

Cooperative Theory: A Neoclassical Approach

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Introduction

This chapter presents an exposition of the neoclassical theory of cooperatives. *Theory* is a tool economists use to study the behavior of economic agents such as consumers and firms. An economic theory begins with assertions about behavior, such as *consumers maximize utility* or *firms maximize profits*. Then a *model*, which is a simplified representation of reality, is constructed by specifying a set of assumptions about how the elements of the theory relate to the real world. By using models, economists reduce the complexities of the real world so they can focus on understanding essential economic relationships. Utilizing logical arguments of deduction or mathematical techniques, economists derive conclusions or predictions about economic behavior from a model.

The *neoclassical* approach to theory is the one economists use most often. In neoclassical economics, the value of products and the allocation of resources are determined by the costs of production and the tastes and preferences of consumers. Neoclassical theory relies on *marginal analysis*, in which the quantity of a product that is purchased or sold is based on the additional utility, revenue, or cost associated with the last unit.

The neoclassical theory of the firm found in most economic textbooks is inadequate for understanding the economic behavior of cooperatives because assertions about cooperative behavior are generally quite different than those for investor-oriented firms (IOFs). For example, the standard theory of the firm begins with the assertion that firms maximize profits. This

assertion is frequently rejected by cooperative theorists, who have ascribed other objectives to cooperatives, including maximization of member welfare, maximization of patronage refunds, and minimization of costs. Each of these objectives requires a separate analysis, and conclusions about IOF behavior, based on profit maximization, do not necessarily apply to cooperatives.

The theory presented in this chapter uses the neoclassical approach, including marginal analysis, to derive conclusions about the economic behavior of cooperatives. The study of cooperative theory is useful because it provides students knowledge about the expected behavior of cooperatives in various market situations and the differences between the behavior of cooperatives and IOFs. Because the theoretical analysis of cooperatives can be based on several different assertions about cooperative objectives, the study of cooperative theory also offers students insights into the economic implications of a cooperative's choice of objectives. In addition, the study of cooperative theory produces some important implications for public policy concerning cooperatives based on the expected impact of cooperatives on the economic performance of imperfect markets.

After a brief review of the basic theory of IOFs, models of a farm supply cooperative and a marketing cooperative are presented in this chapter. Following these models, there is a discussion of the effect of cooperatives on the performance on imperfect markets. Students with an understanding of fundamental economic principles should be able to comprehend the material in this chapter, which is presented verbally and graphically. Mathematical formulations of both cooperative models are included in the appendix at the end of the chapter. The material in the

appendix should be appropriate for graduate students, advanced undergraduate students, and others with elementary skills in calculus.

Not all theoretical analyses of cooperatives have been conducted using the neoclassical approach. Game theory, agency theory, transaction cost analysis, and other theoretical methods that may be conveniently labeled "neo-institutional approaches" have been used to provide additional insights into cooperative behavior and to address shortcomings in the neoclassical theory of cooperatives. These approaches are described in the following chapter.

Theory of Farm Supply Cooperatives

In this section, we focus on the behavior of farm supply cooperatives, which are cooperatives that supply members with inputs they use in farm production. Farm supply cooperatives may manufacture these inputs or purchase them from other firms. For simplicity, we assume the cooperative supplies a single input to farmers. We also deal with the more general case of a farm supply cooperative that manufactures the input. For cooperatives that simply acquire the input, the manufacturing costs of the cooperative can be interpreted as the costs of acquiring and transporting the input.

Profit-Maximizing (IOF) Input Supply Firm

To compare the behavior of a farm supply cooperative with that of an IOF, we must first review the theory of a profit-maximizing firm. Assume that a profit-maximizing input supply firm sells the input to farmers in a perfectly competitive market. In other words, the firm competes

with enough other firms that its market share is so small it cannot affect the price it receives for the input no matter how many units it sells.

The input supply firm's demand curve and cost curves are shown in figure 1. Under perfect competition, the firm faces a horizontal demand curve, reflecting that the price is constant regardless of the quantity sold. The cost curves represent the costs of manufacturing or procuring the input and selling it to farmers. The average total cost (ATC) is simply the total cost of manufacturing and selling the input divided by the number of units sold. The marginal cost (MC) is the change in total cost due to producing and selling one additional unit of the input. The average cost curve shown in figure 1 is U-shaped, representing conventional ideas about costs. Average cost at first decreases over a range before increasing. The marginal cost is assumed to be generally increasing, at least over the relevant range. It intersects the minimum of the average cost curve from below. As long as the marginal cost of producing and selling the input is less than the average cost, the average cost is declining. Once marginal cost is greater than average cost, the average cost curve is positively sloped.

A profit-maximizing input supply firm will produce and sell the quantity of farm input for which marginal cost equals price, represented by Q_1 in figure 1. As long as the marginal cost—the cost of producing and selling an additional unit of the input—is less than the price of the input, the firm can increase its profits by producing additional units. By producing Q_1 units of the input, the firm earns profits equal to the shaded area. That rectangle represents the difference between the firm's total revenue, which is P_1 , the price received for the input, times the quantity Q_1 , and the firm's total cost, which is C_1 times Q_1 .

Monopoly and Monopolistic Competition

Perfect competition does not exist in many markets for farm inputs. Agricultural input supply firms often face downward-sloping demand curves. Instead of selling whatever quantity they produce at a fixed price set by the market, these firms must lower the price they set to increase sales. The flexibility a firm facing a downward-sloping demand curve has in setting its price provides it market power in that it is able to set its price in order to maximize its profits.

