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Forward Integration by Farmer Cooperatives: Comparative Incentives and Impacts

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A model of a three-stage vertical market structure consisting of agricultural producers, an assembler, and a processor is developed to analyze the market incentives farmer cooperatives may have for integrating forward into processing activities and to evaluate the comparative impacts of cooperative forward integration on producers and consumers. Although forward integration by cooperatives generally provides benefits to both producers and consumers under fixed-proportions processing technology and constant assembly and processing costs, the existence of an integration incentive appears to depend upon the ability of the cooperative to restrict the raw product output of its producers to optimal levels.

Farmer cooperatives are typically involved in first-stage marketing and food processing activities as a result of their role as vertical extensions of the farming operations of their members. Consequently, the marketing and processing activities in which cooperatives participate are generally characterized by low margins and little market power. For most commodities, the amount of processing and product differentiation is greater in later stages. Considerable discussion has focused on explaining why cooperatives have not integrated forward into these stages to a greater extent. Explanations are generally based on the organizational characteristics of cooperatives that place them at a disadvantage in competing with noncooperative firms in processed product markets. These explanations include arguments that:

1. The production orientation of directors restricts the ability of a cooperative board to supervise and assist management as the organization's scope grows vertically and increasingly involves consumer-oriented merchandising activities (Jamison 1960),
2. Cooperatives are disadvantaged by scale economies associated with complex organizational tasks,

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3. The obligation of cooperatives to serve a fixed membership base constrains forward integration whenever efficient operation necessitates purchasing inputs from the least expensive source (Caves and Petersen 1986), and
4. Cooperatives are often insufficiently capitalized to make the substantial investments in research and development and in advertising that are necessary to be successful in processed markets (Rogers and Marion 1990).

Unfortunately, there has been little theoretical analysis of the incentives cooperatives may have for integrating forward into later processing stages despite its importance to cooperatives and their members. Only Masson and Eisenstat (1978) have examined aspects of vertical integration by farmer cooperatives. They analyzed the ability of dairy cooperatives to countervail various types of monopsony power through bargaining or vertical integration and evaluated the expected impacts of these strategies on producers and social welfare. They concluded that forward integration by an open-membership cooperative would benefit both producers and consumers when the processor experienced constant returns to scale and possessed market power in the final product market. Integration by the cooperative would countervail the processor's monopsony power in the intermediate product market and eliminate the exercise of market power in the final product market. However, they also concluded that the cooperative would lack an incentive to acquire the processor if its price included the capital value of its monopoly returns.

In this article, we develop a model of a three-stage vertical market structure consisting of agricultural producers, an assembler, and a processor for evaluating the incentives cooperatives may have for integrating forward from marketing to processing activities. Our results provide an additional explanation, based on market power, for the relatively low degree of forward integration by cooperatives. They also yield some important policy implications with respect to public support for integration by cooperatives. Although incentives for vertical integration may arise from the existence of technological or transactional economies, we focus only on the incentives that may result from market imperfections (Perry 1989, 187–89). Specifically, we examine the incentives for integration that may arise from the ability of an integrated assembler to maximize the joint profits of firms in two or more stages of the vertical structure, in contrast to firms independently maximizing individual profits without taking into account the effect of their actions on others. In addition to analyzing the incentives for integration under both assembler and processor dominance (monopoly and monopsony) in the intermediate product market, we examine the effects of integration on prices, output, and welfare. For comparison purposes, the analysis is conducted for investor-owned firms (IOFs) as well as cooperative assemblers.

The cooperative analysis is conducted under two alternative behavioral assumptions. Under the first assumption, the cooperative (which we label an *active* cooperative) maximizes the total profits of its producer-members, including patronage refunds, by setting the quantity of raw product it handles. Under the second, the cooperative is *passive* in that it does not or cannot set the quantity of raw product it handles. Instead, it accepts whatever quantity of output producers choose to market. This assumption conforms to the classic Helmberger and Hoos (1962) model of a marketing cooperative, in which the objective of the cooperative is to maximize the raw product price for the quantity set by producers. In the Helmberger-Hoos model, equilibrium occurs where the raw product supply price equals the cooperative's average net returns from processing, and the cooperative breaks even because its surplus is exhausted by payments to producers. It has been frequently argued that cooperatives will be unsuccessful in restricting producer output to lower levels because the receipt of patronage refunds provides producers an incentive to expand output until average net returns equal the supply price.[1] Instead of choosing between these two assumptions, we examine the implications of both.

