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# COOPERATIVE RISK MANAGEMENT: RATIONALE AND EFFECTIVENESS

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# Cooperative Risk Management:

# Rationale and Effectiveness

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**Cooperative Risk Management: Rationale and Effectiveness**

**Abstract:**

Agricultural cooperatives tend to be riskier than investor-oriented firms, both in a business and financial sense. However, cooperative managers are often reluctant to actively manage risk. Although the "risk management irrelevance proposition" suggests that cooperative managers should be unable to add shareholder value through risk management activities, this study argues that there are several reasons why this is not likely to be the case for cooperatives. Several empirical examples are provided through numerical simulation of pro-forma financial statements from representative agricultural cooperatives. Using mean variance, expected utility and value-at-risk metrics, the results of these simulations show that various risk management strategies can improve the risk-return profile of a typical cooperative.

**keywords:** cooperative, expected utility, futures, option, risk management, value at risk.

## Introduction

Agricultural cooperatives operate in a business environment that is inherently risky. In fact, because most cooperatives tend to be relatively narrowly focused on a particular commodity, region, or level of the marketing channel they tend to have a relatively high degree of business risk compared to investor-oriented firms. Moreover, limited access to public equity markets and the requirement to return earnings to members often mean that cooperatives are highly leveraged and, hence, have greater financial risk than investor-oriented firms. It is perhaps surprising, therefore, that many cooperative managers tend to accommodate, rather than actively manage, the various sources of risk that they face (CoBank).

Investor-oriented firms often justify their lack of risk management strategies on the basis of the "risk management irrelevance proposition" (RMIP). The RMIP states that "...a firm cannot create value by hedging risks when it costs the same for the firm to bear these risks directly than to pay the capital markets to bear them" (Stulz). If shareholders can manage risks by hedging on their own account, then attempts to manage risks directly are largely redundant (Modigliani and Miller; Miller and Modigliani (MM)). As a result, risk management activities cannot be undertaken by management to improve shareholder wealth. This proposition, however, is based on a highly restrictive set off assumptions. If these assumptions are relaxed, however, there are several means by which firms can add value by actively managing risk (Cummins, Phillips and Smith; Smith and Stulz; Smithson). Of perhaps greater importance to agricultural cooperatives, many of these value-adding mechanisms are particularly effective within the context of cooperatives' unique member-owner structure. Specifically, there are at least five major reasons why firms actively manage risks: the existence of non-tradable risks, mitigation of financial distress and the cost of bankruptcy, reduction of tax burden, increased debt capacity

and avoidance of external financing. While there is some empirical evidence that these sources of value can indeed arise among investor-oriented firms, for cooperatives they remain largely theoretical in nature (Mian).

The objective of this research, therefore, is to determine whether well-designed risk management strategies can create value for agricultural cooperatives. By simulating various transactions using real-world financial data from a set of representative U.S. dairy cooperatives, this study shows that it is indeed possible to improve the risk-return profile of a typical cooperative through a variety of common risk management techniques. Further, given the relatively wide size-dispersion among cooperatives, this research shows that the incentives to manage risk, and preferred risk management strategies, differ among cooperatives depending on size.

Many of the risk management strategies examined are already available to cooperative managers (e.g., exchange traded derivative products), but others utilize either relatively new exchange traded instruments or innovative over-the-counter arrangements like revenue swaps, forward contracts, and other contracting arrangements. The relative effectiveness of each strategy is compared using a variety of measures. Assuming cooperative managers are motivated by risk and return objectives, but are sensitive to the size and probability of downside risks, the measures consist of: (1) expected utility of profit, (2) a mean-variance utility measure and (3) a value-at-risk (VaR) calculation based on the 5% tail of return on assets (ROA).

In answering these questions, the next section provides an explanation as to why cooperatives are inherently more risky than investor-oriented firms and how this risk can be mitigated through active risk-management strategies. The following section presents the empirical expected-utility models used to evaluate alternative risk-management strategies, while

the third describes the data used to calibrate each model. A fourth section presents the findings and discusses some of the implications for cooperative risk management strategy while the concluding section offers some extensions to managing risks among agribusinesses more generally defined.