A firm may face a downward-sloping demand curve if it is a monopoly, i.e., if it is the only supplier of the input in the market. It also may face a downward-sloping demand curve if the market is characterized by monopolistic competition. Under *monopolistic competition*, there is competition from other sellers, but each individual firm has a degree of market power.

In markets for agricultural inputs, downward-sloping demand curves frequently result from the spatial distribution of competing firms. If an input supply firm sets a high price, it may sell only to farmers located nearby. At lower prices, the firm may attract additional sales from farmers who are further away and relatively closer to competing suppliers. Downward-sloping demand curves also may be due in part to customer loyalty and product differentiation. Input suppliers may seek to differentiate the products or services they sell by advertising, brand identification, altering the appearance of their product, making it more difficult for producers to substitute other products, altering service quality, product delivery procedures, availability of credit, and application services.

A profit-maximizing input supply firm facing a downward-sloping demand curve is illustrated in figure 2. The marginal revenue curve (MR) is shown beneath the demand curve (D).

The marginal revenue is the additional revenue the input supplier receives from each additional unit of sales. When the demand curve facing a firm is downward-sloping, the marginal revenue curve also declines because the price of all units sold must be lowered in order to sell an additional unit.

The slope of the demand curve depends on the availability of close substitutes for the product. If the input supplier is a monopoly, the demand curve will be steeper than if there is monopolistic competition. The introduction of similar products by firms competing in the same market would flatten a firm's demand curve. At the extreme, if there are many firms offering perfect substitutes, the market would be characterized by perfect competition and the firm's demand curve would be horizontal, as in figure 1.

A profit-maximizing input supply firm facing a downward-sloping demand curve will produce and sell the quantity of farm input for which the marginal cost of producing the input equals the marginal revenue from sale of the input, represented by Q_2 in figure 2. As long as marginal cost is less than marginal revenue, as for quantities less than Q_2 , the firm can increase its profits by producing additional units. The firm's profits equal the shaded area in figure 2. That rectangle equals the difference between the firm's total revenue, which is $P_2 \times Q_2$, and its total cost, which is $C_2 \times Q_2$.

Role of the Cooperative Manager, Board of Directors, and Members

While most economic analyses of the firm are based on the assertion that firms maximize profits, there is no clear consensus about the objective of cooperatives. In fact, while the standard

theory of the firm is based on the existence of an entrepreneur who makes decisions about the allocation of capital, labor, and other factors of production in the creation of profits, there has been disagreement about who the decision maker is in a cooperative. Some early analyses of cooperatives, such as those by Emelianoff (1942) and Phillips (1953), denied that entrepreneurial decisions were made by cooperatives. Instead, Phillips assigned the decision-making role to the cooperative's members, who individually allocated their resources between their farming operations and the cooperative.

In 1962, Helmberger and Hoos presented a model of a marketing cooperative in which the cooperative was given a decision-making role and the objective of maximizing the price it paid its members for the raw product. Helmberger and Hoos did not specify whether it was management or the board or directors that held the decision-making role. Instead, they assumed the existence of a "*peak coordinator*," consisting of an individual or group of individuals who wielded effective control over the cooperative. The peak coordinator was not necessarily associated with the manager or the board of directors, but rather with the individual or group that specified the cooperative's objective and engaged in strategies to attain it.

Since Helmberger and Hoos, neoclassical models of the cooperative generally have assigned the decision-making role to the cooperative, although not addressing the issue of whether management or the board of directors was in control. Some of these models have been based in part on the Helmberger and Hoos model, and they have been based on the objective of maximizing the raw product price paid members. However, several other cooperative objectives have been utilized or mentioned.

Recently, in some theoretical work on cooperatives, there has been a renewed focus on the role of individual members as decision makers. In these models, cooperatives are treated as coalitions of members with different and frequently conflicting interests. Within this framework, game theory has been used to analyze the internal decision-making processes of cooperatives by examining the strategies members and managers use to achieve their goals.¹ Game theory and related techniques are described in the following chapter on neo-institutional approaches.

Possible Cooperative Objectives

Because cooperatives are complex business organizations that serve a wide variety of purposes and perform a wide variety of functions, there is no single objective, like maximizing profits, that is generally accepted by all managers, boards of directors, and members. Further, because an individual cooperative may represent different and frequently conflicting interests of its membership and management, there may be substantial disagreement within a cooperative with respect to which objectives the cooperative should pursue.

A cooperative may pursue a number of objectives simultaneously. For example, a cooperative may attempt to earn a certain level of net income, maximize operating efficiency, maintain and expand its facilities, and increase its sales volume. However, these objectives can all be interpreted as strategies a cooperative might follow in pursuing a single, broader long-term objective such as maximizing member returns.

¹ Cooperative theory has evolved over several decades, and a thorough review of its development is beyond the scope of this chapter. See Staatz (1987 or 1989) for excellent surveys of this topic.

Because the analytical techniques used in neoclassical economic theory usually work best when a single objective is specified, we will follow that approach in this chapter. However, we will examine several alternative objectives that seem plausible given the principles of cooperation, the objectives of cooperative members, and the competitive environment in which cooperatives operate.² As we will see, the output and pricing decisions of a cooperative will frequently differ depending on which objective is sought.

