Cooperative Formation and Financial Contracting in Agricultural Markets

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Abstract

Cooperative formation in agriculture sometimes occurs in response to the exit of a private firm and typically requires substantial equity investment by participating farmers. What economic rationale can explain why farmers are willing to contribute capital to an activity that fails to attract non-farm, or “private” investment? We hypothesize that doing so is a costly mechanism for increasing the maximum penalty farmers face in the case of business failure. For a given market environment, exposing farmers to this risk increases the amount of surplus that can be used to repay lenders, thus expanding the set of market environments in which financing is available. We show how equity investment of this sort can be an efficient organizational response to a reduction in expected markets returns and interpret the resulting financial contract as a “cooperative.”

Keywords: Cooperative, corporate finance, moral hazard, vertical integration

COOPERATIVE FORMATION AND FINANCIAL CONTRACTING IN AGRICULTURAL MARKETS

Introduction

Although there are many forms of cooperative activity in agriculture, among the most prominent are those that involve the processing and marketing of farmers' output. Perhaps surprisingly, many of the cooperative firms engaged in this activity were at one time *not* cooperatives but rather were non-farm, investor-owned firms subsequently purchased by farmers in response to announced plant closings or scaling back of processing activities. For example, American Crystal Sugar, the largest U.S. producer of refined beet sugar, is a producer cooperative that was formed in 1973 with the purchase of the combined assets of the investor-owned firm with the same name (American Crystal Sugar Company, 2003). Similarly, the recent purchase of an Oscar Meyer meat processing plant by a group of Iowa turkey growers occurred in response to an announced plant closing (West Liberty Foods, 2003). Still more examples are provided by Hetherington (1991, pp. 182-186) who notes how past growth in cooperative activity in California's fruit and vegetable canning industry can be mostly explained by farmers purchasing abandoned investor-owned capacity.

The closing or scaling back of operations by a private firm is presumably an indication of poor profitability. What rationale can be provided for growers to invest equity capital in such a venture? Perhaps growers have fewer opportunities to invest their capital and are willing to accept a lower return on investment (that occurs when market conditions are poor) than are non-farm investors. However, for this to be the case, one would have to explain why the firm cannot simply negotiate a slightly lower payment to growers as market conditions deteriorate. In this context, Staatz (1987) describes

bargaining and informational frictions that may impede renegotiation. For example, growers may not believe claims of the firm's management that market conditions are poor, and verifying these claims may be costly. Cooperative formation might achieve a greater degree of transparency in determining the price of farm-level output, thus reducing bargaining costs. However, such a reduction represents a pure efficiency gain. Based on this logic, we should *always* observe the cooperative structure.

Alternatively, Hansmann (2000, p. 124) argues that growers may choose to invest equity in a marginally valuable processing facility if the alternative is one or a small number of oligopsony buyers. That is, the return on investment in such a facility is made up of firm-level profits *plus* any benefit associated with inducing competitive pricing by other buyers. However, in many of the examples where growers have taken over the activities of a private firm, it has been the threat of *no* buyer that has motivated growers, rather than the threat of a small number of oligopsony buyers. Moreover, if growers can induce competitive pricing with cooperative activity, why should we not also expect to see cooperative activity in settings with relatively high market returns?

In this paper, we propose an alternative explanation for cooperative formation that occurs in response to exit by a private firm. In particular, we argue that cooperative formation is a costly mechanism for reducing informational rents paid to farmers. By pledging farm assets to acquire processing facilities, farmers increase their collective private cost of business failure, and this effectively increases the combined pledgeable income of the farming *cum* processing operation. However, if risking the forfeiture of farm assets entails a deadweight cost, or if the cooperative governance structure is inherently less efficient than other forms of governance, then we should only expect cooperative formation when there is otherwise insufficient pledgeable income. This can happen, for example, when expected market returns are sufficiently low.

Thus, the key ingredients in our explanation are an incentive problem between the processing firm and farmers and a deadweight cost associated with forming a cooperative

or with pledging farm assets. Several contributions have already argued that informational asymmetries at the level of the farm can explain the emergence of stronger vertical relationships in the agricultural sector (e.g. Hennessy, 1996; Bogetoft and Olesen, 2003).[1] Our analysis differs from these by focusing on the importance of farm-level assets in financial contracts between liquidity-constrained farmers and competitive lenders.

The notion that cooperative formation involves a deadweight cost, relative to non-farm investor ownership, is meant to capture the idea noted by Hansmann (2000, p. 41) and others (e.g. Fulton, 1999; Holmström, 1999; Rey and Tirole, 2001) that the democratic governance procedures of a cooperative are inherently inefficient. Similarly, we assume that asset seizure involves a deadweight loss to capture the idea that there is a cost associated with the necessary legal transaction, or alternatively (but equivalently for our purposes) because farmers have human capital specific to these assets. We treat these two assumptions, together with the assumption that there is moral hazard in farm production as maintained hypotheses in our analysis.[2] As we will demonstrate below, these assumptions generate the prediction that the cooperative structure (involving asset pledging by farmers) can be an efficient response to low market returns from processing.