**Sources of Cooperative Risk and Risk Management Objectives**

It is somewhat ironic that agricultural producers tend to join cooperatives because they are risk averse and perceive benefits in a risk-sharing arrangement, but cooperatives themselves tend to face more sources of both business and financial risk than investor-oriented firms. There are several reasons why this is the case. First, many cooperatives operate under pooling arrangements wherein all of a member's commodity must be sold within a given time-frame. While individual members are relieved of the need to "time the market," pooling arrangements reduce the flexibility to store commodities and sell outside of the pooling period. Second, cooperative members have access to insurance markets, both government and private, as well as futures and options markets, so cooperative managers often regard risk management as a task that is more appropriate for individual members rather than the cooperative as a whole. Moreover, cooperatives tend to operate in low-margin, commodity-based markets, so do not benefit from the stability of retail or even processing margins. Similarly, most small cooperatives tend to operate in narrowly defined geographic, product or enterprise markets so are less diversified than other investor-oriented businesses. Although relatively small in total value of output, many agricultural cooperatives trade in commodities for which there are no futures, options, nor insurance markets such as fruits, vegetables, or specialty horticultural crops. These firms simply have no opportunity to manage risk using market-based tools.

In addition to these likely sources of business risk, cooperatives may also be subject to a greater degree of financial risk compared to investor-oriented firms. Clearly, the requirement to return earnings to members and the reluctance to issue public equity capital referred to above means that cooperatives tend to be overly reliant on debt financing, thus causing them to be more highly leveraged than would otherwise be the case. Second, all agribusinesses face commodity futures trading regulations that exclude them from using swaps and other over-the-counter (OTC) derivative instruments that are becoming increasingly popular among other commodity-based firms.[1] Third, agricultural cooperatives are also subject to Financial Accounting Standards Board (FASB) rule 133, which specifies that certain derivative products must be "marked to market" or valued on company financial statements at the current market value. Because this rule can create a significant tax liability, many risk-management products are typically written into supply contracts rather than entered into explicitly. Third, the cooperative principles of "user-ownership" and "user-benefits" mean that the success of the cooperative and owner are inextricably linked. Volatility in cooperative financial performance, therefore, can actually increase the riskiness of returns to a producer's entire operation. Fourth, given the recent negative experience that many smaller cooperatives have had in using exchange-traded risk management tools, they are often reluctant to use the strategies that are available to them (Baumel and Lasley). Clearly, therefore, if cooperative managers can effectively mitigate risk, there is likely a large, latent demand for risk management products.

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[1] In the fall of 1998, the Commodity Futures Trading Commission (CFTC) issued a set of rules, after much deliberation and comment by agribusinesses, that established a system of agricultural trade options (ATOs) whereby qualifying agribusinesses could trade over the counter derivative products on otherwise enumerated commodities if they met certain activity rules, size restrictions, and behavioral limitations. To date, the number of ATO merchants (ATOMs) and volume in this market is virtually zero.

Consequently, it is perhaps fortunate that the RMIP is less likely to hold among cooperatives than investor-oriented firms. The first reason why this is so relies on the notion that some risks are "non-tradable" due to information inefficiencies between owners and management. Because cooperatives do not issue publicly traded stock, member-owners do not have the same ability as common shareholders to diversify their risk exposure. In essence, cooperative managers can provide a service to member-owners by engaging in active risk management activities on their behalf.

In addition, firms engage in risk management activities to mitigate the effects, in particular the costs, of financial distress (Smith and Stulz). Thus firms that reduce the variability of their cash flows through risk management may avoid costs associated with bankruptcy such as legal fees, regulatory costs, as well as indirect costs resulting from the deterioration of relationships between the firm's suppliers and customers (Cummins, Phillips, and Smith). This is especially true for cooperatives, given their typically high debt-to-asset ratios.

Third, firms that can reduce the variability of income through risk management may also reduce their overall tax burden over time. Due to the convexity of corporate tax schedules created by inherent progressivity and tax preference items, firms can reduce their average tax payment by shifting income from high-tax to low-tax years. U.S. cooperatives can exploit this opportunity better than other firms because they are exempt from corporate taxes on only a portion of their income.

Similarly, by reducing the volatility of interest-coverage, cooperatives can increase their debt capacity, thereby taking advantage of a larger tax-shield on interest payments each year (Stulz). Finally, in a related point, risk management can may arise due to the firm's desire to avoid costly external financing. By reducing risk, cooperatives are able to increase their debt

capacity and, therefore, the ability to fund positive net present value products without new equity capital – a real benefit given the inherent capital constraints that cooperatives face. Thus in many ways, the relevance and importance of risk management is likely greater for cooperatives compared to investor-oriented firms given both their limited access to capital and unique attributes of their business and financial risk profiles. It remains, however, to show that this is the case in practice.