One possible objective for a cooperative is to maximize its net earnings in the same manner as an IOF maximizes profits. Several reasons have been offered for why cooperatives might seek to *maximize profits*. By pursuing this objective, a cooperative will maximize funds available for patronage refunds or for internally financing growth, and they can avoid hostility and retaliatory pricing by rival firms (Enke, pp. 149–50). The maximization of profit may also result in higher measures of financial performance. To the extent that cooperative managers, boards of directors, and members use financial standards based on profit maximization, the pursuit of other objectives may result in poorer comparisons. It is possible that profit maximization may become a part of a cooperative's corporate culture through hiring managers from IOFs and because it is the objective cooperative directors pursue in their individual farming operations.

Other possible objectives may stem from recognition of the concept that the purpose of a cooperative is to operate, not for its own economic gain, but for the benefit of its members. Two objectives that members might consider appealing and consistent with this concept are

² Many possible objectives have been suggested for cooperatives. This chapter focuses on only five objectives, those analyzed by LeVay (1983a). For a more thorough discussion of cooperative objectives, see Bateman, Edwards, and LeVay (1979).

maximization of the per-unit patronage refund and *minimization of the net price* paid by members. The first of these might at first appear to be an obvious goal for a cooperative. However, minimization the net price paid by members may be a more attractive objective because it takes into consideration the value of both the patronage refund and the cash price. This objective may be particularly appealing to members whose decisions to purchase farm inputs from the cooperative are based on comparison of the prices charged by the cooperative and competing firms.

Another objective that is consistent with the purpose of a cooperative is the *maximization of total member profits*, including the earnings of the cooperative, which are distributed to members as patronage refunds. Support for this objective has been offered by Ladd (1982), LeVay (1983*b*), and Sexton (1984). This objective is consistent with the profit-maximizing behavior ascribed to producers in most neoclassical models, and it would seem to be a more effective means of enhancing the benefits members receive from cooperative than focusing on a single indicator, such as the price of the farm input. A disadvantage of this objective is that it does not provide managers an identifiable target, such as cooperative earnings, the per-unit patronage refund, or the net price.

Finally, there are reasons why a cooperative may seek to *maximize the quantity of input* it produces and sells. Managers, boards of directors, and members may be inclined to judge the cooperative's success in terms of its size and growth. In fact, in some cases, management salaries may be linked to sales or turnover. Increasing the size of the cooperative may also be related to long-run goals of reducing excess capacity, increasing market share, creating entry barriers,

enhancing the cooperative's bargaining power with input suppliers, or introducing branded products.

Price and Output Solutions for Cooperative Objectives

The price and output solutions for these cooperative objectives are illustrated in figures 3A and 3B for cases in which the cooperative faces a downward-sloping demand curve. For convenience, these solutions are summarized in table 1. In these examples, we assume that the cooperative sells the farm input only to its members so that the demand curve facing the cooperative represents the demand of its members for the input. However, we also assume that members are free to purchase the input from other input supply firms.

If the cooperative maximizes its net earnings in the same manner as an IOF maximizes profits, it will produce and sell at level Q_1 , which is determined by the intersection of the firm's marginal revenue and marginal cost curves ($MR=MC$). The price, which is read from the demand curve, is P_1 , and the average cost is C_1 . The net earnings of the cooperative are represented by the rectangle $(P_1-C_1) \times Q_1$. Assuming all net earnings are returned to members as patronage refunds, the per-unit patronage refund is P_1-C_1 and the net price paid by members is C_1 .

A cooperative that maximizes the per-unit patronage refund it pays its members would produce and sell at level Q_2 , which is the quantity for which the distance between the demand curve and the average total cost curve is the greatest. This quantity also corresponds to the point at which the slope of the average total cost curve is equal to the slope of the demand curve, which is also the cooperative's average revenue curve (AR). The price is P_2 and the average cost is C_2 .

A careful inspection of figure 3A verifies that the per-unit patronage refund $P_2 - C_2$ is greater than for any other solution. However, *total* patronage refunds, represented by $(P_2 - C_2) \times Q_2$, are less than those in the previous solution, represented by $(P_1 - C_1) \times Q_1$.

Minimization of the net price occurs at quantity Q_3 , in figure 3B, which corresponds to the minimum of the average cost curve—the point at which average total cost is intersected by marginal cost ($MC = ATC$). The cash price is P_3 , which is greater than P_1 and two other prices, but after deducting the per-unit patronage refund $P_3 - C_3$, the net price is C_3 , which is the lowest possible average cost of providing the input.

Maximization of member profits, including the earnings of the cooperative, which are distributed to members as patronage refunds, occurs at level Q_4 , which is determined by the intersection of the demand curve and the marginal cost curve ($AR = MC$). The cooperative's net earnings, which are represented by the rectangle $(P_4 - C_4) \times Q_4$, are less than the earnings under profit maximization, $(P_1 - C_1) \times Q_1$.

However, the sum of the cooperative's net earnings and consumer surplus is greater in this solution than in any other solution. *Consumer surplus* is the difference between what consumers would be willing to pay for a product and what they actually pay when a single price is charged for all units. It is equivalent to the area between the demand curve and the price. In this model, consumer surplus is equivalent to the member profits that are attributable to the farm input given the price charged by the cooperative, and it is represented by the triangular area below the demand curve but above the price P_4 . This area plus the cooperative's net earnings $(P_4 - C_4) \times Q_4$

represent that portion of member profits that are attributable to provision of the farm input by the cooperative.

