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# The Distributional Impacts of Non-Uniform Pricing Schemes for Cooperatives

***Murray Fulton and James Vercammen***

The traditional pricing mechanism examined in the economic literature on cooperatives is uniform (or linear) pricing. The conclusion of the literature is that uniform pricing mechanisms will often give rise to economic inefficiencies. These inefficiencies emerge when the cooperative is operating in a region of either increasing average cost or decreasing average cost. The reason for these inefficiencies is that uniform pricing schemes cannot allocate the profits or losses of a cooperative among its members without distorting the decisions members make. The purpose of this paper is to explore the role of non-uniform pricing in generating efficient outcomes and to examine the distributional effects of simple non-uniform pricing schemes. Although the focus of this paper is specifically on cooperatives, the results are applicable in other situations in which average cost pricing is used.

## Introduction

The economic literature on cooperatives has focused most of its attention on uniform pricing mechanisms. Under uniform pricing (or linear pricing), all cooperative members pay or receive the same price, regardless of the amount they purchase or sell. A common theme of this literature is that uniform pricing schemes result in economic inefficiencies (or deadweight losses). The reason for these inefficiencies is that uniform pricing schemes do not provide a method of allocating the profits or losses of a cooperative among its members that does not at the same time distort the decisions members make.

More specifically, the problem is that, in an effort to allocate surpluses or deficits or to pool receipts, cooperatives often practice average cost pricing rather than marginal cost pricing. Average cost pricing, in turn, results in economic inefficiencies. The use of average cost pricing, of course, is not confined to cooperatives. Government enforced pooling schemes, the use of price supports, and open access resources such as fisheries (Weitzman 1974) are all examples of situations in which average cost pricing is used to allocate surpluses or deficits. Thus, the problem of how to allocate surpluses or deficits in a manner that does not distort decisions is a generic economic problem.

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Although uniform pricing is common in cooperatives, non-uniform pricing is also practiced. Volume discounts are often offered to large-volume purchasers in agricultural input cooperatives. Direct charge consumer cooperatives require members to purchase a monthly or yearly membership fee to be eligible to purchase goods from the cooperative at wholesale prices. Cooperatives are also known to offer price discounts to members who heavily patronize the cooperative (Saskatchewan Wheat Pool 1990).

The role of non-uniform (or non-linear) pricing in allowing a cooperative to mitigate the economic inefficiencies described above has been examined in the economic literature. The most complete treatment of the topic is by Sexton (1986). He describes a non-uniform pricing mechanism, namely benefit-based financing, that allows a Pareto-efficient outcome to be achieved. However, as Sexton notes, this mechanism is difficult to implement because of the information about members that is required.

The purpose of this paper is to further explore the role of non-uniform pricing in generating efficient outcomes. Although the focus of this paper is specifically on cooperatives, the results are applicable in other situations in which average cost pricing is used. A key element in the analysis is the assumption that members are not identical, but instead fall into one of two groups. In addition, it is assumed the cooperative does not have the information required to determine the group to which any given member belongs, and thus the information required to implement benefit-based financing. Instead, the cooperative relies on a pricing mechanism that requires members to reveal the group to which they belong.

The paper also has another purpose—to examine the distributional effects of simple non-uniform pricing schemes. The distributional issue arises whenever members are not identical. Even though non-uniform pricing schemes can be designed to satisfy efficiency criteria, this is not the only factor that affects cooperative decision-making. Fairness and equity are important principles for a cooperative (and for society when issues such as price supports and open access resources are considered), and a lack of fairness or equity may result in certain practices not being undertaken.

The next section of the paper considers uniform pricing and the economic inefficiencies that can arise from this form of pricing. A simple non-uniform pricing model involving two groups of members is then developed. This model is used as the basis for a graphical examination of the distributional consequences of non-uniform pricing schemes. To further illustrate the distributional consequences of non-uniform pricing schemes, a number of numerical simulation results are presented. The paper concludes with a discussion and summary.