**Empirical Model of Cooperative Risk Management**

Dairy cooperatives provide a good opportunity to study the impact of risk management on financial performance because they tend to face both input and output price risk, the production technology is relatively standard and well-understood and cooperative managers have, for the first time in decades, a variety of market-traded risk management products. In order to create a model of financial performance that is tractable, yet still captures the fundamental sources of risk faced by dairy cooperatives, we assume that cooperatives purchase a fixed amount of fluid milk ($x$), process it, and sell an amount of cheese ($q = \alpha x$) into cash cheese markets.[2] Further, cooperative managers have three means by which they can augment net income earned from the spot, or cash market ($\pi_S$): (1) hedging either fluid milk, cheese, or both ($\pi_F$), (2) buying put and call options on cheese and milk, respectively ($\pi_O$), and (3) forward contracts with retail buyers and / or milk suppliers ($\pi_T$). Further, cooperative managers are assumed to maximize the expected utility of member surplus. For cooperative members, surplus includes both the profit

[2] In the U.S., producers sell milk to processors for end-use either as Class I (fluid), Class II (soft manufactured products such as yogurt or ice cream, Class III (cheese), and Class IV (butter and non-fat dry milk solids). The cheese production technology is assumed to be Leontief, with input-requirements coefficient $\alpha$.

of the firm (producer surplus) and the surplus they receive as patrons (consumer surplus). Assuming that cooperative members sell into competitive commodity markets, however, the welfare maximization assumption is equivalent to one in which cooperative managers maximize the expected utility of profit only from the cooperative level.

Total cooperative profit, therefore, can be written as a composite of four market activities (Wang et al):

$$\pi = \pi_S + \pi_F + \pi_O + \pi_T, \tag{1}$$

where: $\pi_S = p_S q - w_S x - c(q)$, is the profit from cash market sales at cheese price $p_S$, fluid milk price $w_S$ and processing cost $c(q)$. Futures profits, meanwhile, are given by:

$$\pi_F = h_c(p_F^0 - p_F^1) + h_w(w_F^1 - w_F^0), \tag{2}$$

where $\pi_F$ is the return from hedging $h_c$ cheese contracts, and $h_w$ fluid milk contracts that are set at futures prices $p_F^0$ and $w_F^0$ and lifted at $p_F^1$ and $w_F^1$, respectively. Options markets profits depend on the relationship between futures and strike prices for cheese ($s_p$) and milk ($s_w$) and are written:

$$\pi_O = z_c[\max(0, s_p - p_F^1) - V_c] + z_w[\max(w_F^1 - s_w, 0) - V_w], \tag{3}$$

where $z_c$ is the number of cheese options purchased at a premium $V_c$, and $z_w$ is the number of milk options purchased at a premium $V_w$. Unlike either futures or options transactions, however, forward contracts replace the alternative cash market transaction so that, in the framework of (1), forward profits are given by:

$$\pi_T = f_c(p_T - p_S)q - f_w(w_S - w_T)x, \tag{4}$$

where $f_c$ is the proportion of all cheese production sold forward and $f_w$ is the proportion of all milk requirements purchased forward. Notice that, based on (4), either a higher cheese price ($p_T$) relative to cash, or a lower milk price ($w_T$) will generate higher profits. All prices, however, are assumed to be random variables.

Given that realized profit is inherently uncertain, and the plausible assumption that cooperative members are typically risk averse, cooperative managers choose the amount of cheese to sell and milk to buy in the spot market, the number of futures contracts, the number of options and the proportion of milk to buy or cheese to sell forward in order to maximize members' expected utility of profit. Given its widespread use in modeling the impact of risk aversion on optimal choice under uncertainty, the utility function is of negative exponential form:

$$U(\pi) = k_0 - k_1 e^{-\rho\pi}, \tag{5}$$

where $k_0$ and $k_1$ are constants that are calibrated according to an algorithm described below and ρ is the coefficient of risk aversion. The utility function in (5) is assumed to be increasing, concave and exhibit constant absolute risk aversion (CARA). Defining the joint distribution of all prices as $\phi(p_0, p_F, p_T, w_0, w_F, w_T) = \phi(\boldsymbol{p}, \boldsymbol{w})$ the cooperative manager's problem is written as:

$$\max_{d} E[U(\pi)] = \max_{d} \int_0^\infty \int_0^\infty U[\pi(\boldsymbol{p}, \boldsymbol{w})]\, \phi(\boldsymbol{p}, \boldsymbol{w})\, d\boldsymbol{p}\, d\boldsymbol{w}, \tag{7}$$

where $\pi(\boldsymbol{p}, \boldsymbol{w})$ is annual profit and d is the vector of risk-management decision variables, ($s$, $h$, $z$, $f$). Expected utility alone, however, has several disadvantages as a comparative metric if risk-

management program effectiveness. * to here - describe CE, VaR, Sharpe.  Note: EV objective function (Sharpe) assumes normality - we don't.

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