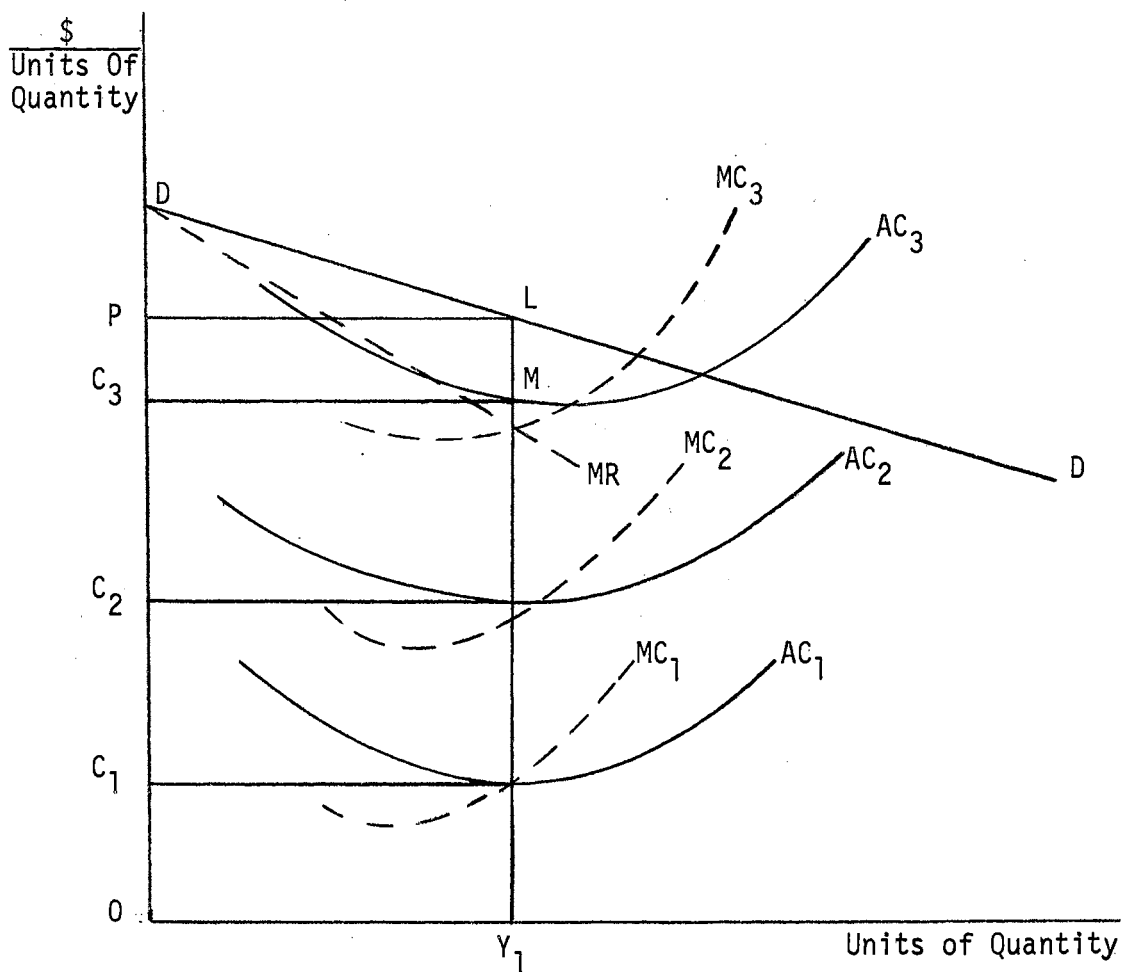
Figure 6. Cost and Revenue Curves for the Vertically-Integrated Firm in the Short-Run.

DD is the demand curve for the product faced by the firm. MR is its respective marginal revenue.

The profit-maximizing output is equal to OY_1 units, and is determined by the intersection of marginal cost and marginal revenue of the final stage. The price per unit at the wholesale level is OP. The average cost of OY_1 units is depicted by OC_3. The cooperative firm has an excess of revenue over costs represented by C_3PLM. If all net savings were distributed to farmer-members, they would receive the going market price for their product,[3] plus a patronage payment equal to C_3P per unit.

Long-run Model

The optimal structure of the firm may not be the same in the long-run as in the short-run. To determine how many economic stages are needed to maximize profits for the firm, a theoretical long-run model is developed under the following assumptions: 1) all production factors are variable; 2) all output of one stage is used as input in the next stage within the firm; 3) factor prices are held constant.

Figure 7 shows the long-run average cost curves for the firm as it continues adding stages of production. The average cost (AC_1) is the long-run average cost of the first stage. The average cost (AC_2) is the long-run average combined cost of the first and the second stages. By adding more economic stages, the long-run average costs go up to AC_3, AC_4 and AC_5. LC_1, LC_2, ..., LC_5 represent the levels of the combined lowest long-run average cost at which the successive stages can be

[3]The farm product is the raw material for the cooperative firm.
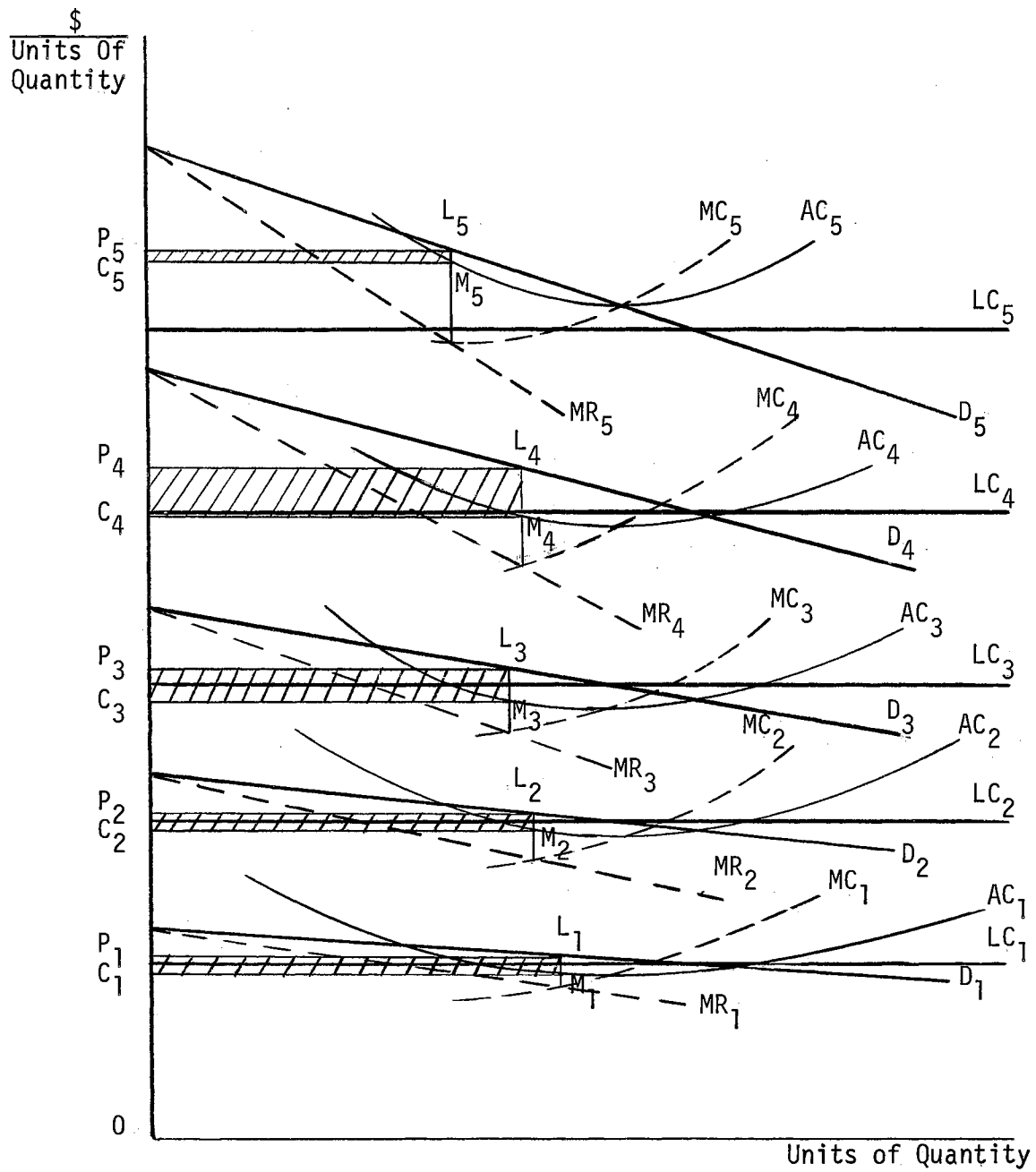
Figure 7. Cost and Revenue Curves for the Vertically-Integrated Firm in the Long-Run.

operated when vertical integration does not exist. The vertical distance between LC_1 and LC_2 represents the lowest average cost of operating stage 2 without vertical integration.

The decreasing part of the long-run average costs reflect the economies of size. As the volume of business increases, more specialization can be achieved which tends to increase the production efficiency and decrease per unit cost. The rising part of the long-run average cost reflects the diseconomies of size. As the volume of business increases, limitations to the efficiency of management will be encountered. Per unit costs of production will increase.

If the output of one stage is an input in the next stage, the vertically-integrated firm can obtain some inputs at a lower cost by eliminating the excess profits made by other firms in the industry. A vertically-integrated firm producing at stage 3, for example, can obtain the product of stage 2 at a price equal to its cost. This will cause the long-run average cost to fall below the lowest nonintegrated level LC_3.

If vertical integration were carried to the point of adding stage 5 in Figure 7, the lowest attainable long-run average cost would lie above the lowest long-run average cost level LC_5 because of the diseconomies of vertical integration and higher per unit costs. If LC_5 were the prevailing level set by competitive pressures, this firm would be forced to limit the number of vertically-integrated stages to four. Thus, stage 4 would be the highest possible stage of vertical integration to be considered by this firm.

Blaich has argued that as additional vertically-integrated processes are considered by the firm, the range of the volume of

business that could be conducted by the firm would decrease.[4] That is, management could operate a firm near LC_1 costs over a wide range of volumes. As more vertical integration is involved, the relatively flat portions of the relevant AC curves would decrease because of coordination problems of management. Therefore the AC curves would be flatter the lower the level of integration.

The demand curve for each stage would help in determining the most profitable stage for the cooperative firm. In Figure 7, D_1 is the demand curve for the product of stage 1 and MR_1 is its respective marginal revenue. D_2, MR_2, D_3, MR_3, D_4, MR_4, D_5 and MR_5 are described in the same way. MC_1, . . . , MC_5 are the long-run marginal costs of stage 1, . . . , 5. The firm would equate MR_i and MC_i (where i=1, 2, ... , 5) to determine the volume of business, price, and profit. By comparing the profits on each stage, the firm would determine the most profitable stage (i.e., stage four has the largest total profit $P_4C_4L_4M_4$, or P_4C_4 profit per unit) and limit its vertical integration to that stage. This stage maximizes profits for this firm.

<h3 style="text-align:center">Economic Effects of Vertical Integration</h3>

Economies

Economies of vertical integration arise from at least three sources. First, they may come from technological changes which require bringing complementary production processes together in a single plant for efficient operation. There are several examples of this source of

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[4] O. P. Blaich, "Integration in Theory with Application to Hogs," _Journal of Farm Economics_, Vol. XLII (December, 1960), pp. 1280-1293.

economies of vertical integration. In the pear packing industry, the
use of new technological techniques in the vertical structure reduced
the per unit cost of production.[5] Dairy cooperatives have used new
developments in technology to make processing and marketing functions
more economical for cooperatives and to increase profits for their
farmer-members. The egg cooperatives have used improved equipment to
grade, pack, and wholesale eggs and thereby increase the net returns
to their members.[6]

Second, economies of vertical integration may result from
elimination of expenses of purchase-sale transactions to move goods
from one stage to the next. The vertically-integrated firm processes
the product, packs it, and sells it to the retailer or the consumer.
But if there were middlemen between the farmer and the processor
and between the processor and the retailer, there also must be trans-
actions between them. Therefore, the vertically-integrated cooperative
firm would eliminate the expenses of purchase-sale transactions.