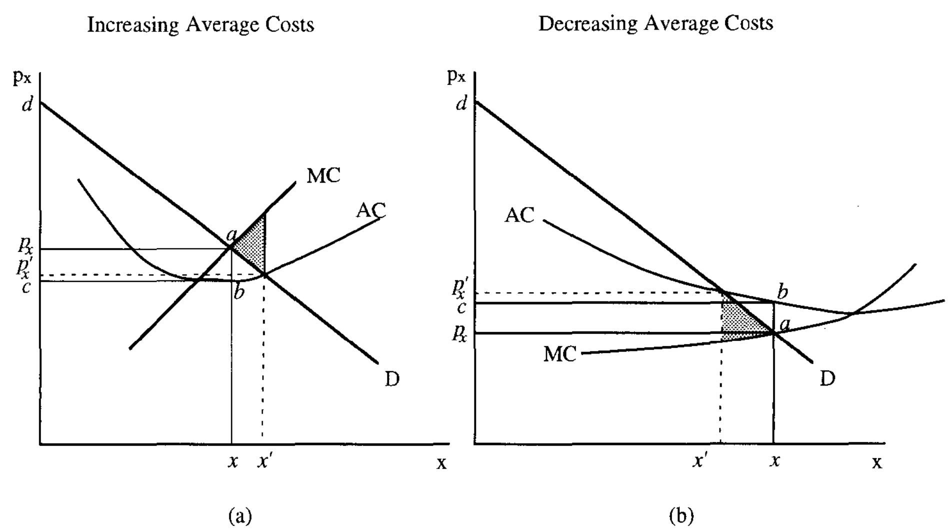
## Uniform Pricing and Average Cost Pricing

Consider a cooperative that has been formed to produce or supply a good required by its members. The cooperative is a form of vertical integration—in this case the members have integrated upstream and replaced their input supplier with an organization they themselves control. Thus, the members are patrons of the firm they own; they have the ability to take account of the impact on themselves of decisions made by the cooperative. In determining the amount of the good to purchase from the cooperative, two items must be considered, since both have an impact on members' welfare. The first is the profitability of the cooperative, since profits earned by the cooperative are generally distributed back to the members as patronage dividends. The second is the profitability of the members' own operations, which is influenced by the price members pay. Members' welfare (cooperative profits plus members' profits) is a maximum when the cooperative's marginal cost of producing the good is equal to the marginal benefit of the good when it is purchased by the members (Enke 1945, Sexton 1986).

Figure 1 illustrates this solution for a cooperative facing increasing average costs (panel (a)) and a cooperative facing decreasing average costs (panel (b)). In both cases, the optimal quantity members should purchase is x; at this level of output, the marginal benefit to the members (given by the demand curve D) is equal to the marginal cost of producing the good (given by marginal cost curve MC). To get members to purchase quantity x, the cooperative charges a uniform price $p_x$. Members receive consumer surplus equal to $p_xad$, while the cooperative earns profits equal to $p_xabc$. With increasing average costs, the cooperative's profits are positive; profits are negative when average cost is decreasing.

The presence of positive or negative profits means the uniform marginal cost pricing scheme is not generally workable. Consider first the case of increasing average costs (figure 1, panel (a)). If the profits $p_xabc$ are retained by the cooperative and not returned to the members, the cooperative can

**Figure 1.—Price and Output Determination in a Cooperative With Increasing and Decreasing Average Costs**



continue to sell an amount equal to x. However, since the cooperative is owned by the members, the profits of the cooperative are generally returned to the members. If members anticipate the return of the profits, they will no longer view price $p_x$ as the price they pay. In anticipation of a patronage refund, which lowers the effective price paid, cooperative members will expand their purchases. The only point where the amount demanded by the members is consistent with the amount the cooperative can afford to supply is where AC equals D. At this price/quantity combination ($p'_x$, $x'$), no profits are being made and hence no patronage payments are returned to the members. The result is an equilibrium, in that the price paid by the cooperative is the effective price that members base their purchase decisions on, and, as a result, the quantity sold by the cooperative is equal to the amount the members wish to purchase. As a consequence of moving to this equilibrium, the total economic surplus available is reduced. The loss of economic surplus (or deadweight loss) is given by the shaded area in figure 1, panel (a).

If the cooperative is operating with decreasing average costs, the problem is similar. If members pay the marginal cost, the cooperative will not obtain enough revenue to cover the fixed costs and profits will be negative (see area $p_xabc$ in figure 1, panel (b)). If the cooperative attempts to allocate this loss in proportion to members' patronage, the members will see an increase in the price they pay. As a consequence, they will reduce their purchases. The only point where the amount demanded by the members is consistent with the amount the cooperative can afford to supply is where AC equals D. At this price/quantity combination ($p'_x$, $x'$), no profits are being made and hence no losses are being allocated to members. As a consequence of moving to this equilibrium, the total economic surplus available is reduced. The loss of economic surplus is given by the shaded area in figure 1, panel (b). The price/quantity combination ($p'_x$, $x'$) is the well-known Ramsey pricing rule.

The assumption underlying the above analysis is that the allocation of surpluses or deficits alters members' behavior. Although, in some situations, members may ignore patronage refunds when making purchasing decisions (members are likely to ignore a refund if the refund is small or if the cooperative retains the patronage payment and redeems it at a later date), the assumption in this paper is that members do respond to the net average price paid to them. Recognition of this essential characteristic allows the analysis to be applied to other situations where average cost pricing is used to allocate surpluses or deficits.