Briefly, we present a model in which we obtain two equilibrium organizational regimes, depending on the level of market returns from the processing activity. When returns are relatively high, both the private investor-owned firm and cooperative are viable in the sense that both generate a positive expected social surplus. However, because cooperative ownership involves a deadweight loss, the non-farm investor-owned structure is Pareto dominant. Though we are agnostic about the exact distribution of gains from private versus cooperative ownership in this regime, there is scope for the threat of cooperative formation to provide some degree of rent transfer from the private owners to farmers.[3]

When returns are relatively low, the non-farm investor-owned firm exits the market because its returns no longer exceed informational rents plus investment costs. When

information rents are strictly positive, there is thus some degree of credit rationing in that the project can generate positive expected social surplus and yet not be implementable. As a response, farmers can acquire the processing facility to continue production. However, farmers are liquidity constrained and must find a loan agreement that both preserves incentives and allows the lender to recoup its investment. When returns to the processing activity are sufficiently low, the equilibrium loan agreement has farmers pledging farm assets against the possibility of business failure, and we interpret the resulting financial contract as a "cooperative." We characterize a region of market returns in which a cooperative of this sort is the only viable organizational structure.

In what follows, we make these arguments more precise. We first present a simple model with complete separation between farm-level production and processing. The processing firm contracts for delivery of a raw agricultural input from farmers. There is moral hazard and limited liability by farmers. Using an approach inspired by Holmström and Tirole (1997), we then introduce a third party, the "outside investor," who can provide capital to farmers wishing to form a cooperative to buy the firm. We then compare the viability of these these two organizational structures as a function of expected market returns from processing and present our main result that the cooperative structure is the only viable organizational when market returns are sufficiently low. In the final section we summarize our results and suggest directions for further research.

Model

Our economy is composed of three types of agents: farmers, non-farm or "private" investors, and institutional investors. For simplicity, we assume that individuals within each group of agent types are perfectly homogeneous, so we can think of their being a single representative member of each type.[4] The representative farmer grows an essential input used in producing some processed agricultural product. The farmer does not have the managerial skills to run a processing facility but can acquire them at a cost.

The private investor possesses the ability to run a processing facility and is not wealth-constrained. We assume, however, that private investors are mobile and can operate in several markets; they can eventually exit the food processing activity if the returns in this market are sufficiently low. A private investor who wants to be active in the processing business must invest an amount $I > 0$ to acquire the physical capital needed to process the agricultural product. He then procures this input from the farmer. Production lasts for one period and we assume that, at the end of the period, the residual value of the processing plant is 0.[5] Institutional investors are passive risk-neutral investors, with no managerial skills. We assume that there exists a competitive fringe of such investors who will lend only if they expect to recoup their initial loan.

We assume that there is moral hazard in agricultural production. The quality of the final output is uncertain and depends in part on unobservable (to both private and institutional investors) actions of growers.[6] For simplicity, we assume there are only two possible outcomes. When the farmer is "diligent," farm output is high-quality with probability P_h, whereas when the farmer "shirks," output is high-quality with probability $P_\ell < P_h$. We let the strictly positive difference between these two probabilities be denoted by $\Delta P = P_h - P_\ell$. The farmer enjoys a private benefit $B > 0$ in monetary units from shirking (or equivalently, incurs a cost $-B < 0$ from being diligent). Revenue of the processor is R when the output is high-quality and is normalized to 0 when the output is low-quality.

These revenues are verifiable, and to make our problem interesting, we assume that that it is always efficient to induce diligence by the farmer:

ASSUMPTION 1 (DILIGENCE IS OPTIMAL)

$$R > \frac{P_h B}{(\Delta P)^2}$$

We model cooperative formation as a Stackelberg game in which the leader is a private investor who contemplates the opportunity to create a processing facility. The

investor must, however, take into account the ability of the farmers to take collective action to create and operate their own processing cooperative.

The timing of activities is as follows:

1. The private investor decides whether to establish a processing facility. He then makes a take-it-or-leave-it procurement offer to the farmer, who decides whether to accept or reject the offer. If the offer is rejected, the private investor exits the market and obtains his reservation utility.

2. If the offer of the private investor has been turned down, the farmers decide whether or not to acquire and run a processing facility by eventually borrowing money from institutional investors. The institutional investors decide whether or not to lend money. If the loan is refused, farmers produce for the "spot market" and earn zero net expected utility.

3. Production takes place and the farmers decide to be diligent or careless. Neither the private investor nor the institutional investor observes the farmers' choices.

4. Processing is performed and outcomes are realized. Payments are made according to the contracts signed either in step 2 or 3. The game ends.

We now turn to the situation in which private investors decide to be present in the processing market.