Third, economies of vertical integration may follow from elimination
of profits to private suppliers or customer's firms in excess of a basic
interest return on the added capital invested.[7] The cooperative firms
would eliminate the wholesale profits in marketing farm products and
purchasing farm inputs. Some cooperatives sell most of their products

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[5] B. G. French, L. L. Sammet, and R. G. Bressler, "Economic
Efficiency in Plant Operations with Special Reference to the Marketing
of California Pears," Hilgardia, Vol. 24 (Berkeley, 1956), pp. 543-721.

[6] R. L. Baker, Integration Egg Production and Marketing, United
States Agricultural Marketing Service, Marketing Research Report 332
(Washington, 1959), p. 46.

[7] Bain, p. 156.

at the retail level. The firms' net profit, which is the difference between total revenue and total cost, is distributed on the patronage basis. Therefore, any middleman's profits which accrued to the firm would be distributed to farmer-members.

Diseconomies

Although vertical integration seems economical because it would reduce the effects of market transactions, it could involve diseconomies. These diseconomies might take the form of higher costs of production, processing, and marketing resulting from the necessity of producing for oneself what might be purchased more cheaply from other firms or operating on the increasing part of the average cost of one or more economic stages.

If the integrated firm could buy products and services from outside firms for less than it would spend to produce them, the product would be purchased rather than produced, and in such a case, vertical integration would not increase costs but would permit the integrated firm to operate at lower costs. The diseconomies of vertical integration also might come as a result of the increasing number of stages performed by the firm. This would complicate the managerial functions and increase the management cost. However, the firm could choose the optimum degree of integration and the economical number of stages to gain from economies of vertical integration.

In summary, cooperative firm's motive to integrate vertically arises from the prospect of increasing its net revenue by marketing farm products or purchasing farm inputs. Cooperatives may increase their net revenue by performing successive functions in production and marketing of their products.

CHAPTER V

COOPERATIVE MARKETING FIRMS IN THE UNITED STATES

Farmers in the United States have worked together because they
have found that many things could be done better cooperatively than
through individual action. At first cooperation was informal, but as
farmers began to produce more farm products than they could consume,
they looked to cooperatives to find a market for their products.[1] The
important objective of marketing cooperative is to maximize the net
returns or net savings for their members.

Early Development of Cooperative Marketing of Farm Products

Since early colonial days, farmers in the United States have viewed
marketing cooperatives as having an economic advantage over the non-
cooperative firms in certain sectors in the marketing system. However,
the first period of real growth in the agricultural cooperative move-
ment in the United States came during the depression of 1871-1877. The
first organization in this period to form group marketing of farm
products was the Grange.

The Grange had a great effect on the establishment of farmer
cooperatives. In the years 1871-76, more than 20,000 local Granges,

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[1]Ward W. Fetrow, Cooperative Marketing of Agricultural Products,
Farm Credit Administration, Cooperative Division, Bulletin 3
(Washington, 1936), p. 23.

as well as some 26 state agency systems were established. County
Granges in many cases acted as business enterprises for members of the
local units. These early Grange movements were active in cooperative
marketing and lessened the distressing consequences of economic mal-
adjustments. But as the United States recovered from the depression
of the 1870's, fewer Granges were organized and many cooperative firms
went out of existence.

Following the decline of the Grange, another farm organization
called the Farmers Alliance, was organized in several areas. Later,
its locals united and spread over the whole southern part of the United
States. Efforts of the Farmers Alliance in cooperative business
enterprises were similar to those of the Grange. Although short lived,
the Farmers Alliance during ten years of its most active existence
placed a great deal of emphasis upon agricultural marketing cooperatives.

The American Society of Equity began in 1902 in southern Illinois.
It sponsored many agricultural marketing cooperatives in the north
central part of the United States. Its efforts were directed mainly to
marketing livestock, grain, and potatoes. Many local cooperatives soon
began to handle farm products. It established and sponsored several
cooperative livestock packing plants in Wisconsin, Minnesota, and the
Dakotas during the period 1913 to 1917. Many of the local cooperatives
in the Midwest still carry equity in their names.

The decade 1910 to 1920 was one exhibiting stirring changes for
agriculture in the United States. The increase in the number of agri-
cultural cooperatives meant shifts in the programs of the state and
federal agricultural agencies. The system of county agents was
established. The state and newly organized extension services took

over the program of the farmers institutes. The Office of Markets was
formed in 1913, and its first project dealt with cooperative marketing
and purchasing. The research and service assistance to cooperatives is
now administered by Farmer Cooperative Service of the United States
Department of Agriculture. Many county agents were active in the forma-
tion of local and large-scale agricultural cooperatives. By 1920, there
were large federations whose members were local cooperatives for market-
ing farm products. Other groups were replacing the local cooperatives
with branch offices and plants of large-scale centralized cooperatives
serving an entire producing district or an entire state. Others were
cooperatives selling in terminal markets.

The American Farm Bureau Federation was formed in 1919. It set up
special committees to prepare plans for establishing national marketing
cooperatives. The committees dealt with livestock, grain, fruits, and
vegetables. Its operations during the period 1920 to 1925 constitute
an interesting period in the development of cooperatives by locals in
the United States. The national cooperatives of grain, livestock, and
wool have received the greatest consideration by this organization.

Other farm organizations have also contributed to the development
of cooperative marketing. The Farmers Educational and Cooperative Union,
which was organized in Texas in 1902, and the Non-partisan League of
North Dakota were effective in getting farmers to work cooperatively
toward the solution of their problems. The Agricultural Wheel, the
Brothers of Freedom, and other organizations of lesser historical
importance were influential in the early cooperative movement in the
United States.

Integration Through Cooperative Marketing

Important development and growth of size and volume of business of
marketing cooperatives in the United States can be interpreted largely
in terms of the economic environment in which they operate. In an era
characterized by the trend toward large-scale enterprises and toward
concentration and control by nonfarming sectors, the cooperative market-
ing firms have attempted to get increased power in the market through
integration. Since the movement of Sapiro in the 1920's, both horizontal
and vertical integration have been applied by cooperative marketing firms
with the view that through cooperative integration and control of a large
percentage of farm commodity sales, farmers would be powerful enough to
achieve the advantage of some monopoly control in marketing.

Development

Integration was a dominant idea in many cooperatives formed in the
1920-1925 period. There were 16 large, centrally controlled cooperatives
with approximately 50,000 members at the end of 1920. Cooperatives of
this type had increased to 74, with more than 879,000 members, by 1926.
Cotton, wheat, and milk were the major commodities represented. Member-
ship contracts which could not be canceled over a ten-year period were
used to ensure that members would deliver their crops. Several large
cooperatives, active today, were formed during this period.

The experience of the "Sapiro-promoted" commodity marketing
cooperatives demonstrated the weakness of the basic premises of monopoly
control because cooperatives never obtained control of a percentage of
any crop sufficient to make an attempt to fix prices. The idea was
taken up again in 1929 by the Federal Farm Board which endeavored to

form strong national marketing federations, and it was instrumental in assisting in the organizations of several additional large organizations, many of which still are active. The idea appeared again in the 1960's as one of the principle aims of the National Farmers Organization.

Since 1933, the existing regional federations have added many local cooperative members, and many new regional federated organizations have been formed through integration. One of the more recent is Associated Dairymen, Incorporated. There are few new independent local associations, as most of them have found it desirable to join an existing regional federation. Many of new local associations which have been formed were formed with the assistance of a federated organization with the understanding that they would become a segment of the already federated system.

Groups of regional federations have made considerable progress in financing and operating national organizations. These organizations may be thought of as federations, although generally the overhead federation includes some member organizations of the centralized type. The field of cooperative marketing includes such firms as the National Livestock Producers Association, the National Federation of Grain Cooperatives, the National Cooperative Milk Producers Federation, and the National Wool Marketing Cooperative. The member associations of the national federations reach back to the farmers who own and control the primary cooperative units. Thus, this national cooperative network horizontally and vertically integrates the market and procurement operations for the members.

Cooperatives began to increase the number of marketing services as one means of integration in the period between 1933 and 1945. The

result has been increased vertical integration in fruit and vegetables, dairy, cotton, grain, poultry, and livestock cooperatives. By 1945-46, for example, there were 20 agricultural cooperatives manufacturing and marketing dairy products and which performed a number or all of the market functions in the channels extending from the local plant to the consumer.[2]

The period 1945-62 was one of continued substantial cooperative growth through integration in the United States. The net volume of yearly business increased by more than 50 percent or from $8 billion in 1945 to $13 billion in 1962. While the number of marketing and purchasing cooperatives declined from approximately 10,000 to 9,039, total membership increased from five million to more than seven million patrons. The decline in number of firms reflects a tendency toward integration and consolidation, especially among the smaller ones.[3]

An Example - Integrated Cotton Marketing Cooperatives

Farmers have formed cooperative cotton gins and cottonseed oil mills to market their cotton and cottonseed through their own firms. Processing cottonseed and marketing the products, however, involves performance of many services not directly connected with the crushing operations, or marketing of products, but which are of real benefit to cooperative members. Such services include buying seed and paying transportation charges, grading, analyzing seed, and product storing.

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[2]Ward W. Fetrow and R. H. Elsworth, Agricultural Cooperation in the United States, Farm Credit Administration, Cooperative Research and Service Division, Bulletin 54 (Washington, 1947), p. 57.

[3]U.S. Department of Agriculture, Farmer Cooperatives in the United States, Farmer Cooperative Service (Washington, 1965), p. 71.

The benefits derived from cooperative cottonseed oil mill operations are shown by the recent growth in cooperative processing. As late as 1934, there were only three cooperative mills in the United States. Since that time, however, cotton producers have placed increasing importance on this phase of their cooperative activity and by 1960, approximately 50,000 cotton farmers were crushing their cottonseed through 19 farmer-owned mills.

The benefits member-patrons have received from cooperative mills are indicated in Table III. Returns from cooperative mills and average farm prices in selected states during the 3-year period 1957-58 through 1959-60 as well as the price differential cooperative patrons received, are shown for comparative purposes.

The average investment in fixed assets at cooperative mills during this 3-year period was $24.65 per ton of seed crushed. Therefore, returns on invested capital (whether borrowed or furnished by members) were 13.2 percent in 1957-58; 22.2 percent in 1958-59; and 29.4 percent in 1959-60.[4]

The data in Table III show that the price the farmer received for cottonseed, including patronage payments, has been substantially higher than the average noncooperative farmer's price from cottonseed. The advantages to cooperative mill members were $12.77 per ton for Arkansas, $18.63 for California, $11.60 for Mississippi, $16.75 for Oklahoma, and $13.99 for Texas in 1959-60 season.

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[4]Elmer J. Perdue, Crushing Cottonseed Cooperatively, Farmer Cooperative Service, U.S. Department of Agriculture, Circular 30 (Washington, 1962), p. 4.

TABLE III

COTTONSEED: AVERAGE FARM PRICES, RETURNS TO PATRONS,
AND ADVANTAGES TO PATRONS OF COTTONSEED OIL MILLS,
SELECTED STATES, 1957-58 THROUGH 1959-60

	1957-58			1958-59			1959-60		
State	Returns To Cooperative Mill Patrons	Average Farm Price	Advantage To Coop. Mill Patrons	Returns To Cooperative Mill Patrons	Average Farm Price	Advantage To Coop. Mill Patrons	Returns To Cooperative Mill Patrons	Average Farm Price	Advantage To Coop. Mill Patrons
					Dollars Per Ton				
Arkansas	56.61	50.60	6.01	52.61	45.00	7.61	50.77	38.00	12.77
California	70.24	52.80	17.44	66.37	43.00	23.37	63.03	44.40	18.63
Mississippi	55.04	50.30	4.74	52.55	47.70	4.85	50.70	39.10	11.60
Oklahoma	63.39	49.70	13.69	58.14	41.40	16.74	54.35	37.60	16.75
Texas	63.67	51.80	11.87	54.62	42.40	12.22	52.14	38.20	13.94
Average	61.79	51.04	10.75	57.36	43.90	12.96	54.70	39.46	14.74

Source: Elmer J. Perdue, Crushing Cottonseed Cooperatively, Farmer Cooperative Service, United States Department of Agriculture, Circular 30 (Washington, 1962), p. 3.

The mill's returns to the patron consisted of sales proceeds less costs incurred. There are variations among the firms with respect to the amount returned by years and between states as shown in Table III. Such factors as volume and quality of seed, crushing efficiency, and location can materially affect the returns a firm is able to make. However, farmers have increased their net returns by integration through their own cooperative firms.

