Agricultural Cooperatives and Risk Management: Impact on Financial Performance

Mark R. Manfredo
Assistant Professor
Morrison School of Agribusiness and Resource Management
Arizona State University
Email: manfredo@asu.edu

Timothy J. Richards
Associate Professor and Power Professor of Agribusiness
Morrison School of Agribusiness and Resource Management
Arizona State University
Email: trichards@asu.edu

Scott McDermott
Business Advisory Services
Co-Bank
Denver, CO.

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Abstract

Agricultural cooperatives, like all agribusinesses, operate in an inherently risky environment. Many risk management tools exist, but agricultural cooperatives have been slow to adopt sophisticated risk management practices. Using simulation methods, this paper presents insight into how both traditional and innovative risk management practices effect the distribution of key financial variables for agricultural cooperatives.

Introduction

Agricultural cooperatives, like all agribusinesses, operate in an inherently risky environment. While many investor owned agribusinesses have embraced both the use of traditional (e.g., futures and options) and innovative risk management tools (e.g., swaps and other over-the-counter instruments), agricultural cooperatives, especially smaller, regional cooperatives with commodity specific focuses, have been slower in their adoption of modern risk management practices. While certainly not ignoring risk, most cooperatives have chosen a path of risk accommodation, in particular through the holding of internal capital reserves, versus that of active risk management. This practice, however, is particularly costly for cooperative members since coops tend to be relatively capital constrained due to their lack of access to public equity markets and their requirement to eventually pay out all earnings (Richards and Manfredo). Thus, capital tied up in non-productive uses can be expensive, particularly during times of high interest rates. As well, given the recent period of low commodity prices, many cooperatives are now experiencing a greater need for efficient risk management tools and practices. While both traditional and innovative risk management tools provide cooperative managers opportunities to augment their risk exposure, and subsequently the risk exposure of their members, managers often avoid these tools due to lack of information regarding their risk-return characteristics. Since this lack of information is likely to be a constraint, research and communication should aid in the adoption of active risk management and eventually improved financial performance for agricultural cooperatives.

Therefore, the objective of this research is to compare and rank several alternative risk management techniques according to their ability to provide an optimal risk-return tradeoff for US agribusiness enterprises. Specifically, this research conducts simulations on how various risk management tools and strategies influence the ultimate financial performance of grain merchandising cooperatives of different size based on total coop revenue. In doing this, we focus on several traditional and innovative strategies including futures and options hedges, an over-the-counter revenue swap, an insurance product to protect against shortfalls in coop throughput, as well as combinations of these strategies. A variety of metrics are also used in evaluating these strategies. Broadly, the set of metrics used include a ranking based on expected return only, Value-at-Risk (VaR), the Sharpe Ratio, and a stochastic dominance measure. Using this spectrum of evaluation procedures (Gloy and Baker) helps to examine these risk management procedures under both simple, intuitive metrics (e.g., VaR) as well as traditional mean-variance measures (e.g., the Sharpe Ratio and stochastic dominance). Further, if there is strong agreement in the rankings implied by each of these measures, this will provide evidence as to the superiority of one risk management strategy relative to another.

Data and Methods

To evaluate alternative risk management strategies, and how they influence the financial performance of cooperatives of different size, a stochastic simulation exercise is conducted using the *@RISK* simulation software ad-in for Microsoft Excel. The following section explains the methodology, assumptions, and data requirements needed for conducting these simulations. Specifically, we describe 1) the development of representative coop financial statements for cooperatives of different size, 2) the determination of risk factors to model in a stochastic simulation framework, 3) the specific risk management strategies employed, and 4) the evaluation procedures used.

Representative Cooperatives

Data provided by Co-Bank are used in creating representative income statements for grain merchandising cooperatives of different size. The Co-Bank data contain financial information of cooperatives that borrow from Co-Bank. These data are used to fulfill required loan documentation, and are also used in developing internal credit scoring models. These data are self-reported by the cooperatives to Co-Bank. Cooperative names are not identified in the database. The data span the time period from 1992 to 2002, and reflect an unbalanced panel in that some firms do not report every year and/or drop out of the database. All data are annual financial data commonly found in a firm’s income statement and balance sheet. Given that most firms have different fiscal years, the financial statement data are not uniform in when they are reported. For grain merchandising cooperatives (SIC 5153), the quantity of cooperative throughput for major commodities sold are also reported for most firms. Thus, in building the representative cooperatives, only firms which reported quantity numbers are used.