The quantity of the farm input produced and sold by the cooperative is maximized at level Q_5 and is determined by the intersection of the demand and average total cost curves ($AR=ATC$). Both the price and average cost are P_5 . Consequently, the cooperative's net earnings and the per-unit patronage refund are zero. Thus, this solution is frequently called the "*breakeven*" solution. Production of quantities greater than Q_5 , although technically possible, would result in losses for the cooperative.

The number of solutions is reduced if the cooperative sells the farm input in a perfectly competitive market, as demonstrated in figure 4. Under perfect competition, the cooperative is a price-taker, and the price it can receive for the input is constant regardless of the quantity it sells. The price indicated by the demand curve represents both the cooperative's average and marginal revenue. Consequently, the criterion for the maximization of cooperative profit ($MR=MC$) is identical to that for the maximization of member profits ($AR=MC$). In other words, the cooperative can ensure that member profits are maximized by simply setting the quantity it produces so to maximize its own net earnings, in the same manner as an IOF would maximize its profits. In figure 4, this quantity is Q_1 , and the average cost of producing and selling the farm input is C_1 . The cooperative's net earnings are $(P-C_1) \times Q_1$, and the per-unit patronage refund is $P-C_1$.

Under perfect competition, the solution for maximization of the per-unit patronage refund is equivalent to that for minimization of the net price. Maximization of the per-unit patronage

refund occurs where the slopes of the demand (average revenue) and average total cost curves are equal. Because the demand curve facing the cooperative is horizontal under perfect competition, maximization of the per-unit patronage refund occurs where the slope of the average total cost curve is zero—at the minimum of the average total cost curve. In other words, the cooperative maximizes the per-unit patronage refund by producing and selling the quantity that corresponds to the point at which the marginal cost curve intersects the average total cost curve, just as if it were minimizing the net price of the input. In figure 4, this quantity is Q_2 , and the average cost is C_2 . The cooperative's net earnings are $(P-C_2) \times Q_2$, and the per-unit patronage refund is $P-C_2$.

If the cooperative maximizes the quantity of the farm input it produces and sells, the quantity is once again determined by the intersection of the demand and average total cost curves ($AR=ATC$). Quantity is Q_5 , and both the price and average cost are P . Consequently, the cooperative's net earnings and the per-unit patronage refund are both zero.

Stability of Cooperative Price and Output Solutions

An important issue concerns the stability of the price and output solutions for various cooperative objectives. For all objectives except the maximization of quantity, members of the cooperative receive a patronage refund. If members recognize the existence of a patronage refund in making their purchasing decisions, they will have an incentive to expand their use of the farm input until the aggregate purchases of the input equal Q_5 . At that level, which corresponds to the intersection of the demand and average total cost curves, the price of the input equals the average cost of producing it, and there is no patronage refund. Consequently, members do not

have an incentive to increase their purchases, and this solution represents an equilibrium, unlike the others.

The instability of the other solutions has important implications for cooperatives that pursue other objectives. Because the receipt of patronage refunds provides members an incentive to expand their use of the input beyond the optimal level, a cooperative will not be able to achieve another objective unless it imposes some sort of restriction on the purchase of the farm input. Restrictions, such as quotas on purchases from the cooperative, may create member relations problems and could contribute to a shift in customer loyalty to rival businesses over time.

Strategies for Lowering Cooperative Costs

In some situations, a cooperative may be able to lower its average cost of producing and selling the farm input by shifting the demand curve or its cost curves. Consider the cooperative in figure 5 represented by the costs curve ATC_1 and MC_1 . Assume that the cooperative faces the demand curve D_1 and that it produces the farm input at the level Q_1 , determined by the intersection of the average total cost and demand curves.

One strategy that may be available to the cooperative is to reduce the demand it faces for the farm input so that it can reduce its production and lower its costs. Assume that the cooperative currently serves both member and nonmember patrons. For example, the cooperative may produce and sell a product, such as fertilizer, that can be used both on farms and residential lawns and gardens. The cooperative may choose to discontinue sales of the product to nonmembers, shifting the demand curve it faces from D_1 to D_2 . The new demand curve intersects

the cooperative's average total cost curve at its minimum. By reducing the quantity it produces and sells from Q_1 to Q_2 , the cooperative can lower its average cost from C_1 to C_2 . As a result of discontinuing service to nonmembers, the cooperative is able lower the cost of providing the farm input to its members.

In this example, the cooperative shifts its demand curve so it can operate at a different point on its short-run average total cost curve. In the *short run*, at least one of the cooperative's factors of production is fixed. In other words, we assume that the plant the cooperative uses to produce the farm input is of a fixed capacity. In the *long run*, all factors of production can be varied. Consequently, an alternative to operating on another point on the short-run average total cost curve is for the cooperative to move along its long-run average cost curve by constructing a larger manufacturing plant or by expanding the capacity of its existing plant.

Assume that the cooperative continues to sell the farm input to nonmembers and that its demand curve remains D_1 . By building a new plant, represented by the cost curves ATC_2 and MC_2 , the cooperative can operate on the long-run average total cost curve (LRAC) where it is intersected by the demand curve. The cooperative will produce Q_3 units of the farm input at an average cost of C_3 .