The Southwestern Irrigated Cotton Growers Association, subsequently referred to as SWIG, is an example of a vertically-integrated cooperative firm involved in marketing cotton and cottonseed. It follows the principles of operating at cost by buying cotton and cottonseed delivered by its members and returns to them the net returns above costs.

SWIG was organized in July 1926 by the cotton producers in irrigated areas of Texas and New Mexico around El Paso, Texas. It is incorporated and is owned by its member cotton producers. It is managed by a board of directors of five elected people. SWIG has a cottonseed oil mill, oil refinery, and cotton marketing department. The cotton producer becomes a member after paying the $10 membership fee and receives a membership certificate in the cooperative. More than two-thirds of the total United States production of American-Egyptian Pima S-1 producers are members of SWIG.

SWIG planned from the beginning to market cotton and process and market cottonseed products. It made a start in 1928 by contracting with a commercial oil mill to receive and process cottonseed delivered by its members on a profit-sharing basis. This arrangement did not prove to be satisfactory since there were no profits after the mill paid going prices for seed. An attempt was then made to purchase a

minority interest in an oil mill. This did not materialize. Finally, it became obvious that the only solution was for SWIG to buy or lease an oil mill.

During the 1934-35 and 1935-36 seasons, a local oil mill then in receivership was leased by SWIG and operated for the benefit of its members. The operation was successful from the beginning. In June 1936, the lease was renewed for another five years with an option to buy at any time during the period for $60,000. Under this option the interests of the minority owners were purchased during the 1937-38 season and of the majority owners the following year.

During the five years of operation under the lease, accumulated equities of patrons in the mill exceeded the purchase cost. At the time the title was obtained, the value of the land and machinery exceeded $100,000. Net returns per ton were above prevailing market price. This price advantage to members for the five years while the mill was leased averaged $2.06 a ton and totaled $118,161 on 57,450 tons cottonseed processed and marketed.[5]

In 1950, SWIG installed a cottonseed oil refinery at a cost of $160,000. This gave the firm the advantage of being able to market either crude or refined cottonseed oil as relative prices of the two products varied. It also made possible better price protection, since refined oil is deliverable on future contracts.

The processing capacity of the oil mill was 165 tons of seed per 24 hours in 1960. It operated 24 hours a day, 7 days a week, and usually

[5]Otis T. Weaver, Southwestern Irrigated Cotton Growers Association, Farmer Cooperative Service, U.S. Department of Agriculture, Circular 29 (Washington, 1962), p. 42.

9 to 10 months a year. SWIG processed cottonseed into many products. The average quantities of processed products obtained from a ton of cottonseed from the 1959-60 crop are shown in Table IV. These products were turned directly or indirectly into products for many uses including food, household uses, feed for livestock, industrial applications, and national defense.

TABLE IV

AVERAGE QUANTITIES OF PROCESSED PRODUCTS OBTAINED FROM A TON
OF COTTONSEED, SOUTHWESTERN IRRIGATED COTTON GROWERS
ASSOCIATION, 1959-60

Product	Pounds
Crude cottonseed oil	381
Cottonseed meal and cake	881
Cottonseed hulls	483
Linters, 1st and 2nd cuts	143
Motes, grabbots	7
Milling loss	105
Total	2,000

Source: Otis T. Weaver, Southwestern Irrigated
Cotton Growers Association, Farmer Cooperative
Service, U.S. Department of Agriculture, Circular
29 (Washington, 1962), p. 8.

SWIG has increased the sales volume of its products in recent years. Starting from a low point with the crop of 1939-40, volume began a steady increase in the early 1940's that accelerated rapidly during the 1950's. Total returns to patrons for both cotton and cottonseed increased from $1.8 million in 1939-40 to over $10 million in the late 1940's and early 1950's, and increased to $27 million for the crop of 1958-59 (Table V).

Bales of cotton marketed increased from less than 30,000 in 1939-40 to more than 50,000 in 1949-50, and then more than doubled

TABLE V

COTTON AND COTTONSEED: QUANTITIES MARKETED AND NET SALES
RETURNS TO PATRONS, SOUTHWESTERN IRRIGATED COTTON
GROWERS ASSOCIATION, 1926-27 THROUGH 1959-60

Fiscal Year	Quantities Marketed		Net Sales Returns To Patrons		
	Cotton	Cottonseed	Cotton	Cottonseed	Total
	Bales	Tons		Dollars	
1926-27	2,816	----	143,000	----	143,000
1927-28	18,017	----	1,478,000	----	1,478,000
1928-29	21,914	----	1,601,836	----	1,601,836
1929-30	35,099	----	3,057,174	----	3,057,174
1930-31	66,593	----	3,424,457	----	3,424,457
1931-32	58,644	----	1,844,745	----	1,844,745
1932-33	33,930	----	1,144,566	----	1,144,566
1933-34	57,486	----	3,173,385	----	3,173,385
1934-35	51,311	10,714.6	1,741,687	424,512	2,166,199
1935-36	32,642	6,327.9	2,745,369	225,653	2,971,022
1936-37	34,052	11,518.4	2,076,252	508,883	2,585,135
1937-38	49,689	15,455.6	2,120,221	358,154	2,505,375
1938-39	33,146	13,433.2	1,489,913	326,561	1,816,474
1939-40	29,950	10,689.0	1,459,879	344,186	1,804,065
1940-41	33,786	13,218.2	1,694,734	366,541	2,061,276
1941-42	36,328	15,057.9	3,825,617	859,249	4,684,866
1942-43	41,879	14,330.9	5,072,072	808,008	5,880,080
1943-44	35,190	16,571.1	4,442,900	1,096,500	5,539,400
1944-45	33,918	16,707.2	4,164,350	1,118,712	5,283,062
1945-46	35,367	18,522.7	4,730,204	1,311,367	6,041,571
1946-47	39,506	19,056.8	6,829,838	2,482,216	9,312,054
1947-48	44,841	20,129.7	8,474,342	2,781,040	11,255,382
1948-49	54,316	30,655.2	9,267,775	2,435,177	11,702,952
1949-50	50,154	33,702.6	8,822,798	2,017,288	10,840,086
1950-51	36,993	27,365.1	9,209,728	3,307,335	12,517,063
1951-52	40,653	32,980.5	8,771,237	2,790,293	11,561,530
1952-53	38,566	41,726.5	7,106,243	3,651,849	10,758,092
1953-54	49,956	38,723.2	10,461,066	2,616,812	13,077,878
1954-55	65,659	37,631.5	13,094,712	2,770,058	15,864,770
1955-56	73,946	31,666.4	14,493,725	1,911,720	16,405,445
1956-57	84,777	38,319.7	16,678,111	2,930,824	19,608,935
1957-58	81,835	38,673.8	16,362,044	2,615,349	18,977,393
1958-59	122,533	45,755.6	24,335,196	2,562,780	26,897,976
1959-60	111,658	50,485.3	21,711,164	2,790,035	24,501,199
Total	1,637,150	649,418.5	227,048,341	45,438,102	272,486,443

Source: Otis T. Weaver, Southwestern Irrigated Cotton Growers
Association, Farmer Cooperative Service, U.S. Department of Agricul-
ture, Circular 29 (Washington, 1962), p. 51.

by 1960. The tonnage of cottonseed processed showed similar increases.

SWIG paid the producers the prevailing prices paid by other mills at the time member-producers delivered their cotton. At the end of the fiscal year, the members received their shares of the net returns to the cooperative as patronage payments.

The net return to members averaged $9.83 a ton on cottonseed over the 26-year period. The mill has returned to patrons a total of $6,385,189 on 649,418.5 tons of cottonseed processed (Table VI). In terms of price per ton, SWIG members received over the 26-year period an average return of $69.97 or 16.3 percent more than the $60.14 average prevailing market price.

Net returns to members of more than $40 per ton for the crops of 1946-47 and 1947-48 were abnormally high. They represented the benefits that member-producers received, as owners of the marketing cooperative during a period of advancing cottonseed prices following the removal of the price controls after World War II.

During a recent three-year period, 1957-59, net returns paid to members averaged $7.69 per ton above the market price for cottonseed in the area and totaled more than $1,000,000 on the 134,915 tons marketed by members. This additional amount received by SWIG members was an average return of about 59 percent on the $701,952 net worth investment in the oil mill plant. For the crop of 1959, the additional net returns received by the members represented a 65.7 percent return on the net worth of the oil mill plant. Therefore, the integrated marketing cooperative increased the net returns through patronage refunds for its members.

TABLE VI

COTTONSEED: PRICES AND NET SALES RETURNS TO PATRONS
OF SOUTHWESTERN IRRIGATED COTTON GROWERS
ASSOCIATION, 1934 THROUGH 1959

Crop Year	Tons Marketed	Prices Paid Per Ton By		Net Sales Returns To Patrons	
		SWIG	Others	Per Ton	Total Amount
	Tons		Dollars		
1934	10,714.6	39.62	37.45	2.17	23,251
1935	6,327.9	35.66	33.31	2.35	14,871
1936	11,518.4	44.18	35.57	8.61	99,173
1937	15,455.6	24.92	23.82	1.10	17,001
1938	13,433.2	24.31	27.00	2.69	36,135
1939	10,689.0	32.20	26.23	5.97	63,813
1940	13,218.2	27.73	23.50	4.23	55,913
1941	15,057.9	57.06	51.70	5.36	80,710
1942	14,330.9	56.38	51.62	4.76	68,215
1943	16,571.1	66.17	57.29	8.88	147,151
1944	16,707.2	66.96	63.00	3.96	66,161
1945	18,522.7	70.80	62.97	7.83	145,033
1946	19,056.8	130.25	85.95	44.30	844,216
1947	20,129.7	138.16	96.27	41.89	843,233
1948	30,655.2	79.44	77.50	1.94	59,471
1949	33,702.6	59.86	44.00	15.86	534,523
1950	27,365.1	120.86	98.24	22.62	618,999
1951	32,980.5	84.60	79.39	5.21	171,828
1952	41,726.4	87.52	76.74	10.78	449,811
1953	38,723.2	67.58	59.49	8.09	313,271
1954	37,631.5	73.61	64.00	9.61	361,639
1955	31,666.4	60.37	53.00	7.37	233,381
1956	38,319.7	76.48	72.00	4.48	171,672
1957	38,673.8	67.63	64.13	3.50	135,358
1958	45,755.6	56.01	46.50	9.51	435,136
1959	50,485.3	55.26	46.00	9.26	767,494
Total Or Average	659,418.5	69.97	60.14	9.83	6,385,189

Source: Otis T. Weaver, Southwestern Irrigated Cotton
Growers Association, Farmer Cooperative Service, U.S.
Department of Agriculture, Circular 29 (Washington, 1962),
p. 53.

Growth in Cooperative Marketing of Farm Products

The proportion of marketing business done by marketing cooperatives is one measure of the importance of cooperative marketing in the economy. Available data, in dollar terms, indicate that about 25 percent of all farm products in United States move through cooperatives. This ranges from highs of 90 percent for cranberries and 70 percent for Florida and Arizona citrus to a low of 5 percent for broilers and tobacco. The proportions handled by cooperatives in 1964 for other commodities were as follows: dairy products, 65 percent; grain, 40 percent; cotton and related products, 25 percent; fruits and vegetables, 25 percent; wool and mohair, 20 percent; turkeys, 19 percent; livestock, 13 percent; and eggs, 10 percent.[6]

The growth of cooperatively marketed farm products has been substantial. Available data in index number form indicate that, from 1950-51 to 1962-63, the net value of farm products marketed through cooperatives has increased along with the total cash receipts by all farmers. These index numbers, developed and used by the Farmer Cooperative Service,[7] are presented in columns (1) and (3) in Table VII.

Comparison of the two indexes indicates that the net value of farm products marketed through cooperatives increased at a faster rate than the total cash receipts by farmers in the same period. This is shown graphically in Figure 8. Since 1956, the index of marketings through

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[6]Martin A. Abrahamsen, Cooperatives Today and Tomorrow, Farmer Cooperative Service, U.S. Department of Agriculture, Information 52 (Washington, 1966), p. 7.

[7]Martin A. Abrahamsen, "Cooperative Trends Show Progress," News for Farmer Cooperatives, Farmer Cooperative Service, U.S. Department of Agriculture (March, 1965), p. 4.