Model

All analyses are conducted within the framework of a three-stage vertical market structure. Producers (*A*) sell a single raw product to an assembler (*B*), which markets the assembled product to a processor (*C*). The processor manufactures a processed product it sells to consumers. We assume that the assembler faces an upward-sloping raw product supply curve and that its per-unit cost of handling the raw product is constant. We also assume that the processor faces a downward-sloping processed product demand curve and that the per-unit processing cost is constant. In addition, we assume that the processor is subject to a fixed-proportions production technology, i.e., that it employs the raw product in fixed proportion to other intermediate inputs. Specifically, for convenience and without loss of generality, we assume that the processor produces one unit of processed product from each unit of raw product. Our model is similar to the two-stage model of successive monopoly developed by Greenhut and Ohta (1976) with respect to its assumption of fixed-proportions production technology and constant handling and processing costs.[2]

The assumption of a fixed-proportions processing technology greatly simplifies the mathematical analysis and allows it to be illustrated graphically. More importantly, the assumption of fixed proportions is appropriate when the quantity of manufactured product is essentially invariant to the alternate production processes that may be employed, as might be expected in processing many agricultural products. Although within a certain range, additional capital and labor might increase the technical efficiency with which raw product is converted into processed product by reducing waste and spoilage, these factors cannot be generally substituted for raw product to increase processed product output.[3]

Constant marginal costs (and average direct or variable costs) can result from a linearly homogeneous production function and competitive factor markets. There is strong empirical evidence that short-run marginal costs in manufacturing industries are constant over broad ranges of output (Johnston 1960, 13, and Dean 1976, 3–35). In addition, there is considerable empirical support for constant long-run costs over substantial output ranges (Scherer and Ross 1990, 22).

Although the price paid the assembler by the processor will depend on the relative bargaining power of the two parties, the solutions for assembler and processor dominance are useful in identifying the bounds for the price and quantity outcomes. In the following two sections, we derive the solution conditions for active and passive cooperative assemblers before and after integration under both assembler and processor dominance. Although we present the IOF solution conditions, for brevity we do not show their derivation. They are derived in the same manner as for the active cooperative, according to the following procedure.

Under assembler dominance, the processor maximizes its profit given whatever price is set for the assembled raw product by the assembler. Solution of the processor's first-order condition yields its derived demand function for the assembled product. The assembler behaves as a monopolist and maximizes its objective function by setting the price of the assembled product given the processor's demand function. Under processor dominance, the assembler maximizes its objective function given the price set by the processor. Solution of the assembler's first-order condition yields its supply function. The processor behaves as a monopsonist and maximizes its profit by setting the assembled product price given the assembler's supply function.

The profit function of producers is

$$\pi_A = p_A q - F(q)$$

where p_A is the price producers receive from the assembler for the raw product, q is quantity, and $F(q)$ is total on-farm production costs. We assume initially that producers maximize their profits by setting the marginal cost of producing the raw product to the price they receive:

$$MC_A = p_A.$$

The objective of the assembler depends on whether it is an IOF or cooperative. The objective of an IOF assembler is to maximize assembler profit:

$$\pi_B = p_B q - p_A q - hq$$

where p_B is the price the assembler receives from the processor for the assembled raw product and h is the assembler's per-unit handling cost. The objective of an active cooperative is to maximize the joint profits of producers and the assembler:

$$\pi_{AB} = p_B q - F(q) - hq. \tag{1}$$

The processor's profit function is

$$\pi_C = p_C q - p_B q - kq \tag{2}$$

where p_C is the price the processor receives for the processed product and k is its per-unit processing cost.