Investor Financing

The problem of the private investor consists in finding a pair of transfers (T_h, T_ℓ) made to the farmer contingent on the processor's revenue. The objective can be stated as

$$V(R) \equiv \max_{(T_h,T_\ell)} P_h(R - T_h) - (1 - P_h)T_\ell \tag{1}$$

subject to the following constraints:

$$P_h T_h + (1 - P_h)T_\ell \geq \underline{U} \tag{2}$$

$$P_h T_h + (1 - P_h) T_\ell \geq P_\ell T_h + (1 - P_\ell) T_\ell + B \tag{3}$$

and

$$T_h \geq 0, \;\; T_\ell \geq 0. \tag{4}$$

The objective function of the processing firm states that the firm obtains net revenue $R - T_h$ with probability P_h and $-T_\ell$ with probability $1 - P_h$. The first constraint states that the farmer's reward has to be greater than expected utility in his outside option given by $\underline{U}$. Later we will take account of the fact that the farmer's outside option is cooperative formation, but for now we treat expected utility under the private investor regime as a parameter. The incentive constraint (3) states that the farmer is induced to be diligent and thus produces a high-quality input with probability P_h. The last pair of constraints (4) characterize the farmer's limited liability; the private firm cannot use unlimited punishments to induce the farmer to behave.

Note that we can rewrite the constraint set as $T_\ell \geq \max\{0, \underline{U} - P_h/\Delta PB\}$ and $T_h \geq B/\Delta P + T_\ell > 0$. Thus, when the farmer's expected utility in his outside option is sufficiently high, the processor must pay the farmer a strictly positive amount even when the project fails. Otherwise, it is possible to set $T_\ell = 0$, and pay the farmer just enough under project success to ensure that the expected (public) payment from working is at least as large as the private payoff from shirking. Note that when the farmer's incentive compatibility and participation constraints are satisfied, the limited liability constraint under project success never binds. Moreover, given that the processor wishes to minimize expected transfers to the farmer, it is straightforward to verify the following proposition:

PROPOSITION 1 (PROCUREMENT CONTRACT) *One solution of the program (1)-(4) is given by the following transfers*

$$T_\ell = \max\{0, \underline{U} - \frac{P_h B}{\Delta P}\},$$

and

$$T_h = \frac{B}{\Delta P} + T_\ell > 0,$$

with expected surplus to the processor given by

$$V(R) = P_h R - I - \max\{\frac{P_h B}{\Delta P}, \underline{U}\}.$$

The farmer derives an expected informational rent of $P_h \frac{B}{\Delta P}$ from his farming activities. When these information rents exceed the farmer's outside option expected utility $\underline{U}$, it is possible to set $T_\ell = 0$; otherwise the farmer must be paid a positive amount in both outcome states and earns exactly his outside option expected utility. The processor will undertake the processing activity when expected returns, $V(R)$, are positive, and no processing activity is undertaken by a private firm otherwise.

We now study the farmer's decision to launch a cooperative, possibly by pledging their farm assets.

Cooperative Financing or "Pledging the Farm"

Arguably, the "cost of democracy" that underlies the cooperative goverance mechanism is the fundamental difference between a cooperative and a private investor owned firm. Thus, we assume that cooperative formation necessarily entails a monetary cost, $K > 0$, borne by our representative farmer during the life of the cooperative, and that this cost is independent of the cost of the assets of the food processing plant, I. This assumption is the simplest possible way to capture the idea that majority participation in firm-level decision making necessarily entails a deadweight loss, relative to private-investor governance.

The farmer does not have sufficient cash to cover the investment and organizational cost, $I + K$, associated with the processing activity but does have some illiquid assets like machines and acreages. These assets can be used as collateral by the farmer in any loan that the institutional investors issue. The farmer derives some utility from possession of these assets, and we assume that this utility is equivalent for him to F monetary units. However, when these assets are transferred to someone else, they are only worth f units, with $F > f > 0$. Several interpretations can be given to this discrepancy in valuation. For example, the farmer may have knowledge needed for efficient operation of the

collateralized assets that is both asset specific and costly to transfer. Alternatively, a discrepancy may arise because farmers have a sentimental attachment to their farms, or possibly because there is a deadweight transaction cost associated with asset seizure itself. For the purposes of our model, a discrepancy in asset valuation represents a strictly positive deadweight loss of $F - f$ if the asset is seized.[7]

The farmers have to invest an amount $I + K$ to form a processing cooperative. There exist several prospective lenders, with no managerial skills, who compete in a Bertrand fashion in issuing a loan to the farmers. The loan contract specifies how the two parties will share the revenue, R, in case of success, as well as possible contingent rights for the lenders to seize the assets. Let R_f denote the farmers' share of income in case of success, where lenders receive the residual $R - R_f$, and let y_s and y_f denote the probabilities that the farmer will have his farm seized (or equivalently, the fraction of total assets that the farmer will give up) in case of success or failure, respectively .