## Non-Uniform Pricing

With uniform pricing, the same per unit price is paid for all units of the good, no matter how many units of the good are purchased. With non-uniform pricing, however, all members do not face the same price for the inputs they purchase. Instead, the cooperative offers members a choice from a price or contract schedule. The contract schedule specifies the price members must pay when purchasing a given quantity. For example, consider a pricing schedule that specifies that the total cost of the inputs will be ten dollars if four units are purchased and twelve dollars if five units are purchased. In this case a volume discount is implied.

The question of non-uniform pricing has typically been investigated in the context of a monopoly. The issue examined in the monopoly case concerns the ability of the monopolist to establish a price schedule that will allow consumers to purchase the quantity that maximizes the total economic surplus available (e.g., quantity x in figure 1) and, at the same time, allow the monopolist to extract the economic surplus as its own (Tirole 1989). The issue examined in the case of cooperatives is the opposite, namely how non-uniform pricing can be used by a cooperative to allow members to purchase the quantity that maximizes the total economic surplus (e.g., quantity x in figure 1) and, at the same time, allow the cooperative to allocate the profits or the losses to the members.

If all the purchasers of a good are identical, non-uniform pricing is easy to implement. The seller of the good simply sets the contract schedule in such a manner that the optimal quantity the seller wishes to see purchased is also the quantity that results in maximum profits for the purchaser. In the case of increasing returns to scale, setting a uniform price of $p_x$ and a membership fee equal to the cooperative's fixed cost divided by the number of members, eliminates the pricing externality and is completely equitable.

If the purchasers of the product are not identical, however, the problem becomes more complex. Non-uniform pricing schemes can be effective only if side deals between members do not take place, since side deals effectively mean that everyone pays the same price. In general, arbitrage by members is difficult to control, although there are ways to circumvent the problem. For example, a menu of long-term contracts with the non-uniform prices built in would make it more difficult for members to put side deals together. It is assumed in this paper that members do not make side deals among themselves.

Second, the seller must establish a contract schedule so that each of the different groups purchases the amount that the seller wishes that group to purchase. For instance, there must be no incentive for small volume purchasers to masquerade as large volume purchasers in order to obtain the good at a lower per unit price. This problem is considered in greater detail below when incentive compatibility is discussed.

To model non-uniform pricing, consider two groups of members in a cooperative. Assume the cooperative supplies an input used in the members' farming operations. The amount of input purchased by each member group is given by $x_i$ $(i=1,2)$. The revenue generated from the use of this input is denoted $R_i(x_i)$. The cost of the input—or the input expenditure—is denoted $E_i(x_i)$ $(i=1,2)$. The expenditure functions $E_1(x_1)$ and $E_2(x_2)$ represent a contract schedule.

The profits of the cooperative members are:

$$\Pi_i = R_i(x_i) - E_i(x_i). \qquad (i=1,2)$$

while the profits of the cooperative are:

$$\Pi_c = E_1 + E_2 - c(x_1(E_1) + x_2(E_2))$$

where $c(x_1+x_2)$ is the cost function for the cooperative and $x_i(E_i)$ $(i=1,2)$ is the amount of input $x_i$ associated with expenditure $E_i$.

The usual objective attributed to cooperatives in the economic literature is to maximize the sum of members' profits and cooperative profits. In this paper, the behavior attributed to the cooperative is different. The role of the cooperative is to choose a contract schedule that, if possible, satisfies four constraints.

The first constraint is that any non-uniform pricing scheme chosen by the cooperative must be in the form of a volume discount, i.e., purchasers of a larger quantity pay a lower average price. Volume premiums are ruled out because, with such a pricing scheme, farmers who wished to buy large volumes could split their purchases and masquerade as low volume purchasers, thereby eliminating the non-uniformity in the price schedule. More formally, the contract schedule considered in this paper is of the form:

$$E_i(x_i) = F_i + p_x\, x_i$$

where $F_i$ is the implicit fee paid by member i and $p_x$ is the marginal price paid by all members. Volume discounts imply that:

$$\frac{E_i(x_i)}{x_i} < \frac{E_j(x_j)}{x_j} \text{ if } x_i > x_j$$

The second constraint is that the cooperative must ensure the members receive sufficient profits so they are as well off purchasing the inputs from the cooperative as they are purchasing the inputs elsewhere. This constraint is known as the individual rationality (IR) constraint and is expressed as:

$$IR_i: \Pi_i = R_i(x_i) - E_i(x_i) \geq \pi_i \qquad (i=1,2)$$

where $\pi_i$ is the profit level for group i if the input x is purchased elsewhere.