Active Cooperative Assembler

Assembler Dominance. The processor exercises monopoly power in the processed product market. However, under assembler dominance, the processor takes the price the assembler sets for the assembled raw product. Thus, from (2), the processor's first-order condition is

$$\frac{d\pi_C}{dq} = \left(p_C + q\,\frac{dp_C}{dq}\right) - p_B - k = 0.$$

Rearranging, we derive the processor's inverse factor demand function for the assembled product:

$$p_B = MR_C - k \tag{3}$$

where MR_C represents marginal revenue in the processed product market. Substituting (3) into (1), the cooperative assembler's objective function is rewritten

$$\pi_{AB} = MR_C q - F(q) - (h + k)q.$$

The corresponding first-order condition is

$$\frac{d\pi_{AB}}{dq} = \frac{d(MR_C q)}{dq} - \frac{dF}{dq} - h - k = 0$$

and can be rewritten

$$MC_A + h = \frac{d(MR_C q)}{dq} - k.$$

The cooperative assembler maximizes the joint profits of producers and the assembler when the producers' marginal cost plus the per-unit handling cost equals the value marginal to the processor's marginal revenue function less the per-unit processing cost.

Processor Dominance. Under processor dominance, the cooperative assembler takes the price set by the processor for the assembled product. From (1), the cooperative's first-order condition is

$$\frac{d\pi_{AB}}{dq} = p_B - \frac{dF}{dq} - h = 0.$$

Rearranging, we derive the cooperative's inverse factor supply function:

$$p_B = MC_A + h. \tag{4}$$

Substituting (4) into (2), the processor's profit function is rewritten

$$\pi_C = p_C q - MC_A q - (h + k)q. \tag{5}$$

The first-order condition is

$$\frac{d\pi_C}{dq} = \left(p_C + q\,\frac{dp_C}{dq}\right) - \frac{d(MC_A q)}{dq} - h - k = 0, \tag{6}$$

which can be rewritten

$$MFC_A + h = MR_C - k. \tag{7}$$

The processor maximizes profit when the assembler's marginal factor cost plus the per-unit handling cost equals the processor's marginal revenue less the per-unit processing cost.

Post-Integration. If the cooperative assembler integrates forward by acquiring the processor, it will maximize the joint profits from producing, assembling, and processing the raw product:

$$\pi_{ABC} = p_C q - F(q) - (h + k)q.$$

The first-order condition for this objective is

$$\frac{d\pi_{ABC}}{dq} = \left(p_C + q\,\frac{dp_C}{dq}\right) - \frac{dF}{dq} - h - k = 0,$$

which can be rewritten

$$MC_A + h + k = MR_C.$$

The cooperative maximizes the joint profits from producing, assembling, and processing the raw product when the sum of the producers' marginal cost, the per-unit handling cost, and the per-unit processing cost equals the marginal revenue from the processed product.

Passive Cooperative Assembler

Assembler Dominance. Here we assume that the cooperative is passive in terms of accepting whatever quantity of raw product producers choose to market. There is assembler dominance only in the sense that the processor is a price-taker. The price of the assembled raw product is determined, not by the assembler, but by the quantity supplied by producers. Producers recognize the existence of patronage refunds and produce the quantity for which marginal cost equals the sum of the raw product price and the per-unit patronage refund:

$$MC_A = p_A + r. \tag{8}$$

The per-unit patronage refund equals the profit of the cooperative assembler divided by the quantity of raw product assembled:

$$\begin{aligned} r &= \frac{p_B q - p_A q - hq}{q} \\ &= p_B - p_A - h. \end{aligned} \tag{9}$$

Substituting (9) into (8), we derive the cooperative's inverse factor supply function:

$$p_B = MC_A + h, \tag{10}$$

which is identical to (4) for the active cooperative assembler under processor dominance. Setting (10) equal to the processor's inverse factor demand function (3), we derive the equilibrium solution:

$$MC_A + h = MR_C - k.$$

Equilibrium occurs at the quantity for which the marginal cost of producing and assembling the raw product equals the marginal revenue from the processed product less the per-unit processing cost.

Processor Dominance. Solution of the model is identical for a dominant processor regardless of whether it purchases the assembled product from a cooperative actively pursuing the joint profit function (1) or one that passively accepts whatever quantity of raw product producers choose to market. After substituting the passive cooperative's inverse factor supply function (10) into the processor's profit function (2), the latter is equivalent to (5), the profit function of a dominant processor that purchases from an active cooperative. The first-order condition is equivalent to (6), or alternatively (7).