The program of the farmer can be stated as

$$U(R) \equiv \max_{(R_f, y_s, y_f)} P_h(R_f - y_s F) - (1 - P_h) y_f F \tag{5}$$

subject to

$$P_h(R_f - y_s F) - (1 - P_h) y_f F \geq P_\ell(R_f - y_s F) - (1 - P_\ell) y_f F + B, \tag{6}$$

$$P_h(R - R_f + y_s f) + (1 - P_h) y_f f \geq I + K, \tag{7}$$

and

$$0 \geq y_s \leq 1; \;\; 0 \geq y_f \leq 1. \tag{8}$$

The farmer undertakes the processing venture with borrowed cash. The incentive constraint (6) states that the loan contract is structured in such a way that farmers are induced to produce high-quality input with probability P_h, which from Assumption 1 we know is efficient. The loan contract must also meet the individual rationality constraint (7)

of the lenders; that is, the lenders must at least recoup their investment, $I+K$, on average. Finally, the probabilities of asset seizure must be between 0 and 1.

The following lemma establishes that in the farmer's optimal loan contract, it is never efficient to seize assets when the project succeeds, and that the lender exactly breaks even.

LEMMA 1 *Any solution* (R_f^*, y_s^*, y_f^*) *to the loan contract that solves the farmer's program (5)-(8) satisfies* $y_s^* = 0$, *and*

$$R_f^* = R - \frac{I+K}{P_h} + \frac{(1-P_h)y_f f}{P_h}. \tag{9}$$

That the lender's rationality constraint is fully saturated can be easily verified by noting that R_f must be strictly positive to ensure that farmers earn positive expected surplus, and moreover that for any solution in which the constraint is slack, it is possible to increase R_f slightly without violating any constraint, thus increasing expected surplus to the farmer.

Although it seems intuitively plausible that farm assets should not be seized when the project succeeds, it is somewhat less straightforward to verify. To see that this is indeed the case, first use the fact that the lender's rationality constraint binds to rewrite the farmer's objective function in (5) as $P_h R - I - K - q(F-f)$, where $q = y_f - P_h(y_f - y_s)$ represents the total probability of asset seizure. Thus, the farmer wishes to maximize expected social surplus, where seizing assets with probability q reduces expected surplus by $q(F-f)$. Clearly, q should be made as small as possible from this perspective. Making the same substitution in the incentive constraint (6) and rearranging yields,

$$P_h R - I - K + (y_f - y_s)P_h(F-f) + y_f f \geq \frac{P_h B}{\Delta P}.$$

From this expression, it is clear that in any solution where $y_s > 0$, it is possible to reduce y_s slightly without violating any constraint. Doing so reduces q, and thus increases expected payoff to the farmer. Intuitively, it is never efficient to use a transfer of assets as a means of transferring surplus from the farmer to the lender. Any transfer of surplus from

the farmer to the lender that is needed to satisfy the lender's rationality constraint can be achieved at lower cost by reducing R_f. Asset seizure is a costly incentive instrument and is most effective when $y_s = 0$.

Lemma 1 provides the solution of program (5) for any given probability of asset seizure when the project fails, y_f. The next result characterizes the optimal y_f when project revenues, R, decrease gradually.

PROPOSITION 2 (FINANCIAL CONTRACT) *As the return R of the processing activity decreases (equivalently, as $I+K$ increases), the financial contract passed with lenders will have two regimes:*

1. *(*Cooperative with no pledging*) When*

$$R \geq \overline{R} \equiv \frac{I+K}{P_h} + \frac{B}{\Delta P},$$

farmers are able to pledge cash for repayment without pledging any physical assets in any state of the world; that is, $y_f^* = 0$. Equilibrium surplus for the farmer is given by

$$U(R) = P_h R - I - K$$

2. (Cooperative with pledging) *When*

$$\underline{R} \equiv \frac{I+K}{P_h} + \frac{B}{\Delta P} - F - \frac{(1-P_h)}{P_h} f < R < \overline{R},$$

then farmers will lose a fraction of their assets in case of failure, with

$$y_f^* = \frac{I+K-P_h(R-B/\Delta P)}{P_h F + (1-P_h) f},$$

with equilibrium surplus for the farmer given by

$$U(R) = P_h R - I - K - (1-P_h) y_f^* (F-f).$$

For lower values of R, farmers do not obtain a loan (although the cooperative project may still have a strictly positive net value).

Using Lemma 1, it is clear from (5) that y_f should be zero unless it is needed for incentive reasons. Thus, if $y_f > 0$, we can find its value from the farmer's incentive constraint (6), which must be binding. If the value we find here is strictly greater than one, then

$$P_h R - I - K - (1 - P_h)(F - f) < \frac{P_h B}{\Delta P} - F,$$

and the problem is infeasible: project revenues, combined with the collaterized value of farm assets, are insufficient to cover project costs and pay the farmer's information rents. Proposition 2 is thus simply a matter of evaluating the farmer's incentive constraint as a function of R. For future reference, note that when y_f^* is strictly between zero and one, it is a strictly decreasing function of R.