Three sizes of grain merchandising cooperatives are examined, with the size categories determined by total revenue for the firm: total revenue less than \$10 million, total revenue between \$10 million and \$50 million, and total revenue greater than \$50 million. The income statements (abbreviated), the average throughput for major commodities (corn, wheat, and soybeans), and total assets are shown for each of the cooperative size categories in Tables 1 and Table 2. For each of the financial variables, and for the quantity numbers, these data reflect the numbers for an "average firm" in that size class. Note, given that we construct the income statements for the average firm, we assume that the average grain cooperative markets all three of the major grain commodities: corn, wheat, and soybeans commensurate with the average quantity marketed by all firms in the panel.[1]

In determining how various risk management strategies effect financial performance, we focus on the Return on Assets defined as Local Savings / Total Assets. In essence, Local Savings is the same as Earnings Before Taxes (EBT) for investor owned firms, and provides an indication of profitability of the cooperative before the inclusion of patronage income and other income and expense categories. Hence, ROA as defined here more appropriately reflects the operating performance of the cooperative. Furthermore, given that ROA is expressed in a percentage form, it is a measure that is easy to compare across firm sizes, and accommodates the evaluation procedures where a return measure is needed (e.g., Sharpe's Ratio).

[1] It may be the case, due to geography, that a grain merchandising cooperative has a more limited scope in the grain marketed than the diversified grain cooperative presented. For instance, a grain merchandising cooperative in Kansas may only market wheat and not soybeans and corn.

Stochastic Simulation Using @RISK

Stochastic simulation is used to determine how various risk management procedures effect financial performance measures of grain merchandising cooperatives of different size. Specifically, we use the *@RISK* add-in software (Palisade Corporation).[2] *@RISK* allows the modeler to specify certain input variables as stochastic. Monte Carlo simulation techniques are then used to draw observations from the designated input distributions. The simulation is conducted many times, in this case 5,000 times, and the distribution of the output variables of interest are examined (e.g., ROA).

To best illustrate how this stochastic simulation works, it is necessary to first describe the cash only (benchmark) strategy used. Here, the cash only strategy assumes that no risk management takes place, and that the cooperative sells their respective throughput solely in the cash market. Referring to Table 1, Sales of Commodities and Grain (Sales_Commod) is modeled as:

(1) Sales_Commod = (Cash Corn Price) x (Bu. Corn Sold) + (Cash Wheat Price) x (Bu. Wheat Sold) + (Cash Soybean Price) x (Bu. Soybeans Sold) .

Subsequently, the cash prices for corn, wheat, and soybeans (commodity i) are defined in the model as:

(2) Cash Price (i) = Nearby Futures (i) + Nearby Basis (i) .

The nearby futures and nearby basis are defined as stochastic inputs in *@RISK*, which ultimately makes the cash prices stochastic as well. In determining an appropriate distribution to use for

[2] Another well-known program, Crystal Ball, allows for the modeling of stochastic input variables in a spreadsheet framework and is a major competitor to the *@RISK* program.

nearby futures and nearby basis in the simulation, the *Best Fit* program is used. *Best Fit* performs as series of goodness-of-fit tests and ranks how well alternative distributions fit the appropriate input data. The data used here are weekly (Wednesday) nearby futures for corn, wheat, and soybeans from the Chicago Board of Trade (CRB/Bridge Database) from 1980 to 2001. As well, in estimating the appropriate nearby basis distribution, cash prices are needed. The cash markets for corn and soybeans are Central Illinois (#2 yellow corn and #1 yellow soybeans respectively), and the cash market for wheat is St. Louis (#2 soft red). These data are also included in the CRB/Bridge Database, and are the same as the cash prices reported daily in the *Wall Street Journal*. The cash data also reflect Wednesday prices from 1980 to 2001. In fitting distributions for nearby futures and basis, the time period of historical data used here is important. During this time period, prices for all commodities realized both extreme highs (e.g., 1995/1996) and extreme lows (e.g., 1999/2000). While basis conditions certainly vary due to geography, the use of these cash prices are still useful in modeling basis, and help in the consideration of basis risk in simulating the futures and options strategies. Ultimately, the simulation could be modified to reflect local conditions by using local cash data to model basis.