Post-Integration. If the passive cooperative assembler integrates forward by acquiring the processor, it still will accept whatever quantity of raw product producers choose to market. Producers again determine the quantity of raw product according to (8). However, the per-unit patronage refund is now

$$r = \frac{p_C q - p_A q - (h+k)q}{q} = p_C - p_A - h - k. \tag{11}$$

Substituting (11) into (8) and rearranging, we derive the equilibrium solution:

$$MC_A + h + k = p_C.$$

Equilibrium occurs at the quantity for which the marginal cost of producing, assembling, and processing the raw product equals the processed product price. Because producers act according to the patronage refund and the cooperative passively accepts whatever quantity producers choose to market, the cooperative is unable to exercise market power in the processed product market by acting as a monopolist.

Comparison of Solution Conditions

A summary of the solution conditions is presented in table 1 for IOFs and both active and passive cooperatives. These conditions reveal important differences in the behavior of the three types of assemblers: (1) Both active and passive cooperative assemblers behave like competitive firms in the raw product market whereas IOF assemblers exercise monopsony power, and (2) passive cooperative assemblers behave like competitive firms in the assembled and processed product markets whereas both IOF and active cooperative assemblers exercise monopoly power. Monopsony power in the raw product market is indicated by the existence of MFC_A instead of MC_A on the left-hand side of the assembler-dominant and post-integration conditions. Monopoly power in the processed product market is indicated by MR_C instead of p_C on the right-hand side of the post-integration condition. Monopoly power in the assembled product market is represented by $d(MR_C q)/dq$ instead of MR_C on the right-hand side of the assembler-dominant condition. The term $d(MR_C q)/dq$ results from the marginalization of the processor inverse factor supply function by a monopolistic assembler.

Whereas the assembler-dominant and post-integration solution conditions correspond to optimal or equilibrium activity by assemblers, the processor-dominant conditions are based on optimal behavior by the processor. The existence of MR_C on the right-hand side of these conditions indicates monopoly power in the processed product market. The terms $d(MFC_Aq)/dq$ and MFC_A on the left-hand side represent the exercise of monopsony power by the processor and stem from marginalization of the assembler inverse factor supply functions. Because the supply functions of the active and passive cooperatives are identical, the processor-dominant solution conditions are the same, and they are equivalent to that for the IOF after integration. In addition, the condition for the passive cooperative under assembler dominance is equivalent to that for the active cooperative after integration.

Graphical Comparison. The solutions in table 1 are compared graphically in figure 1, where $MMFC_A$ and MMR_C respectively represent $d(MFC_Aq)/dq$ and $d(MR_Cq)/dq$, i.e., the schedules marginal to the marginal factor cost and marginal revenue curves. For convenience, the curves in figure 1 are represented in linear form although linearity is not a necessary assumption for the following analysis.

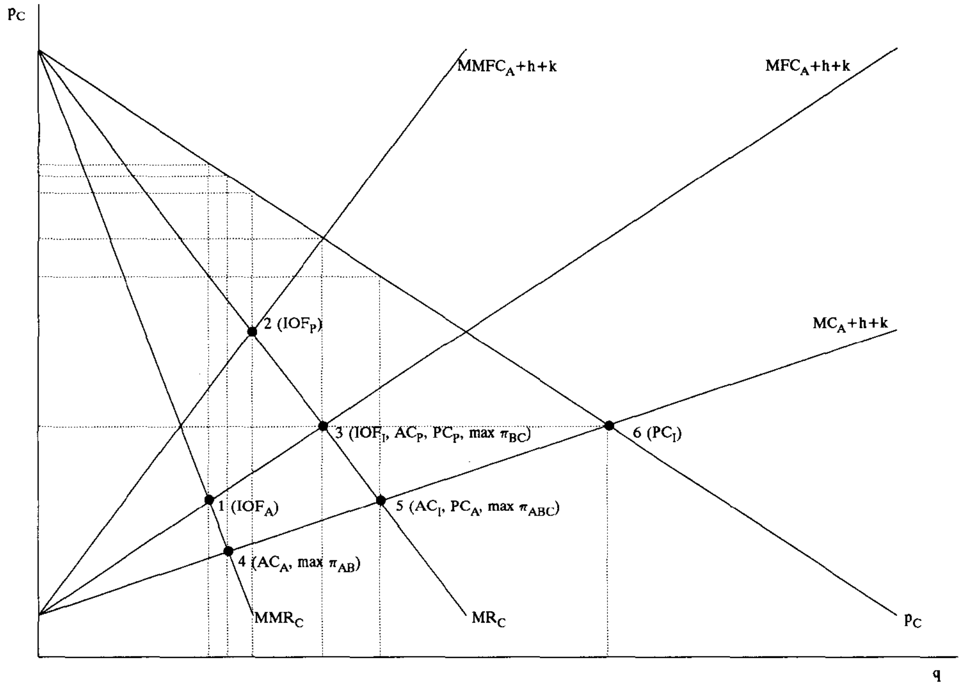
Points 1 and 2 represent the solutions for the IOF assembler under the respective conditions of assembler and processor dominance (IOF_A and IOF_P). Point 3 represents the solution for the IOF after integration (IOF_I). The post-integration solution is characterized by greater output and a lower processed product price than either of the pre-integration solutions. Thus consumers are better off as a result of integration by the IOF. The price paid producers is read from the raw product supply curve, found by subtracting the per-unit handling and processing costs from MC_A+h+k. Integration increases the price paid producers in addition to increasing output. Thus producers also are better off because of integration by the IOF.