TABLE VII

INDEXES AND FIRST DIFFERENCES OF INDEXES OF NET VALUES OF
COOPERATIVELY MARKETED FARM PRODUCTS, AND OF TOTAL
RECEIPTS BY ALL FARMERS, 1950-51 THROUGH 1962-63

Period	Index of Net Cooperative Marketing Value (1) y_1	First Difference Of Column (1) (2) Y_1	Index Of Receipts Of All Farmers (3) y_2	First Difference Of Column (2) (4) Y_2
1950-51	76.1		89.6	
1951-52	88.2	12.1	102.2	12.6
1952-53	88.0	- 0.2	100.8	- 1.4
1953-54	87.7	1.3	97.8	- 3.0
1954-55	88.8	1.1	94.1	- 3.7
1955-56	89.6	0.8	91.1	- 3.0
1956-57	95.6	6.0	95.1	4.0
1957-58	99.4	3.8	92.9	- 2.2
1958-59	108.8	9.4	104.0	12.1
1959-60	111.5	2.7	104.2	0.2
1960-61	115.1	3.5	105.8	1.6
1961-62	121.5	6.4	109.8	4.0
1962-63	129.5	8.0	112.4	2.6
13-year average base period for index	100.0		100.0	

Source: Martin A. Abrahamsen, "Cooperative Trends Show Progress," News For Farmer Cooperatives, Farmer Cooperative Service, U.S. Department of Agriculture (March, 1965), p. 4.
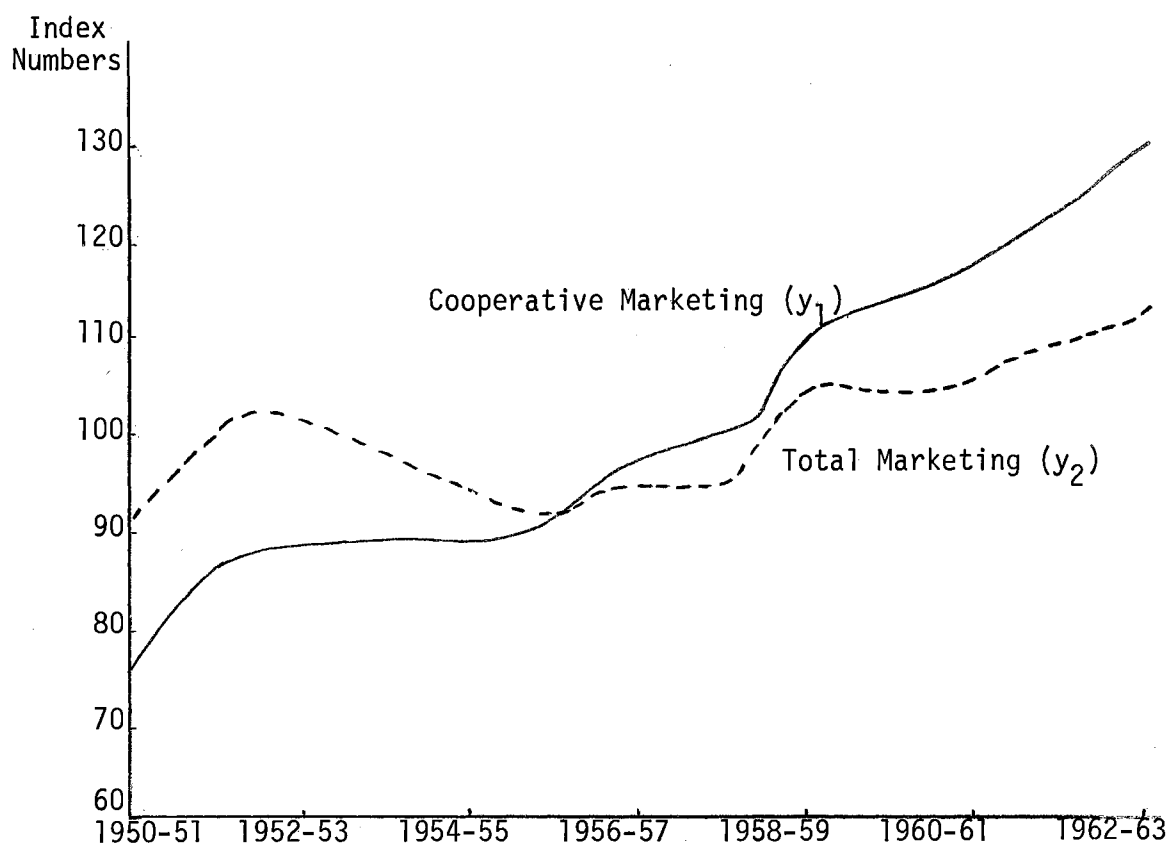
Figure 8. Indexes of Net Value of Cooperatively Marketed Farm
Products and Total Cash Receipts of Farmers,
United States, 1950-51 Through 1962-63.

cooperatives has been higher than the index of total cash receipts of all farmers in the United States.

A linear regression equation using time (T) as the independent variable was computed for the index of marketings through cooperatives (y_1) and for the index of total marketings (y_2).

The results are as follows:

$$\hat{y}_{1t} = 72.43 + 3.94 \underset{(.31)}{T_t} \tag{5.1}$$

$$R^2 = 0.931$$

$$\hat{y}_{2t} = 90.92 + 1.29 \underset{(.38)}{T_t} \tag{5.2}$$

$$R^2 = 0.489$$

The standard errors of the regression coefficients are shown in parentheses below the coefficients. Based on the student t test, the trend coefficient for marketings through cooperatives is significantly different from zero at the 95 percent confidence level. It indicates that the index of cooperatively marketed farm products increased an average of 3.9 points each year. About 93 percent of the variation in cooperative marketings was associated with the trend.

The upward trend in the index of total marketings was lower and less consistent than the trend in cooperatively marketed products. Nevertheless, the coefficient is significantly different from zero at the 95 percent confidence level. The coefficient indicated an annual change in the marketings of 1.3 points, but the percentage of variation associated with trend was less than 50.

The two trend coefficients, $\hat{B}_{11}$ and $\hat{B}_{21}$ were tested to determine whether or not they might have come from the same population. For this test, the calculated t is distributed as the student t with $n_1 + n_2 - 4$ degrees of freedom.[8]

$$t = \frac{\hat{B}_{11} - \hat{B}_{21}}{\sqrt{\left(\frac{2 S_p^2}{\sum\limits_{t=1}^{n} (T_t - \overline{T})^2}\right)}}$$

where S_p^2 is the pooled variance defined as

$$\frac{\Sigma \overset{*2}{y}_{1t} - \hat{B}_{11} \Sigma \overset{*}{t}_{1t} \overset{*}{y}_{1t} + \overset{*2}{y}_{2t} - \hat{B}_{21} \Sigma \overset{*}{t}_{2t} \overset{*}{y}_{2t}}{n_1 + n_2 - 4}$$

where $\overset{*}{y}_t$ and $\overset{*}{t}_t$ represent deviation of the variables y_t and T_t from their means, $\overline{y}$ and $\overline{T}$, respectively, $n_1 = n_2$, and $t = 1, 2, \ldots n$.

The calculated student t-value was 5.19 which indicates that the trend coefficients of equation (5.1) and (5.2) are different at 95 percent confidence level. Therefore, the estimates of trend coefficients are statistically different from each other. The conclusion based on both tests, is that the index of cooperatively marketed farm products increased at a greater rate than the index of total marketings of farm products in the period 1950-1963 in the United States.

First differences can be used to remove the influences of trend from data. First differences of the data for the period 1950-51 through

[8]Robert G. D. Steel and James H. Torrie, _Principles and Procedures of Statistics_ (New York, 1960), p. 173.

1962-63 were used in a statistical model to estimate the interrelation-ships existing between changes in total marketings and changes in marketings through cooperatives.

The statistical model is as follows:

$$Y_{1t} = a_1 + b_1 Y_2 + u_{1t} \tag{5.3}$$

where

Y_{1t} = first differences in successive years $(y_{1t} - y_{1t-1})$ of the index numbers of the net value of cooperatively marketed farm products.

Y_{2t} = first difference $(y_{2t} - y_{2t-1})$ of the index numbers of the total cash receipts of all farm products.

a_1 and b_1 = parameters of the linear equation.

u = error term

t = time designation.

The value of b_1 would be expected to be different from zero. In fact, a coefficient of unity indicating an approximate 1:1 relationship between the first differences would be expected if cooperative marketing firms were experiencing the same growth and variability patterns as existed for all farm marketing firms.

The least squares estimates of equation (5.3) were obtained by regression analysis. The results are as follows:

$$\hat{Y}_1 = 3.33 + \underset{(.08)}{.66} Y_2 \tag{5.4}$$

$$R^2 = .86$$

The number contained in parentheses beneath the estimated coefficient for Y_2 is the standard error of the coefficient. The

coefficient has a significant t-value at the .05 level which indicates that it is different from unity. All signs were consistent with the theoretical framework of the model, and R^2 for the equation is .86.

The coefficient is interpreted in the following manner. As the first difference of the index number of the total cash receipts of all farmers in the United States increased by one unit, the first difference of the index numbers of cooperatively marketed farm products increased by .66 of one unit. The fact that the coefficient reflects a less than 1:1 relationship is indicative that only part of the growth in marketing through cooperatives can be attributed to changes in aggregate sales of all farm products by farmers.

Most of the growth in cooperative marketing apparently was independent of changes in total marketings. During the first half of the period, in fact, the first differences for cooperative marketings were positive while the first differences for total marketings were negative. In other words, cooperative marketing continued to show an increase even though total marketings were declining. During the last half of the period, both series showed increases with the largest increases generally associated with the series representing cooperative marketing.

Distribution of Net Savings

Marketing cooperatives operate on the basis of service at cost. Since it is not possible to operate so as to anticipate the exact cost, they accomplish this by returning net savings at the end of the fiscal year. Allocation of net savings may be based on the value or on the number of units handled. For example, a farmer who delivers 10,000

bushels of wheat to his cooperative has contributed ten times as much

to the business as the farmer who delivers only 1,000 bushels. If the

net saving amounts to three cents per bushel, the farmer who delivers

10,000 bushels is entitled to $300 refund, and the farmer who delivers

1,000 bushels is entitled to $30.

Over the years, one regional grain cooperative, operating in a very

competitive industry, has returned an extra three cents per bushel to

its members or an estimated $60 million more than would have received

if the members had not started their own marketing cooperative. This

cooperative is the Farmers Union Grain Terminal Association which

was formed in 1938 at St. Paul, Minnesota, with $30,000 member capital.

In 1962, it had grown to the extent that it had $42 million in member

capital.[9]

In the United States, at the end of fiscal year 1962, the combined

net savings of 217 regional marketing cooperatives, was about $174

million. This net saving was distributed as shown in Table VIII.

Approximately 93.5 percent of the $174 million after taxes was distri-

buted as patronage payments. They paid 1.1 percent of the savings as

federal and state taxes. Then they paid 57.2 percent of the net

savings in cash to member patrons on the basis of the current year's

business. Many of the regional marketing cooperatives paid dividends

on capital stock and capital equities. The aggregate value was

equivalent to 5.0 percent of net savings in 1962.

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[9]Kenneth J. Samuels, Increasing the Marketing Strength of Farmers, Farmer Cooperative Service, U.S. Department of Agriculture, Information 43 (Washington, 1964), p. 15.

TABLE VIII

DISTRIBUTION OF NET SAVINGS OF 217 REGIONAL
MARKETING COOPERATIVES, FISCAL YEAR 1962

Classification Of Cooperatives	Number Of Cooperatives	Total Net Savings Before Taxes	Percentage Of Net Savings Distributed As--							
			Dividends And Interest On--			Patronage Refunds On Current Year's Business		Unallocated Reserves	Income Taxes	
			Common Stock	Preferred Stock	Other Equity Capital	Paid In Cash	Allocated		Federal	State
		(1,000) (Dollars)	Per Cent							
Marketing	217	173,645	1.8	1.2	2.0	57.2	36.3	0.4	1.0	0.1
Centralized	113	85,510	2.3	1.2	2.8	56.5	36.2	0.5	0.5	(3)
Federated	77	69.777	1.6	1.2	1.0	65.4	28.3	0.7	1.7	0.1
Mixed-Membership	27	18,358	0.2	1.1	2.5	29.0	67.6	0.8	0.4	(3)

(3) Less than 0.05 percent

Source: Nelda Griffin, Financial Structure of Regional Farmer Cooperatives, Farmer Cooperative Service, U.S. Department of Agriculture, General Report 133 (Washington, 1966), p. 40.