The relative magnitude of information rents and expected project surplus (ignoring the deadweight loss from asset seizure) plays an important role in the structure of the loan agreement. When the informational rent attached to the farm product is smaller than expected project surplus (ignoring the deadweight loss from asset seizure), there is sufficient cash to repay lenders and no need to collaterize the farm asset. In contrast, when informational rents are sufficiently high, full contingent asset seizing may be necessary ($y_f^* = 1$) to induce diligence by farmers.

Interestingly, these two cooperative regimes have characteristics resembling organizational features found in some actual cooperatives. For instance, to participate in a so-called "new generation cooperative," a farmer must contribute significant up-front equity to become a member.[8] Harris et al. (1996) note that these minimum up-front capital requirements are sometimes too high for young equity-poor farmers, who are thus indirectly restricted access. Although not universally the case, these new generation cooperatives have tended to concentrate on "niche products" in which branding and organizational reputation are important. It seems reasonable that, relative to the marketing of a generic commodity, incentive provision is relatively important in such a venture, or that, in the context of our model, information rents are relatively high. Thus, our model

seems to describe well the combination of significant equity investment coinciding with large information rents.

Proposition 2 also has some policy implications. When returns are sufficiently low, farmers are credit rationed and cannot create their cooperative. This occurs when

$$(1-P_h)(F-f) < P_hR - I - K < P_h(\frac{B}{\Delta P} - F) - (1-P_h)f,$$

so that the project is not feasible but is socially valuable. In this case, expected project returns plus the expected value of farm assets that are seized in the case of failure are insufficient to cover expected project costs which include both the investment and organizational costs, and the information rents of farmers. Note that this outcome implies that $P_hB/\Delta P > F$, or that expected information rents are large in comparison with the farmer's asset valuation. In this case, providing secured loans or subsidies to farmers can enable cooperative activity that generates positive expected social surplus (ignoring the cost of government funds) but that would be otherwise infeasible. In our model, a secured loan or subsidy to farmers would act like an increase in R or a decrease in $I+K$. However, for incentive purposes, it is important to let the farmers bear the project risk.

Comparison of Investor and Cooperative Financing

The aim of this section is to characterize situations in which we expect to observe private firms or cooperatives. The next results, which are the main results of the paper, discuss the existence, as an equilibrium outcome, of each type of processing organization.

We first state an assumption that provides a pair of necessary conditions for the equilibrium emergence of cooperative activity.

ASSUMPTION 2 (COOPERATIVE ACTIVITY)

$$\frac{K}{P_h} - \frac{(1-P_h)}{P_h} f < F < \frac{P_hB}{\Delta P}.$$

The first inequality, which we can rewrite as $K < P_hF + (1-P_h)f$ says that the expected value of the farm asset, given that it is pledged, is larger than the cost of

cooperative organization. Viewing the expected value of the farm asset as a component of the "project" value, this assumption says that the amount that the farmer contributes to the project must be at least as large as the additional cost which is incurred to accommodate farmer participation in management. Alternatively, this inequality can be viewed as simply a restriction on the magnitude of K. There is no scope for cooperative activity when the necessary organizational costs are sufficiently high.

The second inequality ensures that the farmer always receives positive expected surplus from cooperative activity. To see this, note that $U(\underline{R})$ evaluated at $y_f^* = 1$ yields

$$U(\underline{R}) = P_h(\frac{B}{\Delta P} - F) - (1 - P_h)F.$$

Imposing the condition $U(\underline{R}) > 0$ yields the second inequality in Assumption 2. Thus, if the farmer is to be made at least as well off as in his outside option (which, recall, we assume is the "spot market" yielding a net expected utility of zero), then information rents from the cooperative venture must be relatively large in comparison with the value of assets that are pledged.

Using Assumption 2, we now present a proposition that summarizes equilibrium organizational structure as a function of project returns, R.

PROPOSITION 3 (EQUILIBRIUM ORGANIZATION) *Under Assumption 2, as R increases, we observe the following exclusive sequence of processing organizations:*

- *If $R < \underline{R}$, no organization is formed; farmers sell their product on the "spot market" and earn zero expected utility.*
- *If*

$$\underline{R} \leq R < R_p \equiv \frac{I}{P_h} + \frac{B}{\Delta P},$$

then a cooperative with asset collateralization is the unique equilibrium organization. The structure of its financial contract with the lender is described in Proposition 2.

- *If $R_p \leq R \leq \overline{R}$, then processing activities are exclusively performed by the private firm. Its procurement contract with the farmer is described in Proposition 1.*
- *If $R \geq \overline{R}$, then processing activities are performed by a private firm, but against threat of entry by a cooperative firm. The farmer's procurement contract is as described in Proposition 1.*

Proof. The proof of this proposition is a straightforward comparison of the various regimes characterized in Propositions 1 and 2, under Assumption 2. In Proposition 2, we have already shown that the cooperative is not sustainable when $R < \underline{R}$. Rearranging this inequality slightly yields

$$P_h(R - \frac{B}{\Delta P}) - I < K - (P_h F + (1 - P_h) f) < 0,$$

which, using Assumption 2, demonstrates that a private firm is also not feasible.