Point 4 represents the solution for the active cooperative under assembler dominance (AC_A). Output and raw product price are greater and processed product price is less than when the assembler is a dominant IOF. Thus, under assembler dominance, both consumers and producers are better off when the assembler is an active cooperative, irrespective of the receipt of patronage refunds by the cooperative's producer members. The solution for the active cooperative under processor dominance (AC_P) is

Table 1.—Summary of Solution Conditions for Alternative Market Structures

	Investor-Owned Firm	Active Cooperative	Passive Cooperative
Assembler Dominance	$MFC_A+h=\frac{d(MR_Cq)}{dq}-k$	$MC_A+h=\frac{d(MR_Cq)}{dq}-k$	$MC_A+h=MR_C-k$
Processor Dominance	$\frac{d(MFC_Aq)}{dq}+h=MR_C-k$	$MFC_A+h=MR_C-k$	$MFC_A+h=MR_C-k$
Post-Integration	$MFC_A+h=MR_C-k$	$MC_A+h=MR_C-k$	$MC_A+h=p_C-k$

Figure 1.—Price and Output under Alternative Market Structures



point 3, identical to that for the IOF after integration. Thus an active cooperative under processor dominance provides consumers and producers the same benefits as an integrated IOF without integrating.[4] However, by integrating, an active cooperative (AC_I) can further improve the situation of both consumers and producers, irrespective of patronage refunds, as indicated by the prices and output associated with point 5. This solution also represents an improvement over the unintegrated active cooperative under assembler dominance.[5]

The solution for the passive cooperative under assembler dominance (PC_A) also is represented by point 5. Thus, under assembler dominance, a passive cooperative provides the same benefits to consumers as an integrated active cooperative without integrating. However, producers will be better off with the integrated cooperative because any patronage refunds they receive will include the profits of the processing plant. Notice that the solution for the passive cooperative under assembler dominance yields a greater output and raw product price and a lower processed product price than the passive cooperative under processor dominance (PC_P), which is represented by point 3. In the case of IOF and active cooperative assemblers, no generalizations can be made about the comparative output and prices under assembler and processor dominance. Whether output will be greater or less under processor dominance will depend on the specific demand and cost functions. However, the output of a passive cooperative will be less under processor dominance because the inability of the cooperative to set the quantity of raw product it handles is replaced by the discipline of the processor, which is a monopsonist in the assembled product market. Producers will be worse off than under assembler dominance because the net price paid producers (the cash price plus the per-unit patronage refund), which is read from the raw product supply curve in the case of a passive cooperative, also will be less. The solution for a passive cooperative under processor dominance is identical to those for the IOF after integration and the active cooperative under processor dominance. Thus, when the processor is dominant, the output and price results are the same regardless of whether the cooperative is active or passive.

The post-integration solution for the passive cooperative (PC_I), represented by point 6, yields the most beneficial results to consumers. Output is the greatest and the processed product price is the lowest of all solutions. Although the net price paid producers is greater than for either of the pre-integration solutions, producers would be better off with an active cooperative. The post-integration solution for the active cooperative maximizes joint profits π_{ABC}. Whereas the integrated passive cooperative behaves like a competitive firm in the processed product market, the integrated active cooperative behaves like a monopolist. Consequently, it receives a higher price for its processed product.[6]

Generalized Results. Some generalizations about integration and the three assembler types can be made from the preceding analysis. Both consumers and producers are better off if the assembler is an active cooperative instead of an IOF. Whereas an IOF assembler is a monopsonist in the raw product market, an active cooperative assembler behaves like a competitive firm. Thus output and raw product price are greater and processed product price is less. In addition, because any profits of the cooperative assembler are returned to producers as patronage refunds, the net price received by producers may be further enhanced.