In other situations, the problem may be that the cooperative is *underutilizing* its existing plant capacity. Assume that the cooperative's manufacturing plant is once again represented by the cost curves ATC_1 and MC_1 but that the demand curve is D_2 . The cooperative produces at the level Q_4 at the average cost of C_1 . Increasing production to Q_2 would lower the average cost from C_1 to C_2 . The difference between Q_4 and Q_2 is referred to as *excess capacity*—the

cooperative's existing plant is too large relative to its use. Because the cooperative is using only a small proportion of its existing plant's capacity, those units of the farm input that are produced must cover a disproportionately large share of the plant's fixed costs. The cooperative would be able to lower its average cost by decreasing its plant size or increasing the demand for its production.

One option may be for the cooperative to merge with one or more neighboring cooperatives to reduce industry excess capacity and to allow the merged cooperative to achieve economies of scale. For example, consider three cooperatives, each of which operates a bulk fuel truck at 30% capacity. By merging their operations, the cooperatives might be able to eliminate at least one of the trucks and some excess fuel storage capacity and to reduce its labor expenses. Another option may be for a cooperative to begin selling the farm input to nonmember patrons if it currently is not.

Long-Run Equilibria for Various Objectives

In the long run, none of the factors of production is fixed. Consequently, a cooperative can vary its capacity by expanding or reducing the size of its manufacturing plant, building a new plant, or even exiting the industry. Similarly, new firms can enter the industry or existing firms can exit. In addition, the demand curve for the cooperative's production can shift over time.

If the industry is perfectly competitive, the existence of *excess profits*—profits in excess of the normal return to capital that is included in average total cost—will attract additional firms into the industry or the expansion of existing firms. Consider the cooperative represented in figure 4.

Given the market price P , the potential for excess profits exists in the short run. For example, a profit-maximizing IOF with the same cost structure would produce at the level Q_1 and earn profits equal to the area $(P-C_1) \times Q_1$. The existence of profits or the potential for profits will encourage entry into the industry.

As new firms begin manufacturing the farm input, the market price will fall. As a consequence of the falling price, inefficient firms (i.e., firms that produce the input at an average cost above the market price) will either exit the industry or adjust by lowering their costs. Eventually, the equilibrium situation shown in figure 6 will occur. The market price will fall to P_2 , which is equal to the minimum long-run average total cost (LRAC). Only efficient firms will remain in the industry, and the average cost of producing the input will equal the price P_2 . Consequently, excess profits will be zero, and firms will receive only a normal return equal to the opportunity costs of the factors of production employed.

In the equilibrium situation shown in figure 6, any cooperative, regardless of the objective it pursues, would produce at level Q_2 . Because of the equivalence of average total cost, marginal cost, average revenue, and marginal revenue at Q_2 , all the criteria shown in table 1 are satisfied although net earnings and patronage refunds are zero.

In the long run, a cooperative that is a monopoly may continue to face a downward-sloping demand curve if there are barriers to the entry of new firms into the industry. Under those circumstances, the cooperative might also be able to lower its costs by adjusting the capacity of its manufacturing plant. Thus, figures 3A and 3B can be used to show the long-run price and output

solutions for the cooperative under various objectives if the short-run cost curves are replaced with the corresponding long-run curves.

Under monopolistic competition, individual firms have some market power. However, there are no barriers to entry, and in the long run the existence of excess profits provides an incentive for expansion of existing firms or the entry of additional firms into the industry. A profit-maximizing firm seeks to maximize its profits by setting output at the point at which its marginal revenue curve intersects its long-run marginal cost curve. However, with additional entry and expansion, the residual demand curve facing the firm will shift to the left until it is tangent to the firm's long-run average cost curve and its excess profits are driven to zero.

This is illustrated in figure 7. Assume that all the firms in the industry are profit-maximizing firms and that each has the same set of cost curves. At long-run equilibrium, the residual demand curve facing a firm, which is labeled D_1 , is tangent to the long-run average cost curve LRAC at quantity Q_1 . At this quantity, the firm's marginal revenue curve MR_1 intersects its long-run marginal cost curve LRMC. The firm sets the price P_1 , and profit is zero because price is equal to average cost. Output is at equilibrium because there are no profits or losses in the industry because all firms are assumed to be equally efficient. Consequently, there is no incentive for either entry or exit.

If all firms in the industry were cooperatives, entry or expansion would shift the residual demand curve facing an individual cooperative to the left until it intersected the long-run average cost curve at its minimum. In figure 7, this is represented by the intersection of the demand curve

D_2 and long-run average cost curve LRAC. The equilibrium output would be Q_2 , and the equilibrium price would be P_2 .

It is less clear what the equilibrium output and price would be when the industry consists of both profit-maximizing firms and cooperatives. Assume that there is a single cooperative in a market dominated by profit-maximizing firms and that the cooperative is so small that it cannot affect the market price. The equilibrium price established by the profit-maximizing firms would be P_1 . Because P_2 , the price charged by the cooperative is less than the market price P_1 , an incentive would exist for producers who purchase the input from profit-maximizing firms to purchase it from the cooperative. The residual demand curve facing the cooperative would shift to the right until it intersected the long-run average cost curve LRAC at the price P_1 . The cooperative's output would be Q_3 .

Theory of Marketing Cooperatives

In this section, we focus on the behavior of marketing cooperatives, which are cooperatives that market the farm commodities produced by member farmers. In some cases, a marketing cooperative simply purchases a commodity from its members and resells it to food manufacturing or processing firms after providing some minimal services such as assembling and grading the commodity. After the cooperative sells the commodity to a manufacturer or processor, it distributes any additional revenues, after deducting transportation or handling costs, to members as patronage refunds. In other cases, the cooperative may process the commodity

and sell the processed product to consumers or retailers. In those cases, the patronage refunds would include any value added to the commodity by the cooperative.