Next, note that Assumption 2 ensures $\underline{R} < R_p$. Thus, there is an interval where the farmer's incentive compatibility constraint can be satisfied in the cooperative organization. However, we still need to ensure that the cooperative members earn positive expected surplus in the interval between $\underline{R}$ and R_p while the private processor does not. This is easily verified, again using Assumption 2, by direct substitution into the expressions for $U(R)$ and $V(R)$.

For R between R_p and $\overline{R}$, the private processor earns strictly positive returns, while the farmer receives $P_h B/\Delta P > U(R)$, so that he does better with the processor than by forming a cooperative. For R sufficiently large, the private processor earns $K > 0$, while the farmer earns expected project surplus $P_h R - I$ minus K, which makes him exactly indifferent between producing for the processor and forming a cooperative. □

These arguments can be presented graphically by assuming that farmers must pledge all or none of their assets to the cooperative venture, or that $y_f \in \{0, 1\}$, and that $R < R_p$ so that $T_\ell = 0$ in the firm's procurement problem. In the firm problem, when the project succeeds, the farmer must be paid at least the information rents $B/\Delta P$, while the private

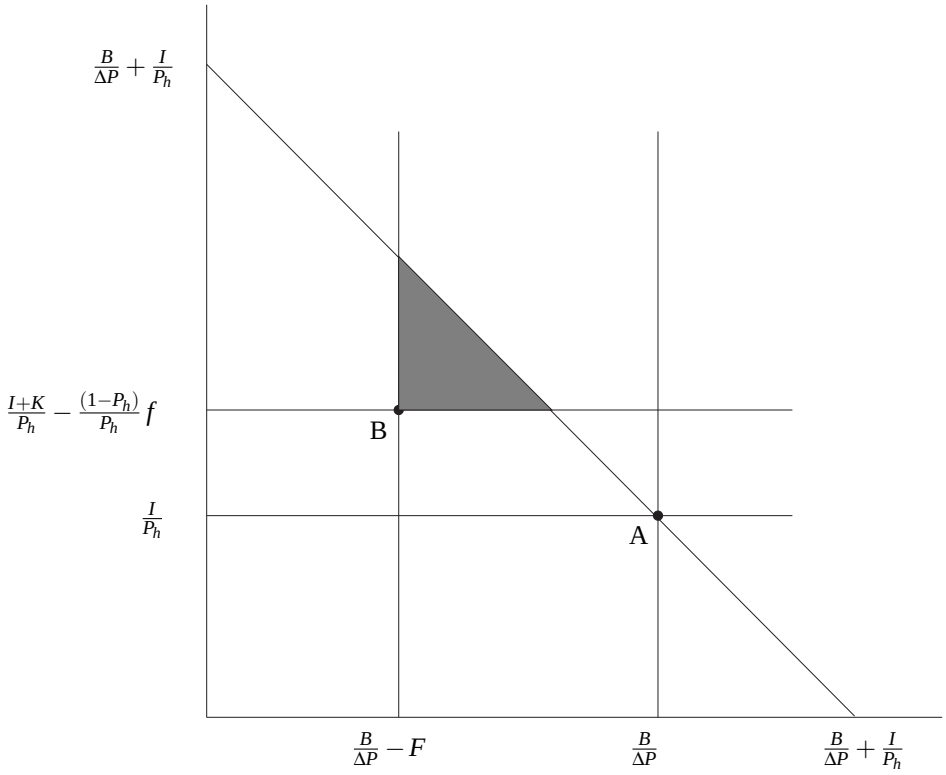

FIGURE 1. Project feasibility with and without pledging by the farmer. Axes represent payoffs under project success, with the farmer on the horizontal axis and the investor on the vertical axis.

investor must receive at least I/P_h so that expected project surplus is positive. Thus, the project revenue R must be at least as large as $B/\Delta P + I/P_h$. In Figure 1, we have drawn the relevant constraint set for the private investor so that the project is just feasible. In the cooperative problem, the farmer must earn at least $B/\Delta P - F$, while investors must earn at least $(I+K)/P_h - f(1-P_h)/P_h$. Thus, there is a region of feasibility for the cooperative that is outside the feasible region for a private firm, provided that $(I+K)/P_h - f(1-P_h)/P_h < I/P_h + F$ as indicated in the figure. This inequality is the first part of Assumption 2.