Consumers are always better off or just as well off if the assembler is a passive cooperative rather than an active cooperative. Whereas an active cooperative assembler behaves like a monopolist in the processed product market, a passive cooperative assembler behaves like a competitive firm. Thus output is greater and the assembled and processed product prices are less, except under processor dominance, for which output and prices are the same.

A similar generalization cannot be made about the effect on producers. Although producer output is always at least as great for a passive cooperative, the receipt of patronage refunds complicates the comparison of producer revenues. Under assembler dominance, the output associated with the passive cooperative assembler is greater than that for the active cooperative. However, the net price paid producers by the active cooperative assembler, found by subtracting the per-unit handling and processing costs from MR_C in figure 1, is greater than that paid by the passive cooperative.[7] Whether producers will be better off with an active or passive cooperative will depend on the specific demand and cost functions. Under processor dominance, the solutions for active and passive cooperatives are identical, and the net price paid producers is the same. If the cooperative integrates, producers are better off if the cooperative is active because this solution is associated with maximum joint profits π_{ABC}.

Both consumers and producers are better off after integration regardless of the assembler type. For each assembler, the post-integration solution yields a greater output and raw product price and a lower processed product price than either pre-integration solution. Again the receipt of patronage refunds complicates the comparisons for cooperative assemblers. However, if the assembler is an active cooperative, producers will be better off after integration because the post-integration solution is associated with maximum joint profits π_{ABC}. If the assembler is a passive cooperative, the net price paid producers is greatest for the post-integration solution, as shown in figure 1.

In addition to making both consumers and producers better off, integration increases total economic welfare. Integration by an IOF assembler results in the maximization of π_{BC}, the joint profits from assembling and processing the raw product. Thus, given that both consumers and producers are better off after integration, total welfare is increased. Integration by an active cooperative results in maximization of π_{ABC}, the joint profits from producing, assembling, and processing the raw product. Consequently, given that consumers are better off after integration, total welfare is once again increased. Economic welfare is the greatest when a passive cooperative integrates because the cooperative acts like a competitive firm in both the raw and processed product markets.[8] Welfare after integration is less when the assembler is an active cooperative because, although it behaves like a competitive firm in the raw product market, it exercises monopoly power in the processed product market. Post-integration welfare is lowest when the assembler is an IOF because the assembler is a monopolist in the processed product market and a monopsonist in the raw product market.

The vertical market structure preferred from a societal perspective would result from integration by a passive cooperative assembler because total economic welfare is greatest.[9] Producers would prefer integration by an active cooperative because joint profits π_{ABC} are greatest under that structure. Both consumers and producers would prefer either structure to integration by an IOF assembler. However, whether vertical integration is likely to arise at all will depend not on the desirability of the outcome but on the incentives for the assembler to integrate, which will be explored in the following section.

Incentives to Integrate

We consider an assembler to have an incentive to integrate forward by acquiring the processor if the capitalized value of its objective function after integration, less what it must pay the owners of the processing plant, is greater than the capitalized value of its objective function before integration. The price the assembler must pay the owners of the processing plant will depend on the relative bargaining power of the two parties. However, under most circumstances, the minimum the owners of the plant would be willing to accept is the capitalized value of the plant's profits. Thus, if we assume that current profits are proportional to the capitalized values, an IOF has an incentive to integrate forward only if

$$\pi^*_{BC} - \pi_C > \pi_B \tag{12}$$

where π^* represents a post-integration profit.[10] Under the same conditions, a cooperative has an incentive to integrate only if

$$\pi^*_A + \pi^*_{BC} - \pi_C > \pi_A + \pi_B. \tag{13}$$

It can be seen from figure 1 that an IOF assembler may have an incentive to integrate forward under both assembler and processor dominance. At point 3, which corresponds to an IOF after integration, π_{BC} is at its maximum. Thus condition (12) would be satisfied, regardless of whether the assembler or processor is dominant. The situation is similar for an active cooperative assembler. At point 5, which corresponds to an active cooperative after integration, π_{ABC} is at its maximum and condition (13) would be satisfied, regardless of whether there is assembler or processor dominance.