The third constraint is incentive compatibility (IC). As outlined above, the cooperative must construct the contracts so members choose the contract bundle designed for them. In other words, the contract schedule must be constructed in such a way that the different groups reveal truthfully who they are. Mathematically, the incentive compatibility constraints can be written:

$$IC_1: R_1(x_1) - E_1 \geq R_1(x_2) - E_2$$
$$IC_2: R_2(x_2) - E_2 \geq R_2(x_1) - E_1$$

Incentive compatibility $IC_1$ indicates that the contract schedules $E_1$ and $E_2$ must be chosen in such a way that members of group 1 will always find it more profitable to choose the contract designed for them (i.e., $E_1$) rather than the contract designed for the members of group 2 (i.e., $E_2$). A similar interpretation holds for $IC_2$.[1]

The fourth constraint is one of equity or fairness between the member groups. Since equity and fairness can be expressed in many different ways, no attempt is made to limit the analysis to one particular type. Instead, in the graphical analysis that follows, a number of different equity and fairness considerations are examined.

The general framework for examining the effect of these constraints on the contract schedules chosen by the cooperative is presented graphically in figure 2.

The basis for figure 2 is the following definition:

$$ES \equiv \Pi_1 + \Pi_2 + \Pi_c + DWL$$

where ES is the total potential economic surplus available in an economic system and DWL is the economic dead-weight loss. The basis for the above equation is that, in any configuration of an economic system, the DWL (or economic inefficiency) is given by the difference between the total potential surplus and the surplus that accrues to the participants in the system.

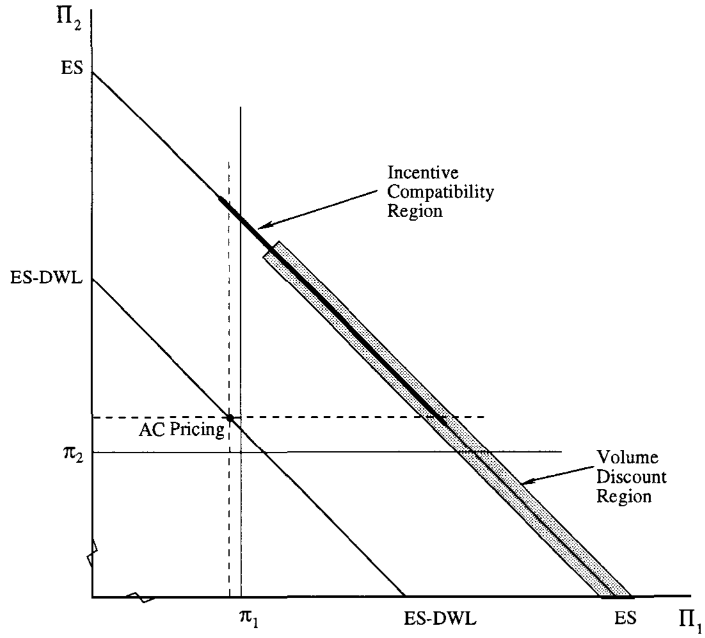
It is useful to rewrite the above equation as follows:

$$\Pi_2 = (ES - DWL - \Pi_c) - \Pi_1$$

This equation says the profits of the first group can be expressed as a linear function of the profits of the second group. Moreover, for a given value of DWL and $\Pi_c$, any increase in the profits of group 1 results in a one-for-one decrease in the profits of group 2.

Figure 2 graphs this relationship between $\Pi_2$ and $\Pi_1$. The line ES·ES shows the potential profits available for distribution between the members of group 1 and group 2 if there are no economic inefficiencies in the system and the profits of the cooperative are zero. The slope of the line ES·ES is

**Figure 2.—A Graphical Analysis of the Trade-Off in Profits Between Group 1 and Group 2.**



minus one. If the cooperative permanently retains a portion of its profits or if economic inefficiencies are present, the profits available for distribution to group 1 and group 2 are reduced. For instance, the line parallel to ES·ES through the point (ES-DWL) shows the potential profits available to the two groups when the profits of the cooperative ($\Pi_c$) are zero and the economic inefficiency is DWL.

The use of uniform pricing schemes in cooperatives operating with increasing or decreasing average cost curves can be expected to lead to average cost pricing, which in turn results in economic inefficiencies. Suppose the magnitude of the inefficiencies that result from average cost pricing is given by DWL. If this is the case, the distribution of profits between group 1 and group 2 that results from average cost pricing must lie on the lower line in figure 2. More precisely, assume the point AC Pricing gives the level of profits for group 1 and group 2 under average cost pricing.

The use of non-uniform pricing by the cooperative will allow the two groups to move from the lower line to the upper line (line ES·ES) in figure 2. This movement is possible because the contract schedule established under non-uniform pricing allows the cooperative to elicit the efficient level of purchases from its two member groups.[2] However, because of the constraints the cooperative faces (volume discounts, individual rationality, incentive compatibility, equity), all points along the line ES·ES are not accessible.