Coop throughput of these commodities is also variable, and this variability of throughput could definitely influence the distribution of coop revenue and ultimately ROA. Given this, coop throughput for each commodity (i) is modeled as:

(3) Bu. Sold (i) = Average Bu. Sold (i) x (1+% Difference from National Average Utilization (i)),

where the Average Bu. Sold (i) reflects the average coop throughput for a given commodity as calculated from the Co-Bank data. Equation (3) also assumes that the Bu. Sold (i) varies with the national utilization of the commodity. Hence, an input distribution for utilization of each commodity is fitted to its respective national historical utilization data. This annual utilization or disappearance data is taken from the *ERS Feed Grain Yearbook* (Corn), *ERS Wheat Yearbook*, *ERS Oilseeds Yearbook*, and various issues of the *ERS Agricultural Outlook* publication for the years 1980 – 2001. From this data, average utilization is calculated, and subsequently, with each draw from the utilization distribution defined, the percent difference from the national average utilization is calculated.

We also consider the correlation relationships between grain prices, grain production, and utilization.[3] For instance, if there is large production in a particular crop year, lower prices are likely to be realized and visa-versa. *@RISK* has the capability to correlate variables within the simulation. For example, when *@RISK* makes random draws from both the corn price and corn production distributions, the price and production numbers will be drawn such that this correlation holds. The ability to correlate these key variables brings considerable reality to the model, and also takes into consideration the "natural hedge" that takes place when low (high) production and high (low) prices are realized. While the data used in fitting the price and utilization distributions have already been described, the data used to fit the production distributions for each commodity are taken from *USDA/NASS Crop Reports Track Record Database* for 1980-2001. Table 3 shows the correlation matrix used in the @RISK simulation.[4]

Finally, it is necessary to consider how the Cost of Sales of Commodities and Grain (COG_Commod) behaves in the simulation. Here, we assume that COG_Commod will vary with coop throughput given that costs of goods sold reflect variable costs which are tied to the volume of throughput. To model the changes in COG_Commod with coop throughput, the

[3] Given that utilization was used as the stochastic variable driving the changes in throughput of commodities, we also included utilization in the correlation matrix. However, national grain prices and national grain production are likely to have more significant correlations.
[4] Note: in defining the correlation matrix, average yearly cash prices for grain as reported by USDA/NASS are used instead of nearby futures prices to be consistent with the yearly data used for commodity utilization and production.

percentage change in average coop throughput is calculated and multiplied by average COG_Commod in the income statement such that:

(4) COG_Commod = Avg. COG_Commod x (1+% difference from average coop throughput).

For example, for grain marketing cooperatives with total revenue less than $10 million, the average coop throughput (all grains combined) is 2,125,298 bushels. When the @*RISK* simulation is run, based on the utilization distributions, coop throughput for each commodity will change, and subsequently total coop throughput will change. If total coop throughput on a particular iteration is 2,000,000 bushels, then the % change from the average throughput would be – 5.9%: (2,000,000 –2,125,298)/2,125,298. This provides a direct relationship between changes in coop throughput and changes in the cost of goods sold for commodities (COG_Commod). For the cash only strategy presented, when a simulation is run, it is possible that Sales_Commod is quite high, but COG_Commodities is low during a particular iteration. This would reflect the unique occurrence of both low coop throughput (thus low variable costs) and high commodity prices. Ultimately, this phenomenon will be captured in the distribution of Gross Margin, Operating Profit, and Local Savings, which are additive entries in the income statement (Table 1).