These results do not hold for a passive cooperative assembler. Point 5, at which π_{ABC} is at its maximum, represents the solution for a passive cooperative under assembler dominance instead of the post-integration solution, which is represented by point 6. Thus, for a passive cooperative under assembler dominance, condition (13) would not be satisfied.[11] In general, we do not know if π_{ABC} is greater at the solution for a passive cooperative under processor dominance, which corresponds to point 3, or at the post-integration solution. Consequently, we cannot determine whether a passive cooperative under processor dominance has an incentive to integrate forward without knowing the specific demand and cost functions.

Quantitative Example

In this section, we present a numerical example determined by solving the conditions in table 1 for a specific set of demand and cost functions. We assume that the processor faces a processed product demand curve of the form

$$p_C = a + bq \quad a>0;\ b<0$$

and that the assembler faces a linear raw product supply curve. To construct the supply curve, we assume that total on-farm production costs take this form:

$$F = \int_0^q \left(\frac{1}{f}q - \frac{e}{f}\right) dq = \frac{1}{2f}q^2 - \frac{e}{f}q + g \quad e\leq 0;\ f,\ g>0$$

where the constant of integration g represents fixed costs. The producer maximizes profit by setting the marginal cost of production equal to the price offered by the assembler:

$$MC_A = \frac{dF}{dq} = \frac{1}{f}q - \frac{e}{f} = p_A. \tag{14}$$

For convenience, in the case of a passive cooperative, we set the price p_A such that the per-unit patronage refund r is zero, which is consistent with pricing in the Helmberger-Hoos model. Solving (14) for q, the supply function facing the assembler is

$$q = e + fp_A.$$

Prices, outputs, and welfare measures corresponding to the solutions are presented in table 2 for the parameters shown at the foot of the table.

In this particular case, the passive cooperative under processor dominance does not have an incentive to integrate forward. Nonetheless, the net increase in total economic welfare that would result from integration exceeds the amount by which post-integration profits would need to be augmented to make integration attractive to the cooperative. Consequently, it is conceivable that a public subsidy could be used to create an integration incentive for the cooperative. This result does not necessarily hold for other demand and cost functions. Neither does it hold for a passive cooperative under assembler dominance.

Conclusions

Although both producers and consumers benefit from the forward integration of cooperatives into processing activities, these benefits do not

Table 2.—Price, Output, and Welfare Solutions for Specific Demand and Cost Functions

	Investor-Owned Firm			Active Cooperative			Passive Cooperative		
	Assembler Dominance	Processor Dominance	Post-Integration	Assembler Dominance	Processor Dominance	Post-Integration	Assembler Dominance	Processor Dominance	Post-Integration
					Million				
q	10.36	11.15	16.11	12.08	16.11	20.71	20.71	16.11	32.22
					Dollars				
p_A	40.41	40.45	40.64	40.48	40.64	40.83	40.83	40.64	41.29
r				1.21	0.00	1.04	0.00	0.00	0.00
p_A+r				41.69	40.64	41.86	40.83	40.64	41.29
p_B	41.96	40.99		41.79	40.74		40.93	40.74	
p_C	44.48	44.44	44.19	44.40	44.19	43.96	43.96	44.19	43.39
					Million Dollars				
π_A	0.15	0.49	3.19	0.92	3.19	6.58	6.58	3.19	18.77
π_B	15.02	4.98		14.60	0.00		0.00	0.00	
π_C	5.36	16.17		7.30	23.36		21.45	23.36	
π_{AB}				15.52	3.19		6.58	3.19	
π_{BC}			23.36			21.45			0.00
π_{ABC}						28.04			18.77
Consumer Surplus	2.68	3.11	6.49	3.65	6.49	10.73	10.73	6.49	25.96
Welfare	23.21	24.75	33.04	26.47	33.04	38.76	38.76	33.04	44.72

Parameters: $a=45$, $b=-0.05$, $e=-1{,}000$, $f=25$, $g=2$, $h=0.1$, $k=2$.

ensure a cooperative has an incentive to integrate. Cooperatives that are successful in restricting producer output to optimal levels may have an incentive to integrate forward because integration allows them to capture monopoly profits in the processed product market and thereby maximize the aggregate profits of the vertical market structure. A cooperative that is unable to restrict producer output would behave like a competitive firm in the processed product market and therefore may not have an incentive to integrate.