Consider the individual rationality constraint first. This constraint is illustrated graphically in figure 2. The area above the horizontal line at $\pi_2$ and to the right of the vertical line at $\pi_1$ indicates the region in which members of both group 1 and 2 are better off than they would be if they purchased the input elsewhere.

The incentive compatibility constraint is shown as a darkly shaded region along the line ES·ES. Depending on the nature of the demand by each of the two groups for the input and the cost structure of the cooperative, the incentive compatibility region will expand or contract, as well as move up or down along the line ES·ES. Since the size and position of the incentive compatibility region depend in a complex way on the specific demand and cost functions, no general closed form expression can be derived for this region. Simulations carried out in the next section will show the nature of this region for a specific numerical example. In figure 2, the IC region is such that not all points in the IR region are attainable; neither, however, are all points in the IC region part of the IR region.

The volume pricing constraint is shown as the shaded area along the line ES·ES. Figure 2 illustrates the case where the members of group 1 are the high volume purchasers. Because group 1 members are the high volume purchasers, they will be the group that benefits from volume discounts. Thus, the volume discount constraint implies that the profits of group 1 will be increased at the expense of the profits of group 2. Thus, the area on the north-west part of line ES·ES is unavailable to the cooperative.

The area to the north-east of the dashed lines in figure 2 shows the region in which members will be better off under non-uniform pricing than under average cost pricing. A comparison of the welfare under these two general types of pricing schemes may be important if a cooperative is considering changing its pricing mechanism from average cost pricing. Such a change might only be possible if it could be shown that no member group is made worse off. Of course, additional distributional and equity considerations besides Pareto-improvement could also apply.

The graph of $\pi_2$ versus $\pi_1$ provides a useful way of considering equity and fairness considerations. A few examples of equity and fairness concepts can be used as an illustration. One fairness concept that has been proposed is the maxi-min solution (Rawls 1971). Under this concept, the cooperative chooses a contract schedule that maximizes the profits of the group obtaining the lowest (or minimum) profit. One of the consequences of this rule is that, if it is possible, the profits of the two groups should be made equal, i.e., the profits will lie at a point where a 45° line from the origin cuts the line ES·ES. If equal profits are not possible because of the IR or IC constraints, then the point on ES·ES closest to the 45° line will be chosen by the cooperative. Figure 3 shows the maxi-min solution (point M) for a hypothetical example in which equal profits are not possible.

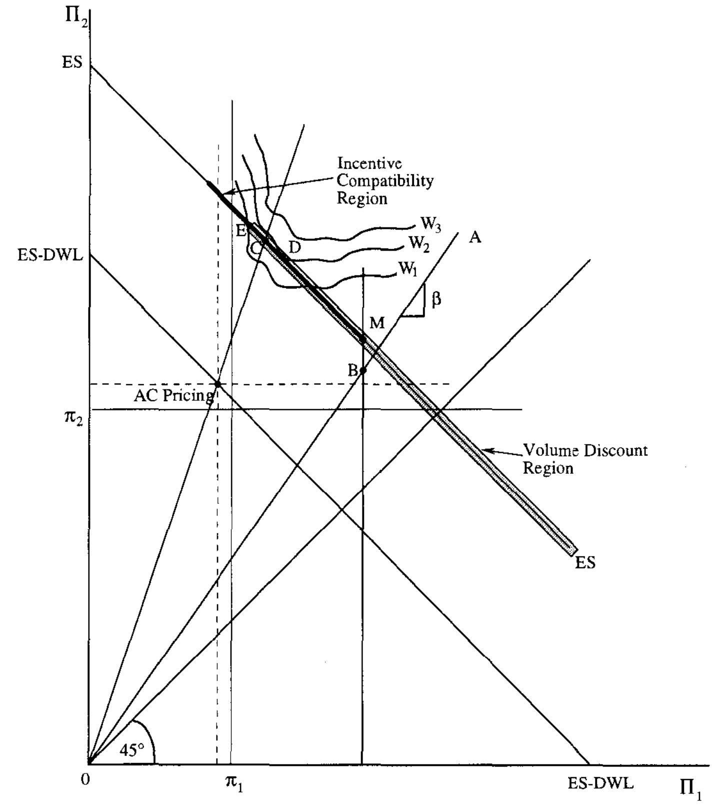
A second fairness consideration might be that the profits of the two groups must be in a certain proportion to each other, e.g., $\Pi_2 = \beta\Pi_1$. In this case, the profits will lie at a point where a line OA with slope $\beta$ cuts the line ES·ES in figure 3. If the IR or IC constraints mean the cross-over point is not achievable, then two possibilities exist. If the members are unwilling to give up the proportionality rule, then the cooperative will be forced to choose a point below the line ES·ES, i.e., a point at which economic inefficiencies are present. Point B in figure 3 is the point that provides the maximum efficiency subject to the condition that the profits of the two groups be in strict proportion. It is important to note that if the groups require strict proportionality, then no solution may exist to the cooperative's pricing problem, and the cooperative will cease to function as a cooperative encompassing all the members. If the members are willing to give up strict proportionality, then the cooperative can move to the point on ES·ES closest to the line with slope $\beta$.