Risk Management Strategies

The cash only strategy described above is used as the baseline strategy in comparing the effects of alternative risk management strategies on the distribution of cooperative ROA. The following risk management strategies are examined, and described in more detail below: 1) routine and selective hedging with futures, 2) routine and selective purchasing of at-the-money put options to establish a floor price for a commodity, 2) an over-the-counter revenue swap, 4) throughput insurance, and 5) combinations of price and insurance strategies.

Futures Strategy

A grain marketing cooperative can manage price risk of their throughput using a straight futures market hedge by taking a short position in the futures market (selling futures). Although this strategy can theoretically lock in a selling price for grain, the cooperative is still subject to considerable basis risk if the cash-futures price relationship changes significantly from when the hedge is set to when the hedge is lifted. In the simulation, the futures hedge is modeled as:

(5) Final Price Received (i) = Cash Price (i) + [Beginning Futures Price (i) – Ending Futures Price (i)].

So, the "cash price" of commodity (i) in equation (1) is replaced by the "final price received" in equation (5) when the futures hedge is simulated in *@RISK*. Again, as was shown with the cash only strategy, cash price is defined as futures (ending) + basis. Also, there are separate distributions defined for both beginning and ending futures. Therefore, when a simulation is conducted, the futures price drawn from "beginning futures price" and "ending futures price" are independent, so there will be either a decrease or increase in futures price of "ending futures" relative to "beginning futures".

Two different futures strategies are examined. First, a routine futures hedging strategy is simulated such that a short position is taken in "beginning futures" regardless of the price that *@RISK* pulls from the "beginning futures" distribution. Second, a selective hedging strategy is examined where a short position is established only if the beginning futures price is greater than or equal to the long-run average nearby futures price over the sample period 1980 – 2001 (corn = $2.61/bu., wheat = $3.51/bu, and soybeans = $6.28/bu). The routine futures strategy is named *Futures* and the selective hedging strategy is named *Futures – TR* in Tables 5 through 7.

<u>Options Strategy</u>

The option strategy simulated is a simple put option strategy (purchasing an at-the-money put option). The purchasing of put options allows the cooperative to hedge against price declines, but allows the cooperative to take advantage of gains in the cash price if realized. Still, the cooperative can be exposed to considerable basis risk which can greatly influence the final price received with an options hedge. Equation (6) defines the final price received using this put option strategy (buying a put).

(6) if Strike (i) > Ending Futures (i), then:

Final Price Received (i) = Cash Price (i) + (Strike(i) – Ending Futures(i)) – Option Premium (i)

and,

if Strike (i) <= Ending Futures (i), then:

Final Price Received (i) = Cash price (i) – Option Premium (i)

where again (i) denotes the commodity of interest (corn, wheat, or soybeans).

Option premiums are simulated using *Financial Cad* (*FinCad*). *FinCad* is a spreadsheet ad-in program which allows for the pricing of a number of financial derivative products. Specifically, we use the Black-1976 model for estimating premiums for options on futures contracts. The inputs into this option pricing formula include the strike price, the underlying futures price, the time to expiration, the risk-free rate of interest, and the volatility of the underlying futures price. Since the risk-free rate of interest has a very minor influence on option premiums, it is set at a fixed 3%, which is reasonably consistent with today's interest rate environment. The volatility used is the average annualized historical volatility of nearby futures prices from 1980 to 2001. This historical volatility data is taken from the Chicago Board of Trade and is available for each commodity (corn = 0.17, wheat = 0.202, soybeans = 0.187). Furthermore, we allow the time to expiration to be stochastic in the simulation, ranging anywhere from 14 to 250 days to expiration. This provides for varying values of the option premium, and thus allows us to make more general statements about the efficacy of option strategies given that we do not designate a specific time horizon for any of the hedging strategies examined, unlike what would be done for a pre-determined, pre-harvest strategy that an individual producer might engage in (AgRisk; Gloy and Baker).

As with the futures strategies above, we allow for the routine purchase of puts (*Put Options*) and also establish a trading rule where put options are only purchased if the strike price is greater than the long-run average nearby futures price (*Put Options – TR*). All put options are "at-the-money", where the strike price is equal to the beginning futures.