Here we explore the general case of a processing cooperative that purchases a raw product from its members that it uses to manufacture a processed product it sells to consumers. For simplicity, we assume that one unit of the raw product is used to produce one unit of the processed product. This model can be applied to the case of a cooperative that simply markets the raw product for its members by considering the processing costs to represent the costs of transporting and handling the raw product.

Analyses of the price and output decisions of a processing firm frequently utilize the concept of *net revenue product*, which is defined as the total revenue of the processor less the total costs of processing the raw product. The costs of processing the raw product used to compute the net revenue product do not include the cost of the raw product itself. The *net average revenue product* (NARP) is defined as net revenue product divided by the quantity of product and is equivalent to the price received by the processor less its average processing cost. It represents the amount per unit that is available for raw product payment and profit. The *net marginal revenue product* (NMRP) is defined as the marginal change in net revenue product from processing an additional unit of raw product, and it is equivalent to marginal revenue less marginal processing cost. Use of the NARP and NMRP curves is appealing because it allows revenues and costs at the processor level to be combined, thereby facilitating the graphical exposition of the relationship between the processor and the producers of the raw product.

The relationship of the NARP and NMRP curves to processing costs and the demand for the processed product is illustrated in figure 8. The average and marginal processing costs are represented by APC and MPC in the upper panel. The demand and marginal revenue curves for the processed product are represented by D and MR. The NARP curve, which is shown in the lower panel, is derived by subtracting the APC curve from the demand curve, which represents the price or average revenue for the processed product. Wherever the demand curve is above the APC curve, the NARP curve is positive, as it is over the range from Q_1 to Q_4 , determined by the intersections of the demand and APC curves. The maximum of the NARP curve corresponds to the quantity Q_2 , determined by the greatest difference between the demand and APC curves (i.e., the point where their slopes are equal). The NARP curve will have a downward-sloping portion if either the demand curve facing the cooperative is downward-sloping or if the average processing cost is increasing, as might be expected in the short run.

The NMRP curve is derived by subtracting the MPC curve from the MR curve. It intersects the NARP curve through the NARP curve's maximum and is positive as long as the MR curve is above the MPC curve. The NMRP intersects the quantity axis at Q_3 , determined by the intersection of the MR and MPC curves.

Possible Objectives for Marketing Cooperatives

Table 2 presents five possible objectives for marketing cooperatives that are identical or analogous to those presented in table 1 for farm supply cooperatives. The price and output solutions for these objectives are illustrated in figures 9A and 9B. In that figure, the NARP and

NMRP curves for a processing cooperative are shown with the raw product supply curve facing the cooperative (S) and the corresponding marginal factor cost curve (MFC). The marginal factor cost curve represents how much each additional unit of the raw product will cost the processor as it increases the quantity it purchases. If a processor faces an upward-sloping supply curve, as in figure 9A, the cost of each additional unit of the raw product will increase because it must be purchased at a higher price and because it increases the price at which all other units of the raw product are purchased. The marginal factor cost consists of both of these factors that increase the cost of additional units.

Like a farm supply cooperative, a marketing cooperative may choose to maximize its net earnings or profits in a manner similar to an IOF. To do so, it would set the price it pays for the raw product at R_1 so that the NMRP and MFC curves intersect. The cooperative would process the raw product at the level Q_1 , and its net earnings would be $(N_1 - R_1) \times Q_1$. These net earnings would be distributed to members in the form of patronage refunds by setting the per-unit patronage refund to $N_1 - R_1$. Subtracting the per-unit patronage refund from the cash price, the net price paid members for the raw product is N_1 .

A cooperative that maximizes the per-unit patronage refund it pays its members would process the raw product at the level Q_2 , the quantity for which the distance between the NARP and supply curves is the greatest. The cooperative would pay members a cash price of R_2 , and the per-unit patronage refund would be equal to $N_2 - R_2$. After deducting the per-unit patronage refund from the cash price, the net price would be N_2 . Maximization of the net price paid

members would occur at level Q_3 , in figure 9B, determined by the maximum of the NARP curve, or where the NARP curve is intersected by the NMRP curve.

Maximization of member profits, including the earnings of the cooperative occurs at level Q_4 , which is determined by the intersection of the NMRP and supply curves. The cooperative would pay members a cash price of R_4 , and the net earnings of the cooperative, which would be returned to members as patronage refunds, would be $(N_4 - R_4) \times Q_4$. Although these net earnings are less than $(N_1 - R_1) \times Q_1$, the net earnings of the cooperative under profit maximization, total member profits are greater than for any other solution.

Total member profits include both on-farm profits from the production of the raw product and the net earnings of the cooperative. The on-farm profits are equivalent to the area in figure 9B representing producer surplus. *Producer surplus* is the difference between what producers receive for a product less the variable costs of producing it. In figure 9B, producer surplus under the maximization of total member profit is the triangular area below the raw product price R_4 and above the supply curve S . The rectangular area $R_4 \times Q_4$ represents the cash revenues of members from the sale of the raw product, and, assuming that the supply curve represents the marginal cost of producing the raw product, the area below the supply curve represents total variable costs. Consequently, producer surplus is the difference between $R_4 \times Q_4$ and the area beneath the supply curve.