A variation of the above rule would be that fairness dictates that the proportionate increase in profits from AC pricing for the two groups be equal. This rule implies that any new profit combination must lie on a straight line running from the origin through the point AC Pricing. Point C in figure 3 is the combination of profits that would be chosen by the two groups if this fairness rule were in use.

A fourth consideration might be for the cooperative to maximize some welfare function $W(\Pi_1, \Pi_2)$. The optimal contract chosen by the cooperative is the one that maximizes the welfare function $W(\Pi_1, \Pi_2)$ subject to the constraints outlined above. Figure 3 shows a set of iso-welfare lines $W_1$, $W_2$, and $W_3$. Given the constraints presented in figure 3, the optimal combination of profits is given by point D.

The choice of the distribution of profits may not be made by the cooperative directly, but, rather, may be chosen by the members through democratic voting. Since all members have a vote in a cooperative and the majority rule is often used, the median voter theory is appropriate in terms of predicting how the members as a whole will vote. Since there are only

**Figure 3.—The Application of Various Equity Considerations to Cooperative Decision Making**




two groups, the group with the larger number of members will effectively determine the choice of contract. Thus, if group 1 has the larger number of members, the point furthest east on line ES·ES that satisfies the IR and IC constraints will be chosen by the members (point M). If group 2 has the larger number of members, the point furthest north on line ES·ES that satisfies the IR, IC, and volume discount constraints will be chosen (point E).

The above examples provide an indication of how cooperative decision-making is influenced by equity and distributional considerations. Of course, many other ways of taking equity and distribution into consideration are possible. The main conclusion of this section is that equity and fairness will influence cooperative behavior if members consider these items important. The framework developed above provides a method of conceptualizing how these considerations affect the choices cooperatives will make.

## A Numerical Simulation

To examine more fully the distributional impacts of non-uniform pricing schemes, consider the following numerical example. The revenue functions for the two groups are assumed to be power functions of the following form:

$$R_1(x_1) = 8\ x_1^{0.6}$$
$$R_2(x_2) = 10\ x_2^{0.4}$$

while the cost function for the cooperative is assumed to be quadratic:

$$c(x) = 2\ x + 0.5\ x^2 + FC$$

where FC is the fixed cost. Two values of FC are assumed: 2.0 and 3.5. The smaller value of FC allows a simulation of a cooperative operating in a region of increasing average cost, while the larger value of FC allows a simulation of a cooperative operating in an area of decreasing average cost.

The average cost pricing solution is found by solving for the quantity x that equates the average cost curve with the total demand curve. The average cost curve is:

$$AC = 2 + x + \frac{FC}{x}$$

while the total demand curve is the horizontal sum of the individual group demand curves. The individual group demand curves are found by assuming the members of each group are profit maximizers and act as price takers in the purchase of the input $x_i$. From the first-order conditions, the individual group demand curves are:

$$x1 = \left(\frac{p_x}{4.8}\right)^{-\frac{1}{0.4}}$$

$$x2 = \left(\frac{p_x}{4.0}\right)^{-\frac{1}{0.6}}$$

where $p_x$ is the price of the input. Table 1 shows the quantity demanded by each of the two groups under average cost pricing for the two different levels of fixed cost. Table 1 also shows the price that equates average cost with demand and the profits of the two groups when average cost pricing is in effect.

Table 1 presents a number of the different cases possible under non-uniform pricing. For each outcome, the expenditure schedule, average prices, quantity purchased, and profit levels for both groups are shown. The quantity purchased by each group in all the non-uniform pricing cases is the optimal level of output each group would purchase if marginal cost pricing could be put into effect. Thus, table 1 shows that the optimal purchases by group 1 are 1.35 and the optimal purchases of group 2 are 0.90 under marginal cost pricing. These quantities were determined by finding the quantities $x_1$ and $x_2$ that equate the marginal cost curve with the total demand curve. Note that, since these quantities are obtained