Revenue Swap

The next strategy examined involves an over-the-counter revenue swap between the grain merchandising cooperative and an end-user of the commodity. These two counterparties' economic interests are nearly exactly opposite, so are naturals to enter into an agreement to offset each other's losses in the event of a revenue shortfall caused by variability in prices and/or volume of grain marketed.

The revenue swap is structured as follows. First, it is assumed that the two parties agree upon a set amount of commodity to be marketed, along with a set price, where the amount of commodity marketed is equal to average coop throughput and the price is equal to the long-run average price. This establishes a benchmark value for revenue. When a simulation is run in *@RISK*, if the actual prices and/or throughput cause revenue to fall below the benchmark value, then the end-user will pay an amount equal to the shortfall to the cooperative. However, if throughput and/or prices rise such that the cooperative has more revenue than expected, the cooperative will compensate the end user the difference between the two. This transaction essentially locks in both the end-user's cost and the cooperative's revenue. The revenue for a particular commodity (i) under the revenue swap is:

(7) Revenue (i) = Cash Price (i) x Bu. Sold (i) + [Benchmark Value – (Cash Price (i) x Bu. Corn Sold (i))] .

The revenue swap strategy is appropriately named *Revenue Swap* in Tables 5 through 7.

Throughput Insurance

The insurance product used here is modeled after the Group Risk Plan (GRP) area-yield insurance offered by the Risk Management Agency (RMA). While government sponsored yield risk insurance products are only available to farmers at this time, it is assumed that this type of insurance product is available to cooperatives, or that cooperatives can offer a federally sponsored production insurance contract to all their members. For the simulation, insurance premiums are taken from the RMA website for Effingham County, Illinois. Effingham County is chosen since GRP insurance is offered for corn, wheat, and soybeans in this county, and it is located in a major grain producing region of the Midwest. The GRP insurance information used is effective as of July 2001 and is shown in table.[5]

The following assumptions are necessary such that the characteristics of the GRP program are meaningful in the context of a cooperative. Using corn for the small cooperative (less than $10 million in total revenue) as an example, average coop throughput is converted into "average equivalent coop acres" by taking average coop throughput for corn (1,333,496 bu) and dividing by the expected county yield for Effingham County (120.3 bu) which yields 11,085 acres. Second, the guaranteed amount must be calculated. Assuming 100% protection of the maximum protection level (100% of $406.1), the guaranteed amount is $4,501,519 ($406.1 x 11,085 acres). Third, the premium is calculated by taking the guaranteed amount and multiplying it by the base premium for the desired yield election. Assuming a 90% yield election, the premium is $256,587 ($4,401,519 x 0.057). Assuming that the premiums are subsidized, the subsidy is calculated taking the subsidy factor for the desired yield election (0.55 for the 90% level) and multiplying it by the premium. Thus, the premium subsidy is $141,123 ($256,587 x 0.55). In other words, for the 90% yield election, the premiums are 55% subsidized. Given this, the total premium paid for this insurance contract is effectively $115,464 ($256,587 - $141,123). Taking the effective premium of $115,464 and dividing by the average equivalent coop acres (11,085) gives the premium per acre of $10.42, which matches the RMA premium per acre for Effingham County for the 90% yield election and 100% protection level. An indemnity is paid if the realized coop throughput on an "equivalent acre basis" is less than the yield guarantee. The yield guarantee is calculated as the yield election (90%) times the expected

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[5] See the RMA website (http://www.rma.usda.gov/) for updated information on GRP insurance, and for the updated premium and subsidy information for Effingham County, IL.

county yield (120.3) which is 108.27 bu / acre. So, if the realized coop throughput per acre is less than the yield guarantee, an indemnity (per equivalent coop acre) is paid which is equal to the percent yield shortfall, times the percent protection level, times the maximum protection level. The total indemnity would be the indemnity per acre times the average equivalent coop acres. Thus, the total revenue for commodity (i) would be:

(8) Revenue (i) = [Cash Price (i) x Bu. Sold (i)] + Indemnity – Insurance Premium.

This insurance strategy described above is used for all commodities within the representative cooperatives (corn, wheat, and soybeans). The insurance strategy is aptly named *Insurance* in Tables 5 to 7.