Figure 2 summarizes the results of Proposition 3 in terms of expected social surplus. Under the assumptions of our analysis, a cooperative is less profitable than a private investor-owned firm when the returns of the processing activity are relatively high. Thus, at R_p there is a discrete jump in social surplus as project returns are reduced slightly, and

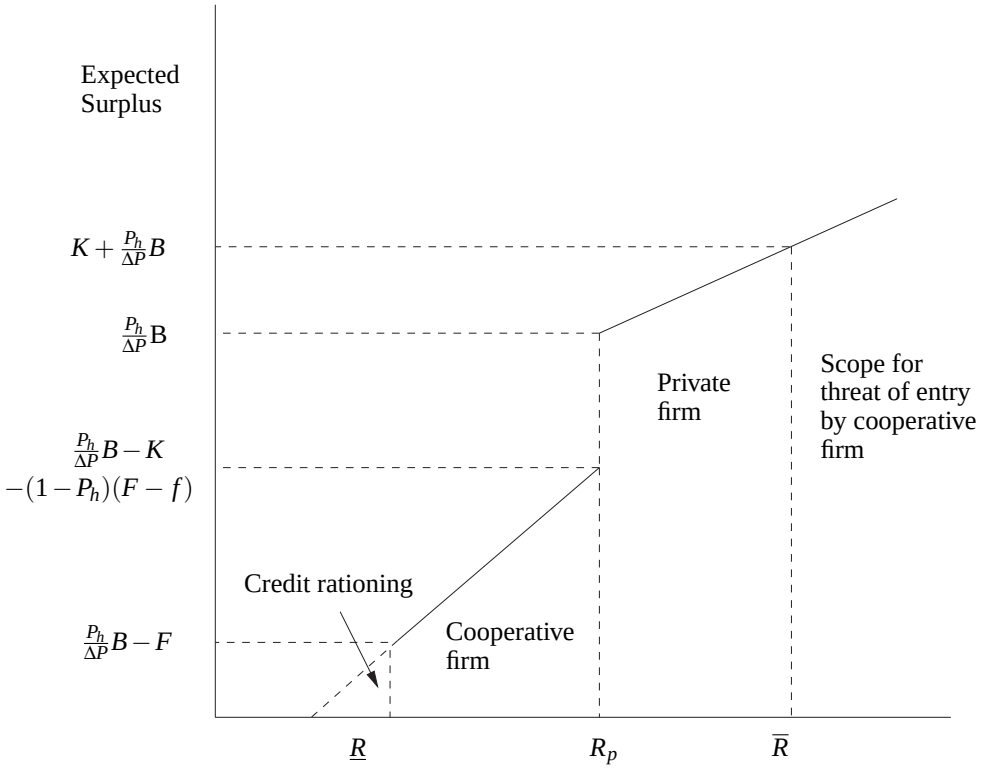

FIGURE 2. Expected social surplus and equilibrium organizational structure as a function of market returns, *R*.

the only feasible organizational structure is the cooperative. Moreover, as returns fall still further, the rate of decrease in expected social surplus is greater in the cooperative organization than in a private firm (at higher *R*); this is because in addition to the loss in social surplus resulting from a reduction in *R*, farmers must pledge additional assets which generate a further deadweight loss. When returns are sufficiently low, some credit rationing can appear as farmers cannot credibly commit to repaying loans to lenders.

The results of Proposition 3 suggest that cooperatives with asset pledging tend to emerge not because farmers choose to develop a product with high returns (i.e., a high *R*) but rather because they are the only feasible organizational structure. One possible implication is that cooperatives be relatively preponderant in low-return segments of the agricultural sector. Parliement et al. (1990) provide some evidence that seems consistent with this prediction. In particular, they note that dairy cooperatives tend to concentrate

their activity in the low-value fluid milk segment of the industry. Stafford and Roof (1984) make a similar observation.

The cost of collective decision making plays an important role in our analysis. If a cooperative organization is to be feasible, it must choose a venture in which these costs are relatively low. Empirical observations by Zusman (1982) and Fulton (1990) show that New generation cooperatives (NGCs) are usually devoted to one commodity and therefore tend to have less conflict of interest than private, investor-owned firms, which tend to be involved in multiple commodity segments.

Interestingly, the farmer-specific valuation also matters in our analysis. Indeed, a higher F relaxes the incentive constraint even if the pledged assets have a small tradable value. Thus, these assets are likely to be included in the loan agreement. Cook and Iliopoulos (1999) suggest that most of the recent cooperative formation in the Upper Midwest have adopted NGC-like organizational characteristics. One of the most recurrent characteristics is a minimum up-front investment. Increases in the financial value of the collateral, f, and the level of informational rent also favor existence of the cooperatives with asset pledging. An increase in information rents makes the provision of incentives through asset pledging more important, and increases in f reduce the deadweight cost of using these incentives.

Finally, Proposition 3 emphasizes that cooperatives can only be viable when the extra organizational costs associated with the cooperative activity, $K + (1 - P_h)(F - f)$, are small relative to information rents that must be paid to the private investor, $BP_h/\Delta P$. The existence of cooperatives thus relies on the ability of farmers to internalize information rents as a source of revenue for the processing firm. Processing cooperatives as such represent a means by which farmers perform vertical integration. The cost of this form of vertical integration is the deadweight loss of collective decision making and the cost of exposing farm assets that have a specific value to the possibility of seizure by a third party.