**Table 1.—Simulation Comparison of Uniform and Non-Uniform Pricing**

| | Fixed Cost=2.0 | | | Fixed Cost=3.5 | | |
|---|---|---|---|---|---|---|
| | Uniform Pricing (Ave. Cost) | Non-Uniform Pricing 1 | Non-Uniform Pricing 2 | Uniform Pricing (Ave. Cost) | Non-Uniform Pricing 1 | Non-Uniform Pricing 2 |
| **Expenditures ($E_i$)** | | | | | | |
| Group 1 | 6.20 | 5.41 | 5.39 | 4.53 | 6.16 | 6.12 |
| Group 2 | 3.97 | 3.64 | 3.66 | 3.44 | 4.39 | 4.43 |
| **Quantity ($x_i$)** | | | | | | |
| Group 1 | 1.53 | 1.35 | 1.35 | 0.91 | 1.35 | 1.35 |
| Group 2 | 0.98 | 0.90 | 0.90 | 0.69 | 0.90 | 0.90 |
| Total | 2.51 | 2.25 | 2.25 | 1.60 | 2.25 | 2.25 |
| **Fixed Fee ($F_i$)** | | | | | | |
| Group 1 | n.a. | −0.34 | −0.36 | n.a. | 0.41 | 0.37 |
| Group 2 | n.a. | −0.20 | −0.18 | n.a. | 0.55 | 0.59 |
| **Marginal Price ($p_x$)** | | | | | | |
| Group 1 | n.a. | 4.25 | 4.25 | n.a. | 4.25 | 4.25 |
| Group 2 | n.a. | 4.25 | 4.25 | n.a. | 4.25 | 4.25 |
| **Average Price ($E_i/x_i$)** | | | | | | |
| Group 1 | 4.05 | 4.00 | 3.99 | 4.98 | 4.55 | 4.53 |
| Group 2 | 4.05 | 4.03 | 4.06 | 4.98 | 4.86 | 4.91 |
| **Profits ($\Pi_i$)** | | | | | | |
| Group 1 | 4.13 | 4.18 | 4.20 | 3.02 | 3.43 | 3.47 |
| Group 2 | 5.95 | 5.96 | 5.94 | 5.18 | 5.21 | 5.17 |
| Total | 10.08 | 10.14 | 10.14 | 8.21 | 8.64 | 8.64 |

from equating marginal cost with demand, the quantities do not change when the fixed cost is changed. The marginal cost associated with these quantities is 4.25. This is the value of $p_x$ used to calculate the expenditure schedules.

Using quantities 1.35 and 0.90 and marginal price 4.25, the expenditures $E_1$ and $E_2$ were obtained by finding the values of $F_i$ that satisfied the IC and volume pricing constraints and resulted in zero profits for the cooperative. The average prices were calculated by dividing the expenditures $E_1$ and $E_2$ by the quantities $x_1$ and $x_2$, respectively.

When the fixed cost is 2.0, the simulations show two of the outcomes possible under non-uniform pricing. In Case 1, both groups are better off as compared to average cost pricing. In Case 2, the members of group 2 are worse off compared to average cost pricing. Although the results are not shown, other simulations indicated that, with the right choice of $F_i$, the members of group 1 could be made worse off compared to average cost pricing. Since this result implied volume premiums, however, it was ruled out.

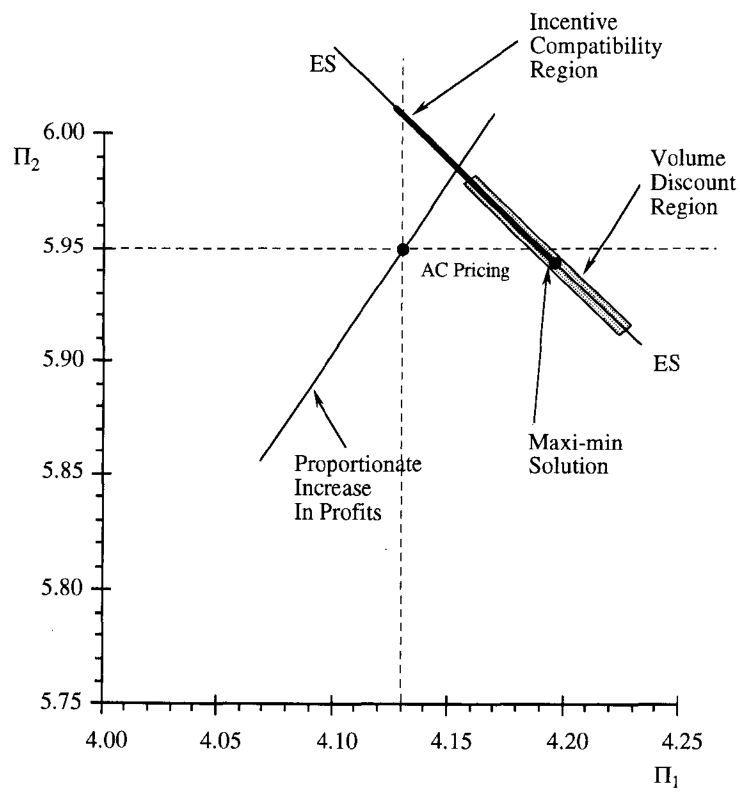
The results of the above simulation are graphed in figure 4. Note how the IC region allows:

- members of both groups to be made better off,
- the members of group 1 to be made worse off while the members of group 2 are made better off, and
- the members of group 2 to be made worse off while the members of group 1 are made better off.