<u>Combination Strategies</u>

Strategies that combine both an element of price risk management (e.g., futures and/or options hedges) and the above throughput yield insurance scheme are also examined. In essence, the use of both a price hedge and a throughput hedge provides for protection against shortfalls in total revenue (Sales_Commod). The combination strategies examined include routine futures hedging and insurance (*Futures / Insurance*), selective hedging and insurance (*Futures – TR / Insurance*), a routine purchase of put options and insurance (*Options / Insurance*), and a selective options hedging strategy and insurance (*Options – TR / Insurance*).

Evaluation Procedures

Similar to the methods employed by Gloy and Baker, each of the outlined risk management strategies are evaluated using a unique set of evaluation procedures. Specifically, the metrics used here include 1) the expected return, 2) Value-at-Risk (VaR), 3) the Sharpe

Ratio, and 4) first degree stochastic dominance with a risk free asset (FDSDRA). For the expected return criteria, strategies are ranked in descending order based on ROA. Hence the strategy yielding the largest ROA would be ranked first, and the lowest ROA ranked last. The VaR measure reflects the probability that ROA will not fall below a certain percentage at a given level of confidence. Here, we use the VaR at the standard 5% level. Strategies that produce smaller VaR numbers are preferred. However, VaR only considers a "safety first" measure of risk and not the inherent trade-off between risk and return. However, the Sharpe Ratio is very similar to the common coefficient of variation, but is expressed as the average return less the return from a risk-free asset over the standard deviation of returns. For the return on the risk-free asset, we use the average 3-month T-bill rate from 1980-2001 which is 4.3% (Source: Federal Reserve Bank of Chicago). While the Sharpe Ratio provides a simple, powerful comparison criteria, it suffers from the usual criticisms of all mean-variance approaches, namely, that is assumes the distributions are entirely characterized by their first two moments. The use of stochastic dominance criteria, however, produces a relevant ranking over a broader range of distributional assumptions. Here, we follow Gloy and Baker and use a first degree stochastic dominance criteria which incorporates the ability to lend or borrow at the risk-free rate. With this measure, the density of returns (ROA) is evaluated at the risk-free rate (4.3%), with strategies being ranked from the lowest value (most preferred alternative) to the highest value (least preferred). In other words, one should choose the strategy with the lowest probability of returning at least the risk-free rate.

The use of these alternative measures are necessary for several reasons. First, managers tend to hold differing intuitive notions of risk. While measures based on statistical notions of a distribution of returns hold meaning for some (e.g. mean-variance efficiency), others are more interested in the probability of a loss. Second, some measures are easier to calculate and ultimately easier to explain to cooperative management and the coop membership. Third, if there is strong agreement in the rankings implied by each of these measures, then this provides corroborating evidence in favor of the superiority of one risk management strategy over another.

Results

For each representative cooperative (small, medium, and large), and for each risk management strategy delineated, the *@RISK* simulation is set at 5,000 iterations. This provides an adequate number of random pulls from the input distributions to provide a meaningful and consistent distribution of ROA. Furthermore, this number of iterations allows the distribution of ROA to be exposed to extreme observations of both price (futures and basis) and utilization which appear in the input distributions.