In summary, these regional cooperatives make savings from manufacturing, processing, and wholesaling farm products. These savings mean that the cooperative members share the net revenue in the vertical stages of the marketing system. These net revenues or savings go to the members and increase their net returns.

CHAPTER VI

COOPERATIVE PURCHASING FIRMS IN THE UNITED STATES

Farmers in the United States have formed purchasing cooperatives
to buy the farm inputs they need. The main objective of these firms
is to share net revenues among farmer-members on the inputs purchased
by farmers.

Early Development of Cooperative Purchasing

Cooperative purchasing firms began in the United States around 1850
in Illinois and Wisconsin. The early farm organizations made contribu-
tions toward establishing this type of cooperative as well as the
marketing and service cooperatives. The Grange was particularly active
just after the Civil War. Purchasing agents were established to assemble
orders and place them with dealers who shipped the farm supplies
directly to farmers at special prices. After 1875, Grange farm supply
and general warehouse stores were formed throughout the United States.[1]
However, some of the stores lasted only a few years.

The Farmers Alliance established many purchasing cooperatives
between 1880 and 1890. The Alliance's interest was short lived because

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[1]R. H. Elsworth, Agricultural Cooperative Associations, Marketing
and Purchasing, U.S. Department of Agriculture, Tech. Bulletin 40
(Washington, 1925), p. 98.

organization soon turned to political action as a means of securing
relief for farmers. For several years during the middle 1890's,
purchasing cooperatives presented few opportunities for savings. Many
merchants were in financial distress, competition was keen, and margins
were small.

The American Society of Equity, formed in 1902, also sponsored
purchasing as well as marketing cooperatives. In 1902, the Farmers
Union was organized which helped in establishing purchasing cooperatives.
It was one of the few organizations which stressed the fact that effi-
cient buying was of as much importance to the farmer as efficient
selling. The Farmers Union helped organize production supply coopera-
tives along the modern pattern to produce and handle farm inputs for
farmer-members. The Farmers Union, either directly or through a
subsidiary company, made contact with selling agencies in order to
achieve the advantages of car-lot buying of such supplies as mill feeds,
flour, coal, fence posts, and other input commodities.

During the period from 1901 to 1920 approximately 2,250 farm
supply cooperatives were organized in the United States, with over
half of these formed in 1916-20 period. Several regional farm
purchasing cooperatives organized during this period are still
operating. For example, the Fruit Growers Supply Company in Los
Angeles was organized in 1907 to provide containers and packing
materials for citrus growers in California; the Farmers Union State
Exchange in Omaha, Nebraska, was organized in 1914 to serve both
farmers and local cooperatives; Central Cooperative Incorporated in
Superior, Wisconsin, was organized in 1917 to serve local cooperatives
in northern Wisconsin and Minnesota areas; Eastern State Farmers

Exchange Inc. (now Agway, Inc., Syracuse) in West Springfield, Massachusetts, was organized in 1918 to serve farmers through branch warehouses and a car-door distribution system; and the Cooperative Grange League Federation Exchange Inc., was formed in 1920.[2]

One of the factors which had encouraged the rapid development of buying farm supplies cooperatively was the success experienced in making savings from the wide margins existing at that time. During World War I, food production and use of production supplies expanded rapidly.

Price declines following World War I caused the failure of several general supply cooperatives that had overexpanded. As a result, the number of active supply cooperatives declined slightly until the latter 1920's. This was offset to some extent, however, by a number of marketing cooperatives adding supply services. The adverse economic conditions facing the farmers during the 1920's, coupled with the growing trend toward mechanized and commercial agriculture, caused another increase in the number of farm supply cooperatives around 1928.

The Farm Bureau Federation provided a stimulus to cooperative purchasing in the 1920's. County and State Farm Bureaus first served their members by using an agent system in purchasing carloads of supplies. In other cases they bargained with local dealers for price concessions or discounts for their members. Many Farm Bureau cooperatives were organized and they, in turn, formed state wholesale supply associations. These were most active in the Central and Southern parts of the United States.

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[2]Joseph G. Knapp, Seeds that Grew, A History of the Cooperative Grange League Federation Exchange (New York, 1960), p. 35.

2,657; they had 980,000 members and a volume of business of about $369 million.

Some of the regional firms organized during the 1930's, with dates in parentheses, were: Farmers Union Central Exchange, Inc., St. Paul, Minnesota (1931); Pacific Supply Cooperatives, Portland, Oregon (1933); Pennsylvania Farm Bureau Cooperative Association, Harrisburg (1934); Farmer's Cooperative Exchange, Inc., Raleigh, North Carolina (1934); and National Cooperatives, Inc., Albert Lea, Minnesota (1933).

World War II and post-war conditions stimulated the organization of additional supply cooperatives. Some of these were established either to manufacture supplies or to give farmers more dependable sources of supplies. The shortage of supplies existing at times during this period caused a rapid increase in manufacturing, in membership, and in volume of cooperative purchasing.

Many regional cooperatives added fertilizer plants and feed plants, and many bought oil refineries. For example, the Midland Cooperative purchased a refinery at Cushing, Oklahoma, in 1943.[4] Regional wholesale associations to handle feed and other supplies were organized in Missouri, Arkansas, and Tennessee. The National Cooperative Refinery Association was organized in 1943 and purchased an existing plant at McPherson, Kansas. Associated Cooperatives Inc., Sheffield, Alabama, also was formed in 1943 to purchase fertilizer for local and regional cooperatives. Select Seed Inc., Ft. Wayne, Indiana, was set up by regional cooperatives in 1947. Mississippi Cotton Growers invested

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[4]Jerry Voorhis, American Cooperatives (New York, 1961), p. 104.

some $4 million in Mississippi Chemical Corporation and built the first farmer owned nitrogen plant in Yazoo City in 1948. During the period from 1941 through 1950 15 other small regional wholesale cooperatives were formed. Many were set up to manufacture only one or two farm supply items.

By 1951, a total of 3,282 production supply cooperatives with 2.9 million members had over $1.9 billion of gross business and $1.1 billion net, excluding inter-cooperative volume. In addition, about 3,399 marketing and 100 service cooperatives handled another $800 million of gross supply business ($600 million on a net basis after eliminating duplication of intercooperative business).[5]

Supply cooperatives continued to progress in the 1950's. Integration of functions, use of research, diversity of services, and net savings for farmers all increased. These cooperatives continued to adjust to rapid changes in agriculture. They added a wider variety of supplies, especially pesticides, animal health products, liquid nitrogen, and building supplies.

Many associations further integrated their operations on a vertical basis. They built new automated feed mills and seed processing plants. Several cooperatives handling broiler and turkey feed began contract production programs. They spent large sums in modernizing the larger oil refineries and sold the smaller ones.

Regional associations have organized national fertilizer cooperatives. They built several new nitrogen plants requiring heavy

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[5]Bruce L. Swanson, Statistics of Farmer Cooperatives, 1962-63, Farmer Cooperative Service, U.S. Department of Agriculture, General Report No. 128 (Washington, 1965), p. 3.

capital outlays, added granulating equipment to dry fertilizer plants, and built bulk-blending plants. They started mining and processing phosphate rock in the West, acquired the stock of a potash company, and both invested in and contracted with nitrogen manufacturing organizations.

A number of regional cooperatives made an important advance when they arranged to share in the costs and results of several feed research and testing farms. Several regionals also established a research farm for forage seeds, and three firms in the East joined in a cooperative hybrid seed corn project.

Farmers also looked to their cooperatives for more related services such as feed grinding and mixing, bulk feed delivery, seed cleaning, fertilizer spreading, and paint spraying. There were serious requests that the supply cooperatives add marketing services.[6] An increasing number of farmers expected accommodation credit and seasonal financing.

Interest in mergers increased among both local and regional supply associations in the 1950's, although relatively few such mergers had occured by 1963. Western Fertilizer Association, Seattle, Washington, merged with Central Farmers Fertilizer Company, Chicago, in 1958. Illinois Farm Supply Company, Bloomington, and Farm Bureau Service Company, of Des Moines, integrated to become Farm Supply Services, Incorporated, Bloomington, Illinois, in 1962.

The regional supply and grain marketing cooperatives in Indiana and Michigan merged in each state in 1949 and 1962 respectively.

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[6]U.S. Department of Agriculture, Major Regional Cooperative Handling Supplies, 1962-63, Farmer Cooperative Service, General Report No. 125 (Washington, 1965), p. 95.

Eastern States Farmers Exchange, Incorporated, Springfield,

Massachusetts, and Grange League Federation Exchange, Incorporated,

Ithaca, New York, merged to form Agway, Incorporated, Syracuse, New

York, to provide their members better services.

An Example - Integrated Cooperative Purchasing

Farmland Industries Incorporated, with headquarters in Kansas City,

is an integrated purchasing cooperative firm.[7] It was organized in 1929

with the primary objective of maximizing profits for its members. It

controls and manages its individual plant, subsidiaries[8] and wholesale

firms. Its member-cooperatives are located throughout Iowa, Kansas,

Missouri, Nebraska, Colorado, Oklahoma, South Dakota, Wyoming,

Minnesota, North Dakota, Arkansas, and Texas.

The record of the Farmland Industries shows that sales in fiscal

year 1929 included 2,976 thousand gallons of refined fuel and petroleum

gas, 135 thousand gallons of lube oil and 74 thousand pounds of grease.

It had 22 member-cooperatives and the gross sales were $309,891.[9] Since

that time, it has followed a policy of expansion through conglomerate

integration by adding more farm supplies. In 1935, it handled tires and

in 1940, it began handling auto parts. It added plants in 1950's for

manufacturing feed and chemical fertilizers.

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[7] It was Consumer Cooperative Association (CCA) until September, 1966.

[8] A subsidiary is defined as a partially or wholly owned and controlled cooperative or noncooperative by the holding firms.

[9] Farmland Industries, Inc., 38th Annual Report (Kansas City, 1966), p. 36.

The membership of Farmland Industries had increased to 1,693 local cooperatives by 1955, with gross sales of $93,623,993 and net savings for members amounting to $2,534,423. Farmland Industries continued to grow by expanding its operation in purchasing, processing, and manufacturing farm supplies for distribution at the wholesale level to retail farmer cooperatives. In 1966 it was engaged directly in manufacturing fertilizer, feed, grease, batteries, paint, and fabricated steel products. Four supply subsidiaries which produce crude oil, refined fuels, lube oils, fertilizer and soybean meal, were merged with Farmland in fiscal years 1964 and 1965.

Sales in the fiscal year 1966 were 696,730 tons of feed, 1,333,009 tons of fertilizer, 969,769 gallons of refined fuels and light petroleum gases, and 489,840 gallons of paints. Approximately 70 percent of the total commodities supplied patrons in 1966 were produced by Farmland and its subsidiary plants and 10 percent by other cooperative plants. Gross sales in fiscal year 1966 were $330,131,036 with net savings of $23,328,253.

Farmland Industries prices its products according to the going prices in the market. For most of the products, an oligopoly market situation prevails, and Farmland is interested in maintaining a profit margin for each product so that a significant cash patronage refunds can be paid to its members. In 1964, for example, it sold fertilizer for $71.84 per ton to the local cooperatives and it refunded $7.39 per ton to the local cooperatives as patronage refunds. In 1965, the price of fertilizer was $70.84 per ton and patronage refunds totaled $8.52.[10]

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[10]Farmland Industries, Inc., Annual Stockholder Notification Report, 1964-65 (Kansas City, 1966), p. 12.

The volume of fertilizer increased from 858,350 tons in 1964 to 997,659 tons in 1965.[11] In 1966, a relatively large decrease in price occurred as a result of the increase in the supply of fertilizer produced by Farmland and the other firms in the market. The decrease in price was from $70.84 per ton in 1965 to $67.51 per ton in 1966. However, this was accompanied by an increase in the volume sold up to 1,333,009 tons. The patronage refund per ton declined to $6.93.

There has been a reduction in the per unit cost of fertilizer. From 1965 to 1966, for example, the price decreased by $3.33 per ton but the refunds decreased by only $1.59 per ton of fertilizer. Therefore, the net price declined by $1.74 per ton.

The experience of Farmland Industries, Inc. supports the conclusion that integration by cooperative firms, horizontally and vertically, can offer lower prices to farmers and a share of the middleman's profits as patronage refunds to its members.