Not all the points in IC can be chosen by the cooperative, however. As the diagram shows, the volume discount constraint rules out combinations that substantially increase the profits of group 2.

In terms of equity and fairness, figure 4 illustrates that, because of the volume discount constraint, the cooperative could not simultaneously move to the line ES-ES and support a proportionate increase in the profits of both member groups. Figure 4 also indicates the choice that would be made by cooperative if the maxi-min rule were used in isolation. If the maxi-min rule were used, the members of group 2 would be made worse off as compared to the AC pricing situation.

**Figure 4.—Graphical Representation of the Simulation Results**



When the fixed cost is increased to 3.5, a similar pattern to that described above emerges. In Case 1, both groups are better off compared to average cost pricing, while in Case 2, the members of group 2 are made worse off compared to average cost pricing. Unlike the results when the fixed cost equals 2.0, volume premiums are not possible since they violate the $IC_1$ constraint; that is, the volume discount constraint is not binding. Note also that, because the cooperative is operating in an area of increasing returns to scale, the quantities purchased under non-uniform pricing are greater than the quantities under average cost pricing.

## Concluding Remarks

The traditional pricing mechanism examined in the economic literature on cooperatives is uniform (or linear) pricing. The conclusion of the literature is that uniform pricing mechanisms will often give rise to economic inefficiencies. These inefficiencies emerge when the cooperative is operating in a region of either increasing average cost or decreasing average cost. The reason for these inefficiencies is that uniform pricing schemes cannot allocate the profits or losses of a cooperative among its members without distorting the decisions members make.

Non-uniform pricing schemes offer a solution to this problem. Because members are given a schedule of prices *and* quantities, rather than simply a price (which members use to determine the quantity), the opportunity for distortion in incentives is reduced. As a consequence, non-uniform pricing schemes can be used to generate a more efficient outcome.

The effect of non-uniform pricing is not limited to efficiency considerations, however. Non-uniform pricing can have a substantial impact on the distribution of benefits among the members and the cooperative. In fact, as pointed out, some of the original interest in non-uniform pricing came from industrial organization theorists who were interested in how monopolists could use non-uniform pricing to generate efficient outcomes while at the same time extracting economic surplus from customers. The results of this paper show that non-uniform pricing schemes have the potential to generate a number of quite different distributional outcomes for cooperative members. The choice from among these outcomes is made by considering different fairness and justice criteria or by considering different decision-making processes within the cooperative.

Non-uniform pricing schemes can be used in many situations. For instance, the pooling of revenues that is common practice in many agricultural marketing cooperatives is a form of uniform pricing. It is well known that the resulting average price can distort the decisions made by the farmer members. Non-uniform pricing offers an alternative to this pooling. However, as this paper points out, the use of non-uniform pricing is likely to have distributional consequences. In fact, it is often because of the distributional consequences of at least some of the non-uniform schemes that farmers have turned to the use of pooling. Of course, pooling also has consequences for the distribution of benefits. Indeed, member unhappiness over the distributional effects of pooling is a major reason for some groups moving away from pooling.

The potential application of non-uniform pricing is even greater. Conceivably, farm income support could be provided through the use of non-uniform pricing schemes rather than the traditional uniform pricing schemes of price supports. Application of non-uniform pricing to this problem could generate increases in efficiencies. At the same time, the use of non-uniform pricing will have distributional consequences. While a non-uniform pricing scheme could be used to provide greater benefits to lower income farmers or to farmers with a lower level of output, the scheme could also be used to provide larger benefits to higher income or larger farmers. In fact, one of the conclusions of this paper is that, since different non-uniform pricing schemes have the potential to substantially influence the distribution of benefits, non-uniform pricing schemes have to be carefully examined before they are adopted.

## Notes

1. If the two types of members are sufficiently similar, but not identical, it may be advantageous for the cooperative not to try and separate types, but to rather anticipate that both types will select the same contract. In this situation, the cooperative can obtain the efficient level of output. However, since there is only one type of contract, the cooperative will not be able to alter the distribution of profit that results from the use of this contract.

2. The result that the cooperative is able to move to the line ES·ES is conditional upon the assumption that a discrete number of member groups exist. If there is a continuous distribution of different member types, then it is not possible to move to the line ES·ES. Instead, some inefficiencies are retained in the system as a result of the IC constraints and the need for these to be satisfied by all members along the continuum. See Vercammen and Fulton (1994).

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