The quantity of the raw product processed by the cooperative is maximized at level Q_5 , determined by the intersection of the NARP and supply curves. As in the case of a farm supply cooperative, the maximization of quantity produces the only equilibrium solution. In the solutions

for the other four objectives represented in table 2, members will have an incentive to increase their deliveries to the processing cooperative if they take the existence of patronage refunds into account in making their marketing decisions. The supply of the raw product will increase until it reaches the level Q_5 . At that point, the price of the processed product equals the sum of the raw product price and the per-unit cost of processing the raw product. Consequently, there is no longer a patronage refund, and members do not have an incentive to increase their supply of the raw product further. A cooperative that pursues another objective may have to resort to a nonprice instrument for restricting output, such as delivery quotas, processing rights, and penalty schemes, or allocate cooperative net earnings to members according to a criterion unrelated to patronage (Lopez and Spreen, p. 389).

Strategies for Increasing Raw Product Price

Just as farm supply cooperatives may be interested in strategies that can reduce the cost of providing members with a farm input, marketing cooperatives may be interested in steps that can raise the price they are able to pay their members for the raw product. Consider the marketing cooperative represented in figure 10. Assume that the supply of the raw product by members is represented by S_1 . The cooperative would process the raw product at level Q_1 and pay members a net price of R_1 .

The cooperative would be able to increase the price it pays members for the raw product to R_2 if it could shift the supply curve to S_2 , which intersects the NARP curve at its maximum. A cooperative in this situation—operating along the upward-sloping portion of its NARP

curve—would have an incentive to increase the quantity of raw product it processes by shifting its supply curve to the right. In the long run, it may be able to accomplish this by encouraging new members to join the cooperative or by getting existing members to expand their production.

Another way the cooperative may be able to increase the price it pays members for the raw product is to adjust the capacity of its processing plant in the same manner as a farm supply cooperative might adjust the capacity of the plant it uses to manufacture a farm input. Remember that the NARP curve is derived by subtracting the average processing costs from the price of the processed product. Consequently, if the cooperative can lower its processing costs by building a new processing plant or adjusting the size of its existing plant (see figure 5), it can shift its NARP curve upward, thereby increasing the raw product price.

If the cooperative is operating along the downward-sloping portion of its NARP curve, as when the supply of the raw product by members is represented by S_3 in figure 10, the cooperative would have an incentive to shift its member supply curve to the left. By shifting the member supply curve from S_3 to S_2 , the cooperative would be able to increase the raw product price it pays members from R_3 to R_2 . A cooperative may be able to shift its supply curve to the left by implementing delivery quotas or some other nonprice instrument, as discussed in the previous section.

Open- and Restricted-Membership Cooperatives

To avoid operating along the downward-sloping portion of their NARP curves, some cooperatives adopt *restricted-membership* policies. Under a restricted-membership policy, a

cooperative restricts its membership in order to maximize the raw product price it pays its existing members. Under an *open-membership* policy, a cooperative accepts any bona fide producer who applies for membership. As a consequence, it may not be able to maintain its membership in order to set the quantity that results in the greatest raw product price.

Assume that the raw product supplied by farmers in a cooperative's trade area is represented by S_3 . A restricted-membership cooperative would set its membership so that the supply curve of members was S_2 . As a consequence, the cooperative would process raw product at the level Q_2 and could pay its members a raw product price of R_2 . If the cooperative were to adopt an open-membership policy, its member supply would eventually shift to S_3 , expanding the raw product processed by the cooperative to Q_3 . Consequently, the raw product price would gradually erode, eventually falling to R_3 .

Note that if the cooperative was operating along the upward-sloping portion of its NARP curve, it would have an incentive to accept new members in order to shift the raw product supply curve to the right. Some marketing cooperatives have alternately adopted open- and restricted-membership policies over time, presumably to balance member supply with changing economic conditions in order to maximize the raw product price they are able to pay members.

Long-Run Equilibria for Marketing Cooperatives

In our long-run analysis, we assume that the objective function of the cooperative is to maximize the net price paid members for the raw product and that processing firms are price-takers in the processed product market. The first of these two assumptions, which is made for

economy of presentation, allows us to focus on the difference between open- and restricted-membership cooperatives and is consistent with the assumptions made in most of the literature on marketing cooperatives. The second assumption allows us to focus on the raw product market.

If the processor is a profit-maximizing monopsony, it may continue to earn excessive profits in the long run if entry into the industry is blocked. In fact, the monopsony may be able to increase its profits in the long run by adjusting the scale of its processing plant. Figure 11 shows the long-run NARP and NMRP curves of a processor and the long-run supply and marginal factor cost curves facing the firm. The profit-maximizing firm will seek to maximize profits by setting output so that $NMRP = MFC$. It will pay producers a raw product price of R_M and process the quantity Q_M .

An open-membership cooperative that is the only buyer and that has the same NARP and NMRP curves would process at the level Q_O , determined by the intersection of the supply and NARP curves. The cooperative would pay members a raw product price of R_O . Consumers would benefit from greater output, and producers would benefit from a higher raw product price.

The situation would be different if the cooperative practices a restricted-membership policy. A cooperative with a restricted membership would seek to set its membership so its supply curve (S_2) intersects the NARP curve at its maximum. The cooperative would process the quantity Q_R , and pay its members a raw product price of R_R . Although producers would benefit from a higher raw product price, consumers would be faced with a lower quantity of processed product and a higher processed product price. In this case, output restriction exceeds that of pure monopsony, a point emphasized by Helmberger (1964).