Conclusion

This paper examines the motivation for cooperative formation in agricultural markets. Our principal aim is to provide an explanation for the observation that cooperatives sometimes form in response to the exit of an investor-owned firm. Our explanation relies on two key ingredients that we treat as maintained hypotheses in our analysis. First, there is moral hazard in farming: the quantity and quality of farm output is uncertain, and depends to some extent on the unobservable actions of growers. Second, the cooperative organizational form entails a deadweight loss relative to an investor-owned organization.

Moral hazard in production implies that in addition to the resource costs associated with farm production and processing, an informational cost must be collectively borne by farmers and the processing firm. There is sufficient revenue to cover both forms of cost when market returns associated with the processed output are sufficiently high. In this case, it is efficient for processing to be undertaken in an investor-owned firm because doing so avoids the deadweight loss associated with the cooperative form.

However, when market returns are sufficiently low, there may be insufficient resources to provide an incentive for growers to work hard. An alternative to rewarding growers for good performance is to punish them for poor performance. One way this can be accomplished is to require that their assets be seized when there is a "project failure." Of course, this is a costly means of providing incentives, because the farmers must bear considerable risk, and in the event assets are actually seized, society bears a deadweight loss associated with the transfer of farmers' assets. Nevertheless, we show how in some market environments this may be the only feasible means of implementing socially efficient actions.

We note how farmers who choose to engage in cooperative activity are often required to contribute an up-front investment that leverages their farm assets. This is particularly true when farmers acquire abandoned investor-owned capacity. Our analysis suggests one possible rationale for this observed behavior. Intuitively, by leveraging their farm assets,

and hence increasing the negative consequences of "project failure," farmers reduce the cash amount they must pay for incentive reasons in the case of "project success." Asset pledging of this sort effectively increases the range of feasible projects. Our contribution is thus to point out that cooperatives increase farmers' liability in the case of firm failure and that this potentially expands the scope of the firm's activity.

However, we are unable to explain why similar outcomes cannot be achieved *within* a private firm by having farmers pledge their assets to a third party. Even if it seems reasonable to suppose that farmers who pledge assets to finance a risky project will exercise some degree of managerial control over the project (and hence govern "cooperatively"), the reason remains to be explained. One possibility is that a third party introduces the chance for collusion and moral hazard among private investors and the third party. Similarly, the presence of private information and the need to bargain over the distribution of surplus between the relevant parties may introduce inefficiencies that can be somewhat mitigated by the cooperative organization. Alternatively, Martinez (1999) notes that private processors in the livestock sector effectively leverage their *own* assets by using procurement contracts with farmers (who purchase or own land and equipment), rather than self-producing the farm input. To the extent that the capital purchases of farmers are debt-financed, this is potentially another way of effectively implementing the incentives that occur in our model. If so, then the cooperative organization can be viewed as just one of many possible means of achieving the outcomes that are possible with asset pledging. Although we do not address these questions in in our analysis, they certainly warrant further thought and represent a useful direction for future research.

Endnotes

1. The general trade-off between vertical integration and separate ownership has been emphasized by Williamson (1985), who argues that vertical integration tends to weaken incentives but improve the quality of information available for decision making. In contrast, as we will show, "vertical integration" in our analysis involves an exchange of an organizational deadweight loss for improved incentives.

2. For evidence of moral hazard in settings with both private and cooperative agricultural processing firms, see Hueth and Melkonyan 2004; Hueth and Ligon 1999; and Knoeber and Thurman 1985.

3. The results of this regime are a simple version of those in Sexton and Sexton 1987, where cooperative activity provides a degree of yardstick competition in an oligopoly market.

4. Farmer heterogeneity is clearly a source of friction within the cooperative governance structure and potentially a source of inefficiency relative to a non-farm investor-owned firm. In order to focus our analysis on the potential benefits, rather than the costs, of the cooperative structure, and to keep our model tractable, we do not model this heterogeneity explicitly.

5. This assumption is made for simplicity; the extension to the case in which the processing facility has some salvage value is immediate.

6. The term "quality" here is used for expositional ease. Output quantity and possibly delivery timing are other attributes of farmers' output which may be stochastic and influenced by unobserved actions of the farmer. The important point is simply that there is an incentive problem, and that farmers must be rewarded for performance.

7. See Chan and Kanatas 1985 who also study financial contracting with discrepancy in valuation between lender and borrower.

8. New generation cooperatives have several other organizational features in addition to the requirement of significant equity contribution by farmers. Perhaps the most important of these is that members have tradable (and appreciable) delivery rights associated with their equity participation. The tradeability of delivery rights seems to play an important role in

addressing conflicts among members with hetergeneous organizational tenure (i.e., the "horizon problem"). For a recent formal treatment of the horizon problem in cooperatives, see Rey and Tirole 2001.

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