<center>Growth in Cooperative Purchasing of Farm Supplies</center>

Purchasing cooperatives in the United States have made progress and have experienced growth since 1950. They handled, in dollar terms, 17.7 percent of all farm supplies in 1950-51. By 1963-64, farmer-members obtained 20 percent of all farm supplies and equipment from purchasing cooperatives (Table IX). The proportions in 1963-64 for individual products were: 29 percent for fertilizer, 27 percent for petroleum products, 21 percent for seed, 17 percent for feed, and 2 percent for farm machinery and equipment.

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[11]Farmland Industries, Inc., Weekly Wholesale Volume Report, Annual Summary, 1964-65 (Kansas City, 1966), p. 18.

TABLE IX

FARM SUPPLIES: PERCENTAGES OF SELECTED GROUPS OF INPUTS
PURCHASED FROM COOPERATIVES, UNITED STATES, 1963-64

Item	Percent of Farm Supplies
Feed	17
Seed	21
Fertilizer	29
Petroleum Products	27
Farm Machinery and Equipment	2
All Other Supplies	15
Total	20

Source: Martin A. Abrahamsen, "Cooperative Trends
Show Progress," News for Farmer Cooperatives, Farmer
Cooperative Service, U.S. Department of Agriculture
(May, 1966), p. 4.

Both the net value of farm supplies purchased through cooperatives
and the total expenditures for these supplies have increased during the
period 1950-51 through 1962-63 (Table X). However, the net value of
cooperatively purchased farm supplies increased at a faster rate.[12] In
only one year, 1957-58, was a decrease reported for the index of
cooperatively purchased farm supplies. In contrast, decreases were
reported in five of the 12 years for the index of total expenditures.

Trends during the 13-year period, 1950-51 through 1962-63, of
cooperatively purchased farm supplies (y_3) and total expenditures for
the same supplies for all farmers (y_4) were estimated using time (T) as
the independent variable. The results are as follows:

$$\hat{y}_{3t} = 76.77 + 3.32 \, T_t \atop (.21)$$ (6.1)

[12]Martin A. Abrahamsen, "Cooperative Trends Show Progress," News
for Farmer Cooperatives, Farmer Cooperative Service, U.S. Department
of Agriculture (March, 1965), p. 15.

TABLE X

INDEXES AND FIRST DIFFERENCES OF INDEXES OF NET VALUES OF COOPERATIVELY
PURCHASED FARM SUPPLIES, AND OF TOTAL EXPENDITURES
OF ALL FARMERS, 1950-51 THROUGH 1962-63

Period	Index Of Net Cooperative Supply Value (1) y_3	First Difference Of Column (1) (2) Y_3	Index of Cash Expenditures Of All Farmers (3) y_4	First Difference Of Column (3) (4) Y_4
1950-51	76.8		97.7	
1951-52	87.8	11.0	97.0	- .7
1952-53	91.8	4.0	93.0	-4.0
1953-54	90.2	-1.6	91.0	-2.0
1954-55	92.2	2.0	91.8	.8
1955-56	93.3	1.1	90.5	-1.3
1956-57	97.8	4.5	93.9	3.4
1957-58	99.7	1.9	100.3	6.4
1958-59	108.1	9.4	106.3	6.0
1959-60	109.8	1.7	101.9	-4.4
1960-61	112.7	3.9	105.9	4.0
1961-62	116.8	4.1	111.8	5.9
1962-63	123.3	9.5	118.8	7.0
13-year average base period for index	100.0		100.0	

Source: Martin A. Abrahamsen, "Cooperative Trends Show Progress," News For Farmer
Cooperatives, Farmer Cooperative Service, U.S. Department of Agriculture (March, 1965), p. 15.
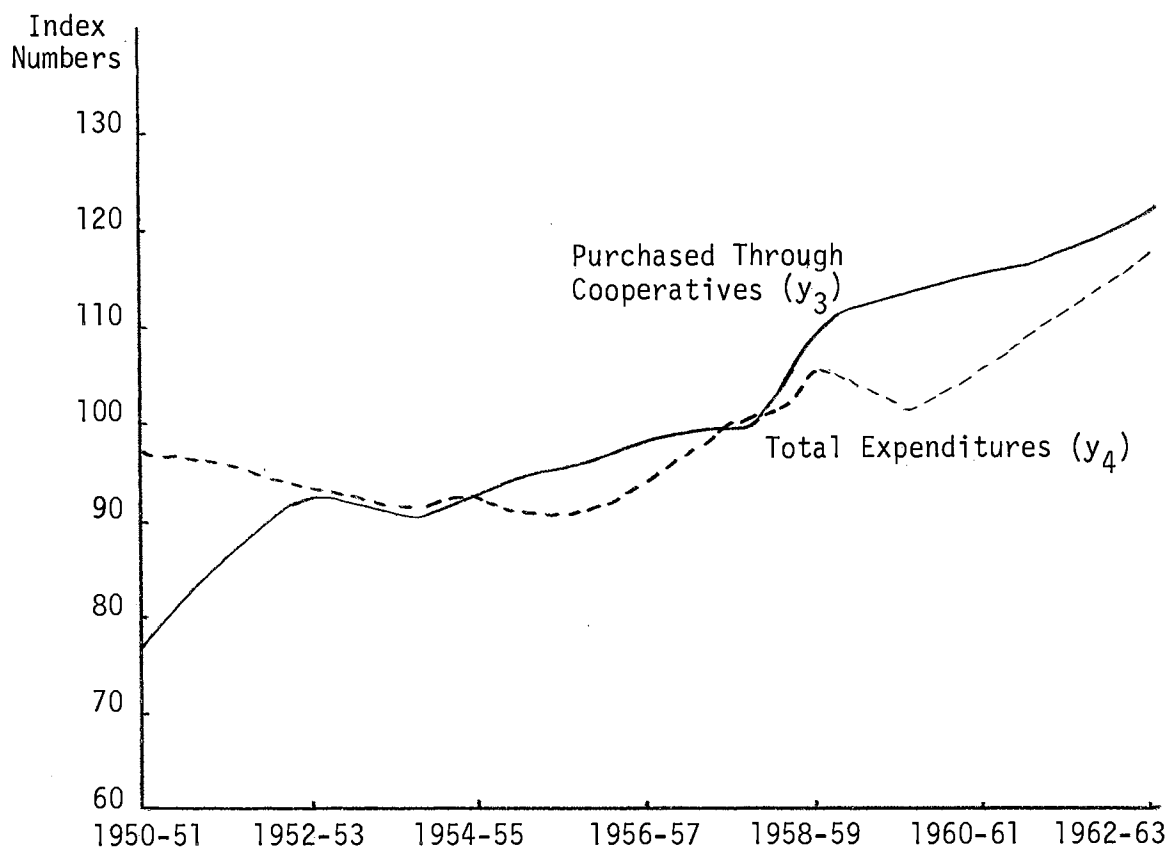
Figure 9. Indexes of Net Value of Cooperatively Purchased Farm
Supplies and Total Expenditures for Farm Supplies,
United States, 1950-51 Through 1962-63.

$$R^2 = 0.95$$

$$\hat{y}_{4t} = 87.54 + \underset{(.39)}{1.78} T_t \qquad (6.2)$$

$$R^2 = 0.63$$

The numbers contained in parentheses beneath the estimated coefficients for T are the standard errors of the coefficients. In equation (6.1), R^2 is .95, and the estimated coefficient has a significant student t-value at .05 level which indicates that it is different from zero. In equation (6.2), R^2 is .63 and the estimated coefficient is different from zero at .05 level.

The results imply that the index numbers of cooperatively purchased farm supplies increased by 3.32 points each year. On the other hand, the index numbers of total expenditures for all farmers for certain supplies increase by 1.78 points each year.

The two trend coefficients $\hat{\beta}_{31}$ and $\hat{\beta}_{41}$, were tested to determine whether or not they were from the same population. With a calculated t-value of 3.300 and a tabulated t-value of 2.074 for the 95 percent level, the results indicate that the two coefficients are not from the same population. The conclusion is that the index numbers of cooperatively purchased farm supplies increased at a faster average rate than the index number of the total expenditures for all farm supplies by all farmers in the period 1950-1963.

First differences of the data for the period 1950-51 through 1962-63 were used in a statistical equation to estimate the inter-relationships existing between changes in total farm inputs purchased

and changes in purchasing through cooperatives. The equation was similar to equation (5.3) which was used for farm marketings.

The estimated equation is as follows:

$$\hat{Y}_{3t} = 2.898 + \underset{(.148)}{.793} \; Y_{4t} \tag{6.3}$$

$$R^2 = .75$$

where

Y_{3t} = first difference in successive years $(y_{3t} - y_{3t-1})$ of the index numbers of the net value of farm supplies purchased through cooperatives.

Y_{4t} = first difference in successive years $(y_{4t} - y_{4t-1})$ of the index numbers of the total cash expenditures by all farmers for farm supplies.

The number contained in parentheses beneath the estimated coefficient for Y_4 is the standard error of the coefficient. R^2 is .75 and the coefficient for the independent variable has a significant t-value at the .05 level, which indicates that it is different from zero.

The results indicate that a one unit increase in the index (as a first difference) of total cash expenditures by all farmers for farm supplies is accompanied by a .79 unit increase (as first difference) in cooperatively purchased farm supplies. However, this coefficient is not significantly different from a 1:1 relationship which indicates that changes in cooperative purchases are associated very closely with changes in total expenditures.

Distribution of Net Savings

Net savings of cooperative firms commonly are distributed among farmer-members as patronage payments. These savings of purchasing cooperatives vary by years, by areas, and by types of supplies and equipment.

Most retail cooperatives in the early years realized substantial savings. They began by pooling their funds for the joint purchase of fertilizer from whatever source it could be bought on the best terms. On this single farm input, there has been a 10 percent decline in the price.[13] This was considered a net savings for the members.

Purchasing cooperatives saved an average of ten to twelve cents on each dollar's worth of petroleum products handled in 1920-40 period.[14] In recent years, net savings on retail and wholesale operations of regional purchasing cooperatives have not been as great as in earlier years and have been exceeded by savings from manufacturing and processing operations. Reports from 105 regional purchasing cooperatives showed that their total net savings were about $88 million in 1962. These net savings were allocated to their member-patrons. The distribution of net savings, classified on the basis of membership of the cooperatives, is shown in Table XI.

In 1962, the 105 regional purchasing cooperatives as a group paid federal and state income taxes amounting to nine percent of their total net savings. They paid 12 percent of their net savings after taxes as

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[13]Voorhis, p. 18.

[14]U.S. Department of Agriculture, Farmer Cooperatives in the United States, Farmer Cooperative Service, Bulletin 1 (Washington, 1955), p. 166.

TABLE XI

DISTRIBUTION OF NET SAVINGS OF 105 REGIONAL PURCHASING
COOPERATIVES, FISCAL YEAR 1962

Classification Of Cooperatives	Number Of Cooperatives	Total Net Savings Before Taxes	Percentage Of Net Savings Distributed As--						
			Dividends And Interest On--			Patronage Refunds On Current Year's Business		Unallocated Reserves	Income Taxes	
			Common Stock	Preferred Stock	Other Equity Capital	Paid In Cash	Allocated		Federal	State
		1,000 (Dollars)	Per Cent							
Farm Supply	105	77,971	2.3	7.9	0.9	28.2	48.0	3.7	8.5	0.5
Centralized	22	10,862	0.4	17.4	2.0	40.4	17.2	3.6	18.8	0.2
Federated	59	50,228	0.1	6.7	0.3	24.3	56.6	3.5	7.8	0.7
Mixed-Membership	24	16,881	10.0	5.3	2.0	31.6	42.4	4.1	4.1	0.5

Source: Nelda Griffin, Financial Structure of Regional Farmer Cooperatives, Farmer Cooperative Service, U.S. Department of Agriculture, General Report 133 (Washington, 1966), p. 40.

dividends and interest on their equity capital. They retained about 4 percent on unallocated reserves. They refunded 83.8 percent of their net savings after taxes to their patrons on the basis of current year's business and unallocated reserves. They paid 37 percent of the refunds in cash.

In summary, the purchasing cooperative firms make savings from purchasing, manufacturing, processing and marketing farm inputs. These savings, or net revenues that the members get, mean that part of the profits that otherwise would have been made at the expense of farmers have been returned to them through their own cooperative firms. These net savings are considered as additional income to the farmer-members.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The basic problem underlying this study is the apparent lack of market power of farmers in the market place. Farmers have faced monopsony power in marketing their products and monopoly power in purchasing farm inputs.