If there are no barriers to entry into the industry, the long-run implications are similar to those for farm supply cooperatives under monopolistic competition. Here, however, the situation is of *monopsonistic* competition. Assume that all processors are profit-maximizing firms with the same NARP and NMRP curves. At long-run equilibrium, the residual supply facing a firm, which is labeled S_1 , is tangent to the long-run NARP curve at quantity Q_1 . At this quantity, the processor's marginal factor cost curve MFC_1 intersects its long-run NMRP curve. The processor sets the price R_1 , and profit is zero because price is equal to average cost. Output is at equilibrium because there are not profits or losses in the industry. Consequently, there is no incentive for either entry or exit.

If all firms in the industry were cooperatives, entry or expansion would shift the residual supply curve facing an individual cooperative to the left until it intersected the long-run NARP curve at its maximum, the solution that would be sought by restricted-membership cooperatives. In figure 12, this solution is represented by the intersection of the supply curve S_2 and the long-run NARP curve. The equilibrium output would be Q_2 , and the equilibrium raw product price would be R_2 .

Again, the equilibrium results are somewhat ambiguous when the industry consists of both profit-maximizing firms and cooperatives. Again assume that there is a single cooperative in a market dominated by profit-maximizing firms and that the cooperative is so small that it cannot affect the market price. The equilibrium price established by the profit-maximizing firms would be R_1 . Because R_2 , the price paid by the cooperative is greater than the market price R_1 , an incentive would exist for producers who sell their output to profit-maximizing firms to sell it to the

cooperative. If the cooperative was an open-membership cooperative, the residual supply curve facing the cooperative would shift to the right until it intersected the long-run NARP curve at the price R_1 . The cooperative's output would be Q_3 . A restricted-membership cooperative would seek to maintain its output at Q_2 and to continue paying members the higher raw product price R_2 .

Effect of Cooperatives on Imperfect Markets

Public policy toward cooperatives generally has been supportive. Cooperatives have benefited from favorable treatment with respect to tax status, credit access, technical assistance, and limited immunity from antitrust laws. Farmers often can improve their economic welfare by forming a cooperative to raise the prices they receive, lower their input costs, or provide improved services. However, most of the public support for cooperatives is based on the notion that cooperatives are procompetitive forces that improve the performance of imperfect markets and increase general economic welfare (Sexton and Iskow).

Central to this notion is the *competitive yardstick* concept, which maintains that the existence of a cooperative in a market will force profit-maximizing firms to behave more competitively. The logic behind the competitive yardstick is that the cooperative will offer farmers more favorable prices because of its practice of providing members service at cost. Competing firms must match the cooperative's performance to avoid losing patrons to it. Consequently, the market will move toward competitive equilibrium. Beneficiaries of the competitive yardstick effect are not cooperative members but the farmers who continue to

patronage other firms in the market, who benefit from more favorable prices, and consumers, who benefit from greater output and lower consumer prices.

Helmberger (1964) argued that an important factor in determining the existence of the yardstick effect was the cooperative's membership policy. If faced with a downward-sloping demand function or increasing average processing costs, only an open-membership cooperative could be expected to exert a positive effect on competition. In fact, Helmberger concluded that a closed-membership cooperative could produce "socially undesirable" market performance by restricting output to a level less than that associated with a profit-maximizing monopsony. In a spatial oligopsony analysis, Sexton (1990) found that a closed-membership cooperative could result in poorer performance than an industry consisting entirely of profit-maximizing processors.

LeVay (1983*b*) challenged Helmberger's conclusions about the socially undesirable effects of a closed-membership cooperative. LeVay maintained that an open-membership cooperative *overproduced* by accepting whatever quantity of raw product members chose to supply. By offering members the highest price possible, an open-membership cooperative processed at a level beyond the social optimum because the value of the raw product input exceeded its derived demand. LeVay conceded that total economic welfare still could be enhanced by the stimulating effect the cooperative would have on competing firms but maintained that this role might also be filled by a cooperative that restricted output in order to maximize its members' welfare.

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TABLE 1. Price and output solutions for various farm supply cooperative objectives.

Objective	Criterion	Quantity	Price	Patronage refund	Net price
Maximization of cooperative profits	$MR=MC$	Q_1	P_1	P_1-C_1	C_1
Maximization of per-unit patronage refund	Slope AR= Slope ATC	Q_2	P_2	P_2-C_2	C_2
Minimization of net price	$MC=ATC$	Q_3	P_3	P_3-C_3	C_3
Maximization of member profits (including patronage refunds)	$AR=MC$	Q_4	P_4	P_4-C_4	C_4
Maximization of quantity	$AR=ATC$	Q_5	P_5	0	P_5

TABLE 2. Price and output solutions for various marketing cooperative objectives.

Objective	Criterion	Quantity	Price	Patronage refund	Net price
Maximization of cooperative profits	$\text{NMRP} = \text{MFC}$	Q_1	R_1	$N_1 - R_1$	N_1
Maximization of per-unit patronage refund	$\text{Slope NARP} = \text{Slope S}$	Q_2	R_2	$N_2 - R_2$	N_2
Maximization of net price	$\text{NMRP} = \text{NARP}$	Q_3	R_3	$N_3 - R_3$	N_3
Maximization of member profits (including patronage refunds)	$\text{NMRP} = \text{S}$	Q_4	R_4	$N_4 - R_4$	N_4
Maximization of quantity	$\text{NARP} = \text{S}$	Q_5	R_5	0	R_5