The results of these simulations for each of the three cooperative sizes are presented in Tables 5 to 7 respectively. Each table contains the strategies examined, and the rankings produced by the respective evaluation procedures. Overall, there is considerable consistency in the rankings of the various risk management strategies both across evaluation procedures and across the different firm sizes. Namely, the routine put option strategy (*Put Options*) ranked first across all evaluation procedures and across all firm sizes. This is an interesting result since the routine options strategy under many circumstances would set a very low floor price. However, in these cases, the underlying price would likely rise, and the option would be allowed to expire. As well, there are likely enough observations, through 5,000 simulations, where purchasing at-the-money puts at historically high strike prices were very beneficial as well, and these contracts were likely exercised. Overall, this finding says a lot about the power of options in managing risks. The *Put Options / Insurance* strategy and the *Futures-TR* strategy also performed relatively well, ranking usually second or third among evaluation procedures. The swap strategy (*Revenue Swap*) and the use of throughput insurance alone (*Cash Only / Insurance*) consistently fared poorly across evaluation procedures and firm sizes. While the revenue swap is a very intuitively appealing risk management strategy, it is likely the case that the probability of positive basis risk (i.e., basis gains) help to increase the performance of the price hedging strategies (e.g., *Put Options; Futures – TR*) relative to the swap. With respect to *Insurance*, the relatively poor rankings of this strategy confirm the idea that price risk likely dominates that of quantity or throughput risk of grain merchandising cooperatives. However, the combination strategies, in particular *Put Options / Insurance*, performed very well across firm sizes and evaluation procedures. This result, combined with the overall lackluster performance of the revenue swap, suggests that some form of revenue protection is prudent, but that a better form of revenue insurance is where price and throughput risks are managed separately. This finding may also bode well for the development of a revenue insurance product for cooperatives. Also, for over-the-counter revenue swaps, the counterparty risk may be very high, which is certainly not the case with exchange traded options and subsidized insurance products.

While the majority of results are fairly consistent across evaluation procedures and firm sizes, the biggest dichotomy is found in the rankings of the VaR evaluation versus the measures that rely on traditional mean-variance efficiency (e.g., Sharpe's Ratio). Namely, the performance of the revenue swap strategy has a much higher ranking under VaR criteria than under the Sharpe's Ratio and FDSDRA – a result that is fairly consistent across firm sizes. Across firm size, *Revenue Swap* has the highest VaR ranking for firms with total revenue between $10 million and $50 million (ranked fourth) and is ranked fifth for firms with total revenue greater than $50 million. However, *Revenue Swap* still ranks fairly low for coops with total revenue less than $10 million. This is an interesting result especially considering that larger cooperatives are more likely to engage in over-the-counter strategies than small firms. As well, the performance of routine hedging with futures (*Futures*) improves greatly under VaR evaluation than with the mean-variance approaches, with a third place ranking across the differing firm sizes. However, *Futures-TR* is ranked much lower under VaR criteria for medium size cooperatives while ranking consistently between third and fifth across evaluation procedures for the small and large cooperatives. The strategies that consistently finish last using VaR criteria are *Cash Only* and *Cash Only / Insurance.* Again, clearly the best performing strategy is that of *Put Options* and *Put Options / Insurance* using both the VaR ranking as well as the mean-variance evaluation approaches.

The two evaluation procedures relying on mean-variance efficiency, Sharpe's Ratio and FDSDRA, provide in essence the same rankings across firm sizes. However, worth noting are the rankings of *Put Options / Insurance* and *Futures-TR / Insurance* with these two evaluation criteria. For each firm size, the FDSDRA favors *Futures-TR / Insurance* (ranked second) over *Put Options / Insurance* which is ranked fourth with FDSRA, but ranked second with Sharpe's Ratio.

One interesting observation, one that really is immaterial with respect to evaluating risk management strategies, is the performance of the cash only strategy across firm sizes. Interestingly, the performance of small firms is greater than that of large firms based on ROA and the Sharpe's Ratio. In fact, the Sharpe's Ratio for the representative small firm, with total revenue less than $10 million, was three percentage points better than the representative large firm (total revenue greater than $50 million), with the Sharpe's Ratio of the medium size coop falling between the two. This result is interesting, especially given the perceived economies of scale with large cooperatives and their potential to be more diversified in their revenue generating activities than smaller cooperatives. It may also be that while having a large asset base, that larger cooperatives are actually less efficient in their asset utilization.

Summary and Conclusions

Agricultural cooperatives are responsible for producing and selling billions of dollars of farm output and input supplies per year (USDA). However, many cooperatives have not embraced active risk management practices at the same pace as their investor owned competitors, but more routinely take a position of risk accommodation through the holding of capital reserves. A lack of understanding of the risks and rewards of alternative risk management tools, both exchange traded and over-the-counter tools, and the effect of these strategies on ultimate financial performance of cooperatives has also likely been a constraint to the adoption of active risk management.