In this study, the economics of the cooperative firm have been investigated. The economics of horizontal and vertical integration by cooperatives have been reviewed. The major purpose was to evaluate the growth and potential benefits to farmers of cooperative firms in the marketing of farm products and in the purchasing of farm inputs. Specifically, the objectives were: 1) to determine the potential advantages of cooperative firms for farmer-members; 2) to investigate the effects of horizontal and vertical integration by cooperatives; and 3) to review the historical growth and determine the growth rates of cooperative marketing of farm products and purchasing of farm supplies in the United States.

The cooperative has been defined as a firm. The three fundamental principles which distinguish the cooperative from noncooperative firm are democratic control, limited return on capital, and service at cost.

The cooperative firm through its marketing activities may differentiate homogeneous farm products and change the farmers' perfectly competitive market to an imperfectly competitive market

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structure. The cooperative firm has some degree of monopolistic control over its output and product prices in the market if the cooperative faces a downward sloping demand curve for its product. If average cost is less than price, economic profits exist. The cooperative's economic profit could be distributed as patronage payments. Thus, the entry of an efficient cooperative firm into the market may force the noncooperative firm to increase the prices paid to the farmers for farm products. This entry would tend to increase the returns to farmers as owners of the farm products by noncooperative firms.

Market advantage as a motivation for integration through cooperatives may operate in two directions. First, it may be through forward integration to market farm products. Second, it may be through backward integration to purchase and process farm inputs. The possible enhancement of economic gains becomes a further incentive.

Horizontal integration is one basis for gaining market advantage. This motive for horizontal integration arises under conditions of an imperfect market structure. In some instances it is related to control of one or more stages in the sequence of marketing farm products and purchasing farm inputs. The cooperatives, through horizontal integration, may achieve lower per unit costs as the size of the firm's plant is increased. Empirical studies indicated that the horizontal integration of fruit packing cooperatives could reduce average packing expense from $.95 to $.85 per box. This would be the economic gain from horizontal integration and economies of size.

The motives for vertical integration are: 1) to maximize the cooperative's net revenue which will be refunded to its members; and 2) to gain market power to influence the price for its own benefit.

Therefore, the cooperative firms may become more profitable and gain market power through vertical integration.

Forward vertical integration by cooperatives may involve differentiation of farm products through processing, grading, canning, and branding. Empirical studies indicated that vertically-integrated cooperative marketing and processing of cottonseed have increased the net returns for members. Increased net returns to the farmer-members for cottonseed were $12.77 per ton for Arkansas, $18.63 for California, $11.60 for Mississippi, $16.75 for Oklahoma, and $13.99 for Texas in 1959-60 season. In marketing farm products, the Southwestern Irrigated Cotton Growers Association is a vertically-integrated cooperative firm. It gins cotton and processes cottonseed for its members. In 1959, it paid $9.26 per ton or about 15 percent as net revenue over the market price.

The cooperative may integrate backward through production or purchasing of farm inputs such as feed, fertilizer and petroleum for sale to farmers. Many cooperative purchasing firms have integrated backward in order to counter the monopolistic practices which farmers believe suppliers are exercising. In purchasing cooperatives, great emphasis has been placed on gaining economies of size, improving the quality of farm inputs, and increasing net returns to cooperative members. For example, Farmland Industries, Incorporated, is a vertically-integrated fertilizer manufacturer. It sells fertilizer at wholesale to its local cooperative members. In 1965, the price of fertilizer was $70.84 per ton and farmers were refunded $8.52 net revenue as patronage payments.

More than 8,000 cooperative firms were engaged in marketing farm products and purchasing farm inputs in the United States in 1966. Total membership in these cooperatives was more than 7 million, but this includes some duplication because some are members of more than one cooperative.

The growth of the cooperative marketing sector has been substantial, based on an analysis of index numbers of the net value of cooperatively marketed farm products and of the total cash receipts by all farmers, during the period 1950 through 1963. The index of cooperatively marketed farm products increased an average of 3.9 points each year. The increase in the index of total marketing was lower, 1.3 points annually. The estimated coefficients are statistically different from each other. Therefore, the value of cooperatively marketed farm products increased at a greater rate than the value of total marketings of farm products in the period 1950 through 1963.

First differences of data were also used to investigate the interrelationships between changes in total marketings and changes in cooperative marketings. The results indicate that only part of the growth in marketing through cooperatives can be attributed to changes in aggregate sales of all farm products.

The growth of cooperatively purchased farm supplies also has been substantial. Comparison of the index numbers of the net value of cooperatively purchased farm supplies and the total cash expenditures of all farmers for farm supplies shows that, from 1950 through 1963, the cooperatively purchased farm supplies increased at a greater rate than the total expenditures. The index of cooperatively purchased farm supplies increased an average of 3.3 points each year as compared with

an increase of 1.7 points per year for total expenditures for farm supplies. The estimated coefficients are statistically different from each other.

Based on first difference analysis, the relationships between changes in total expenditures for farm supplies and changes in cooperatively purchased farm supplies was quite close. The coefficient indicated that the first difference of the index number of the net value of cooperatively purchased farm supplies increased 0.79 points for each one point increase in the first difference of the index of the total expenditures of all farmers. The coefficient was not significantly different from unity.

Farm cooperatives in 1964 marketed about 25 percent of all farm products and handled 20 percent of all farm inputs purchased in the United States. Even though the cooperatives' share of the market may be small, the unique feature of providing service at cost may return a part of the profit of the marketing and purchasing sectors to the cooperatives' members and result in higher product prices and lower input prices.

The results of this study indicate that farmers have formed marketing and purchasing cooperatives to obtain increased net returns. Apparently they have been successful since cooperative marketing and purchasing have expanded and there is evidence of higher net returns to member-patrons. In a dynamic economy, further changes may be needed. Indications are that with further horizontal and vertical integration by cooperatives, the farmer-members may get higher net revenues from above-market prices in marketing farm products and below-average costs in purchasing farm inputs.

It is hoped that the cooperative firm models reviewed in this study will help in understanding the economics of horizontal and vertical integration by cooperative firms. However, the models need empirical testing which can be provided only through further research. Measurement of the effects of horizontal and vertical integration and the determination of the optimum degree of horizontal integration and the optimum economic stage of vertical integration are needed.

The effects of cooperative firms on production supply and prices appear substantial. However, quantitative estimates of these effects are not available. An analysis is needed which would trace the economic effects of the cooperative firms' existence and actions on the supply, prices, and the net incomes for both members and nonmembers of cooperative firms.

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APPENDIXES

APPENDIX A

VIEWS THAT A COOPERATIVE IS NOT A FIRM

The notion that a cooperative is not a firm has been pointed out
by many writers. Ivan Emelianoff regarded a cooperative as an aggregate
of economic units coordinating their activities, but each fully retaining
its economic individuality and independence. The aggregate is "an
agency of the associated units, owned and controlled by them through
which they conduct their business activities".[1] Further, "an aggregate
is functioning only as a branch or part of associated economic units.
Therefore, a cooperative as an aggregate is perfectly identical with
the special departments and branches of single economic units".[2] He also
said that "since a cooperative is inherently furthering or completing
the economic activities of members, all the members of cooperative
association necessarily participate in the economic work of the
association."

Emelianoff's major conclusion is that a cooperative association is
not a firm but rather is an aggregate or association of economic units
(firms or households). He presented an analytical explanation in which
he has reconciled that concept of a cooperative association with the

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[1]Ivan V. Emelianoff, Economic Theory of Cooperation (Ann Arbor,
Michigan, 1948), p. 248.

[2]Emelianoff, p. 249.

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distinctive techniques, methods, and practices that are characteristic of cooperative association.

Robotka pointed out four characteristics of cooperatives.[3] First, horizontal combination of autonomous economic units. Second, because the member units retain their autonomy, it follows that the combination must have a federal rather than an authoritarian form of organization. Third, every true cooperative represents an effort on the part of two or more autonomous units jointly to conduct, coordinating with each other, given operations essential to the economic activity of member units. It is the avowed purpose of true cooperators not to interpose a business enterprise (a firm) between themselves and their market. In a technical economic sense, this can mean only that it is their purpose to function in their own capacities as sovereign units, that is, to perform designated functions or services as integrated with their individual economic pursuits. Fourth, the cooperative organization consists of the sum of the relationships and arrangements established among member units in order to effectuate their purpose. In an economic sense, these arrangements are designed to enable member units jointly to participate in the performance of their entrepreneurial functions with respect to the given activities which they desire to conduct in coordination with each other. In a legal sense, the cooperative organization consists of a bundle of multilateral agreements among the members designed to give legal effect to their economic purpose. The cooperative association is thus the economic and legal instrumentality through

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[3]Frank Robotka, "A Theory of Cooperation," _Journal of Farm Economics_, Vol. XXIX (February, 1947), pp. 94-114.

which or by means of which member units carry out their purpose to conduct a jointly integrated activity.

Phillips advanced the same view. He drew a distinction between the cooperative association on the one hand and the cooperative plant on the other. The cooperative plant has no economic life of its own, and rather should be conceived as a part of each participating firm.[4]

Phillips' model involves: (1) the economic structure of the cooperative association; (2) the economic relationships among the participating units; and (3) the condition necessary for profit maximization in the cooperating firms.

With respect to the economic structure of the cooperative association, Phillips says that when a group of individual firms forms a cooperative association, they agree mutually to set up a plant and operate it jointly as an integral part of each of their individual firms. The cooperative has no more economic life or purpose, apart from that of the participating economic units, than one of the individual plants of a large multiplant firm. Instead, the participating firms agree to function coordinately with respect to their joint activity. He concludes that, when two or more economic units conduct any of their individual business activities cooperatively, the result is not a new firm but a common economic plant. And it is technically correct to speak of the cooperative plant and of cooperating firms but not of the cooperative firm.

With respect to the economic relationships among the member firms, Phillips says that each member firm's share of the joint plant is

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[4]Richard Phillips, "Economic Nature of the Cooperative Association," Journal of Farm Economics Vol. XXXV (February, 1953), p. 74-87.

defined by the relative size of the production activities in the individual plant of each firm with which the activities conducted through the joint plant are integrated. This proportionality determines how participating firms will share the use of the joint plant, voting, control, costs and risks, uncertainties, financial responsibilities, and the economic benefits. This proportionality also applies over time and among the different departments of the joint plant if more than one activity is conducted through the joint plant.

With respect to the conditions necessary for profit maximization of the firms participating in a joint plant, these are the same as those of any firm. A cooperating firm determines its optimum output by equating the sum of the marginal cost functions in all plants (including the joint plant) with the marginal revenue in the final plant from which the product is marketed.

Phillips' treatment is based on the orthodox theory of the firm as a profit-maximizing enterprise. However, the firm which he speaks of is the household, and he denies that a cooperative association composed of firms or households can have economic life or purpose apart from participating economic units.

In conclusion, all the above writers agree that the cooperative organization is not viewed as a firm because the cooperative does not operate for profits for itself and is therefore not capable of entrepreneurial decisions. Thus, according to their views a cooperative is not a firm.

APPENDIX B

SINGLE PLANT AND MULTIPLANT FIRM MODELS

Single Product-Single Plant

Based on the marginal analysis, the cooperative firm allocates the productive inputs, minimizes costs, and maximizes profits for its member-patrons. The production function assumes technical efficiency and the maximum output, Y, from the combination of variable inputs $(X_1, X_2, X_3, \ldots, X_n)$. Equation (B.1) represents a single product short-run production function in which n inputs are variable and $(X_{n+1}, \ldots, X_z)$ inputs are fixed.

$$Y = f(X_1, X_2, \ldots, X_n \mid X_{n+1}, \ldots, X_z) \qquad (B.1)$$

It is assumed that all X_i $(i = 1, 2, \ldots, n)$ are purchased at P_i and Y is sold at P_y per unit and cost function expressed the minimum cost of producing a specific level of output Y given the technical conditions of production function and the input prices. The total cost is

$$TC = A + \sum_{i=1}^{n} P_i X_i \qquad (B.2)$$

A represents the cost of the fixed inputs. The total variable cost is defined by equation (B.3).

$$TVC = \sum_{i=1}^{n} P_i X_i \qquad (B.3)$$

The cooperative firm's total revenue and total cost can both be expressed as functions of output in (B.4).

$$TR = R(Y) \qquad \text{and} \qquad TC = C(Y) \qquad (B.4)$$

The cooperative firm's profit (π) is the difference between its total revenue and its total cost, and is defined by equation (B.5).

$$\pi = R(Y) - C(Y) \qquad (B.5)$$

To maximize profit (π) set the first derivative of (B.5) with respect to Y equat to zero as in (B.6).

$$\frac{d\pi}{dY} = \frac{\partial R(Y)}{\partial Y} - \frac{\partial C(Y)}{\partial Y} = 0 \qquad (B.6)$$

or

$$\frac{\partial R(Y)}{\partial Y} = \frac{\partial C(Y)}{\partial Y}$$

or

$$MR_Y = MC_Y$$

Therefore, marginal revenue must equal marginal cost for the profit maximization condition. To insure a profit maximum rather than a minimum, the second derivative must be less than zero.[1]

$$\frac{d^2\pi}{dY^2} = \frac{\partial^2 R(Y)}{\partial Y^2} - \frac{\partial^2 C(Y)}{\partial Y^2} < 0 \qquad (B.7)$$

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[1]James M. Henderson and Richard E. Quandt, _Microeconomic Theory: A Mathematical Approach_ (New York, 1958), p. 169.