Because forward integration by a cooperative increases total economic welfare, an argument can be made for public policy support of cooperative integration. This would include support for forward integration by active cooperatives, even if they exercise monopoly power in processed product markets. It also could include the use of public subsidies for the creation of integration incentives for passive cooperatives.

Cooperative theorists have argued that cooperatives will be unsuccessful in restricting producer output because the receipt of patronage refunds provides producers an incentive to expand output. Unless cooperatives can restrict the quantity of raw product they handle through use of a nonprice mechanism, they may not have an incentive to integrate forward into processed markets. This result provides an additional explanation, based on market power, for the relatively low degree of forward integration by cooperatives.

Notes

1. For recent examples, see Cotterill (1987, 190–92), Schmiesing (1989, 159–62), and Staatz (1989, 4–5).

2. Other expositions of this model include Blair and Kaserman (1983, 28–35) and Warren-Boulton (1978, 51–61), the latter of which also analyzes the case where the downstream firm is a monopsonist. Our presentation follows that of Waterson (1984, 82–91) the most closely.

3. The results of this model are qualitatively equivalent to those derived from a variable-proportions model. See Royer and Bhuyan (1994) for a description and comparison.

4. Patronage refunds will be zero for an active cooperative under processor dominance. We know that

$$p_B = MC_A + h$$

from the cooperative's inverse factor supply function (4). We also know that

$$p_A = MC_A$$

from the producer raw product supply function. Substituting p_A for MC_A in the first of these two equations, we find that the price paid producers for the raw product exhausts the cooperative's average net returns:

$$p_A = p_B - h.$$

5. The observation that output and the cash price producers receive for the raw product are greater after integration is not sufficient to ensure that producers are better off because they may receive patronage refunds from the unintegrated cooperative under assembler dominance. However, because the integrated cooperative maximizes joint profits π_{ABC}, producers will be better off after integration when patronage refunds are taken into consideration.

6. For convenience, fixed costs were ignored in the determination of the per-unit patronage refund in (9) and (11). Alternatively, average fixed cost could have been subtracted from the right-hand side of (9) and (11) and included in the subsequent equilibrium conditions. Consideration of average fixed cost would shift PC_P, PC_A, and PC_I leftward along the MR_C and p_C curves in figure 1, resulting in lower outputs and raw product prices and greater processed product prices. Although this would not affect short-run comparisons of PC_P, PC_A, and PC_I, it could potentially affect comparisons between a passive cooperative and other assemblers if average fixed cost is large relative to per-unit assembly and processing costs.

7. The net price paid producers by a cooperative assembler is $p_A + r$ where

$$r = p_B - p_A - h.$$

We know that under assembler dominance

$$p_B = MR_C - k$$

from the processor's inverse factor demand function (3). Substituting the right-hand side for p_B in the first equation, we see that the net price paid producers is

$$p_A + r = MR_C - k - h.$$

In the case of the passive cooperative, this is equivalent to the price read from the raw product supply curve because of the intersection of MR_C and $MC_A + h + k$.

8. Figure 1 can be used to verify the conclusion that the greatest total economic welfare stems from an integrated passive cooperative. The welfare triangle consisting of the area below the processed product demand curve (p_C) and above the cooperative's supply curve ($MC_A + h + k$) is greater than any corresponding combination of consumer surplus and profit interior to it and to the left of point 6.

9. This result depends on the assumptions about costs and processed product demand. As LeVay (1983, 107–8) observes, a cooperative with unrestricted output will produce beyond the social optimum when marginal cost exceeds average cost.

10. An exception to this and the following rule would exist if the assembler could construct a new processing plant for less than the capitalized value of the existing plant's profits. Assuming that the assembler would be successful in redirecting the entire raw product supply to the new plant, recognition of this threat would force the owners of the existing plant to consider its replacement cost as the minimum they would accept. This possibility and related strategies are beyond the scope of this article.

11. This result is consistent with Masson and Eisenstat's conclusion concerning a cooperative's acquisition of a processor facing constant returns to scale and a downward-sloping demand curve (1978, 58).

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