Single Product - Multiplant

The cooperative firm may use more than one plant to produce its product. The marginal analysis is applicable to this situation. Assume that a cooperative firm produces its output in two separate plants with some geographic separation among plants. Assume further that the output Y is sold in a single market. Then the output of the product which maximizes the firm's profit, will be produced in all plants until marginal costs (MC_i) in each plant ($i = 1, 2$) are equivalent and all MC's eventually will be equated to the marginal revenue (MR). The firm's profit (π) is the difference between total revenue (TR) and total costs (TC_i) for both plants:

$$\pi = R(Y_1 + Y_2) - C_1(Y_1) - C_2(Y_2) \tag{B.8}$$

where Y_1 and Y_2 are the quantities which the firm produces in the two plants, $R(Y_1 + Y_2)$ is the revenue function and $C_1(Y_1)$ and $C_2(Y_2)$ are the cost functions. Setting the partial derivatives of (B.8) with respect to Y_1 and Y_2 equal to zero, and with the assumption that Y_1 and Y_2 are different quantities of the same product Y.

$$\frac{\partial \pi}{\partial Y_1} = \frac{\partial R(Y_1 + Y_2)}{\partial Y_1} - \frac{\partial C_1(Y_1)}{\partial Y_1} = 0 \tag{B.9}$$

$$\frac{\partial \pi}{\partial Y_2} = \frac{\partial R(Y_1 + Y_2)}{\partial Y_2} - \frac{\partial C_2(Y_2)}{\partial Y_2} = 0 \tag{B.10}$$

$$\frac{\partial C_1(Y_1)}{\partial Y_1} = MC_{Y_1} \tag{B.11}$$

$$\frac{\partial C_2(Y_2)}{\partial Y_2} = MC_{Y_2} \tag{B.12}$$

Assuming that MC_{Y_1} is equal to MC_{Y_2}, therefore,

$$\frac{\partial R(Y_1 + Y_2)}{\partial Y_1} = \frac{\partial R(Y_1 + Y_2)}{\partial Y_2} = MR_y \tag{B.13}$$

Thus,

$$MR_Y = MC_{Y_1} = MC_{Y_2} \tag{B.14}$$

The MC in each plant must equal the MR of the output as a whole.[2]

The second order condition requires the principle minors of the relevant Hessian determinant alternate in signs beginning with a negative sign.

$$\begin{vmatrix} \dfrac{\partial^2 R(Y_1 + Y_2)}{\partial Y_1^2} - \dfrac{\partial^2 C_1(Y_1)}{\partial Y_1^2} & \dfrac{\partial^2 R(Y_1 + Y_2)}{\partial Y_2 \partial Y_1} \\ \\ \dfrac{\partial^2 R(Y_1 + Y_2)}{\partial Y_2 \partial Y_1} & \dfrac{\partial^2 R(Y_1 + Y_2)}{\partial Y_2^2} - \dfrac{\partial^2 C_2(Y_2)}{\partial Y_2^2} \end{vmatrix} \tag{B.15}$$

Therefore,

$$\frac{\partial^2 R(Y_1 + Y_2)}{\partial Y_1^2} - \frac{\partial^2 C_1(Y_1)}{\partial Y_1^2} < 0 \tag{B.16}$$

(B.16) implies that

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[2]Henderson and Quandt, p. 173.

$$\frac{\partial^2 R(Y_1 + Y_2)}{\partial Y_1^2} < \frac{\partial^2 C_1(Y_1)}{\partial Y_1^2} \tag{B.17}$$

and

$$\left[\frac{\partial^2 R(Y_1 + Y_2)}{\partial Y_1^2} - \frac{\partial^2 C_1(Y_1)}{\partial Y_1^2}\right]\left[\frac{\partial^2 R(Y_1 + Y_2)}{\partial Y_2^2} - \frac{\partial^2 C_2(Y_2)}{\partial Y_2^2}\right] -$$

$$\left[\frac{\partial^2 R(Y_1 + Y_2)}{\partial Y_2 \, \partial Y_1}\right]^2 > 0 \tag{B.18}$$

Then (B.16) and (B.17) imply that

$$\frac{\partial^2 R(Y_1 + Y_2)}{\partial Y_2^2} < \frac{\partial^2 C_2(Y_2)}{\partial Y_2^2} \tag{B.19}$$

This means that marginal costs (MC_i) in each plant must be increasing more rapidly than the marginal revenue (MR_y) of the output as a whole.

APPENDIX C

THE MULTIPRODUCT COOPERATIVE FIRM[1]

The profit-maximizing conditions for the cooperative firm producing more than one product are developed. When a firm produces more than one product, there usually exists interrelationships among inputs and outputs which must be taken into account to determine the profit-maximizing conditions of the firm.

The case when n variables inputs are used to produce two products will be discussed. Let Y_1 and Y_2 be two products produced by a firm with variable resources $X_1, \ldots, X_n$. The output of Y_1 and Y_2 is now a function of the variable inputs $X_1, \ldots, X_n$, and the amount of the other product produced.[2]

$$Y_1 = f(X_1, X_2, \ldots, X_n, Y_2) \tag{C.1}$$

$$Y_2 = f(X_1, X_2, \ldots, X_n, Y_1) \tag{C.2}$$

It is assumed that marginal products of Y_1 and Y_2 with respect to each of the variable inputs is positive. The rate of technical substitution between Y_1 and Y_2 is given by the partial derivative of (C.1) with respect to Y_2 or the partial derivative of (C.2) with respect to Y_1.

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[1]This model is applicable to the conglomerate integrated cooperative firm.

[2]Sune Carlson, A Study on the Pure Theory of Production (New York, 1956), p. 84.

$$\frac{\partial Y_1}{\partial Y_2} = \frac{1}{\frac{\partial Y_2}{\partial Y_1}} < 0 \qquad (C.3)$$

In a case where one variable input is used to produce two products, the amount of the variable input employed is a function of the level of output of the two products. The technical relationship in this case is defined by the nature of the mixed derivative $\frac{\partial^2 X}{\partial Y_1 \partial Y_2}$. Y_1 and Y_2 are defined to be technically complementary, technically substitutable or technically independent, according to whether $\frac{\partial^2 X}{\partial Y_1 \partial Y_2}$ is negative, positive or zero.[3] Where more than one variable input is used to produce two products, the quantity of each variable input used depends not only on the quantity of the products produced, but also on the employment level of the other inputs. In such a case, the technical relationships between Y_1 and Y_2 cannot be defined in terms of the mixed partial derivatives as in the case where a single input is used. The relationship between costs and output is used to define the technical relationship between the products Y_1 and Y_2 where more than one variable resource is used.

Resources are employed such that the ratio of the price of the resource to the marginal product of the resource is the same for each resource in the production of a product. The equality of ratios is not necessarily equal among products. These ratios give the marginal cost of producing the respective products.

In joint production, the marginal cost of one product, say Y_1, may vary with a change in the level of other product, Y_2. This may be

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[3] Carlson, p. 79.

because the resources change with the level of inputs or because the products are technically interdependent. If resource prices are assumed to be independent of the level of employment, the technical relationship between the products Y_1 and Y_2 can be determined from the mixed derivative $\dfrac{\partial^2 C}{\partial Y_1 \, \partial Y_2}$, where $C(Y_1, Y_2)$ is the firm's total cost function. The products are defined to be technically complementary, substitutable, or independent according to whether $\dfrac{\partial^2 C}{\partial Y_1 \, \partial Y_2}$ is negative, positive, or equal to zero.

In the multiproduct cooperative firm, the demand for the products may also be interrelated. In such case, the product prices are functions of all products produced instead of only one product. For the two product case, the following relations exist:

$$P_{y_1} = P(Y_1, Y_2)$$

$$P_{y_2} = P(Y_1, Y_2)$$

$$(C.4)$$

It is assumed that $\dfrac{\partial P_{y_1}}{\partial Y_1}$ and $\dfrac{\partial P_{y_2}}{\partial Y_2}$ are always negative. The direction of effect of a change in the quantity of one product on the price of the other product is not always the same. That is, $\dfrac{\partial P_{y_1}}{\partial Y_2}$ and $\dfrac{\partial P_{y_2}}{\partial Y_1}$ may be positive, negative, or equal to zero. In the two product case, total revenue is a function of Y_1 and Y_2,

$$TR = R(Y_1, Y_2) = P_{y_1} Y_1 + P_{y_2} Y_2 \qquad (C.5)$$

The profit, π, also is a function of Y_1 and Y_2. Expressing profit as

$$\pi = P_{y_1} Y_1 + P_{y_2} Y_2 - C(Y_1, Y_2) \qquad (C.6)$$

The first-order conditions require that

$$\frac{\partial \pi}{\partial Y_1} = Y_1 \frac{\partial Py_1}{\partial Y_1} + Py_1 + Y_2 \frac{\partial Py_2}{\partial Y_1} + Py_2 \frac{\partial Y_2}{\partial Y_1} - \frac{\partial C}{\partial Y_1} = 0 \qquad (C.7a)$$

and

$$\frac{\partial \pi}{\partial Y_2} = Y_1 \frac{\partial Py_1}{\partial Y_2} + Py_1 \frac{\partial Y_1}{\partial Y_2} + Py_2 + Y_2 \frac{\partial Py_2}{\partial Y_2} - \frac{\partial C}{\partial Y_2} = 0 \qquad (C.7b)$$

Second-order conditions require that

$$\frac{\partial^2 \pi}{\partial Y_1^2} \text{ and } \frac{\partial^2 \pi}{\partial Y_2^2} < 0$$

and

$$\frac{\partial^2 \pi}{\partial Y_1^2} \frac{\partial^2 \pi}{\partial Y_2^2} > \left(\frac{\partial^2 \pi}{\partial Y_1 \partial Y_2} \right)^2$$

Equations (C.7a) and (C.7b) express important relationships in the determination of the firm's price and sales policy. From (C.7a) the price of Y_1 that maximizes profit is

$$Py_1 = \frac{\partial C}{\partial Y_1} - Y_1 \frac{\partial Py_1}{\partial Y_1} - Y_2 \frac{\partial Py_2}{\partial Y_1} - Py_2 \frac{\partial Y_2}{\partial Y_1} \qquad (C.8)$$

$$\therefore Py_1 - \frac{\partial C}{\partial Y_1} = - Y_1 \frac{\partial Py_1}{\partial Y_1} - Y_2 \frac{\partial Py_2}{\partial Y_1} - Py_2 \frac{\partial Y_2}{\partial Y_1} \qquad (C.9)$$

If $\frac{\partial Py_2}{\partial Y_1}$ is positive and $\frac{\partial Y_2}{\partial Y_1}$ also positive, then $Py_1 - \frac{\partial C}{\partial Y_1} < 0$. Then it is possible that Y_1 should be sold at a price less than its marginal

cost. Then Y_1 and Y_2 are complements.[4] If $\frac{\partial Py_2}{\partial Y_1}$ is negative and $\frac{\partial Y_2}{\partial Y_1}$ is also negative, then $Py_1 - \frac{\partial C}{\partial Y_1} > 0$. Then Y_1 should be sold at a price more than its marginal cost. Then Y_1 and Y_2 are substitute products. The above relationships indicate that a firm desires to have technical and market complementarity among products and groups of products, while technical and market substitutability is desired among inputs and groups of inputs.

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[4]R.G.D. Allen, <u>Mathematical Analysis For Economists</u> (London, 1962), p. 362.

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