In this research, we specifically examine how various risk management procedures and strategies affect the distribution of ROA for grain merchandising cooperatives of different size. The results generally support the use of exchange traded options contracts in establishing a floor price for grain prices, and also support the use of some type of revenue protection specifically through the use of exchange traded price risk management instruments (options and futures) combined with a form of throughput insurance. However, the results are generally not favorable for over-the-counter revenue swaps, especially in light of the considerable counterparty risk associated with these contracts. It is also found that downside risk evaluation procedures, such as VaR, at times provide considerably different rankings for certain risk management strategies than those approaches which rely on mean-variance efficiency. Given this, it is important for cooperative managers to carefully consider their risk management objectives when implementing any of the described strategies.

Given the importance of agricultural cooperatives in American agriculture, this research provides critical information to cooperative managers regarding risk management strategies that may be preferred for use in their organizations. However, this research needs to be expanded to other cooperative businesses such as dairy cooperatives. By using these strategies, coop managers will be able to reduce their reliance on internal capital reserves, increase their flexibility in using external capital for other productive uses, reduce ownership risk faced by cooperative members, reduce their cost of capital, and potentially expand membership base.

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Table 1. Representative Income Statements for Grain Merchandising Coops

DATA CODE	*DESCRIPTION*	< $10 mill	> $10 mill & < $50 mill	> $50 mill
Sales_Commod	**Sales Commodities & Grain**	**$6,930,330**	**$21,980,741**	**$64,144,327**
Sales_Processed_Gds	Sales Processed Goods	4,317	192	2,197
Sales_Supplies	Sales Supplies	210,446	629,623	1,671,024
Finance_Rev	Finance Company Revenue	0	0	0
Sales_Oth	Sales Other	63,734	411,347	5,198,655
Sales_Serv	Sales Service Revenue	1,475	5,202	83,946
Sales_Adj	Sales Adjustments	1,746	-2,181	5,939
	Net Sales	**7,208,556**	**23,029,286**	**71,094,210**
Op_Income	Storage and Handling Rev + Other Operating Rev	312,251	888,283	1,941,318
	Total Revenue	**7,520,807**	**23,917,569**	**73,035,528**
COG_Commod	**Cost of Sales Commodities & Grain**	**6,638,818**	**21,243,916**	**61,802,540**
COG_Processed_Gds	Cost of Sales Processed Goods	0	2,714	1,717
COG_Supplies	Cost of Sales Supplies	185,213	506,736	1,490,601
Cost_Funds	Cost of Funds Finance Co.	0	0	0
COG_Oth	Cost of Sales Other	52,525	334,036	3,940,477
Cost_Serv	Cost of Service Revenue	0	973	0
COG_Deprec	Cost of Sales Depreciation	0	0	0
	COGS	**6,876,556**	**22,088,375**	**67,235,335**
	Gross Margin	**644,251**	**1,829,194**	**5,800,193**
Personnel_Exp	Personnel Expense + Benefits Expense	217,611	634,333	2,064,934
SGA_Exp	Selling, General, and Administrative	90,462	289,663	1,028,614
Oper_Exp	Operating Expenses	111,741	280,879	1,021,607
Lease_Exp	Lease Rent Expense	4,105	14,108	24,331
Deprec	Depreciation and Depletion	94,459	261,839	637,030
Amort	Amortization	0	116	431
	Total Operating Expenses	518,378	1,480,938	4,776,947
	Operating Profit (EBIT)	**125,873**	**348,256**	**1,023,246**
Int_Inc	Interest Finance Charge Income	13,307	38,799	163,217
Int_Exp	Interest Expense	35,996	112,793	485,841
	Profit Before Distribution & Taxes (Local Savings)	**$103,184**	**$274,262**	**$700,622**
Total_Assets	Total Assets	$2,389,882	$6,439,596	$22,157,691
N (observations)		237	353	91
Firms		30	47	14

Table 2. Average Coop Throughput For Coops of Different Size

	< $10 mill	% of total	> $10 mill & < $50 mill	% of total	> $50 mill	% of total
Corn (bu.)	1,333,496	62.7%	3,459,241	55.3%	9,652,574	54.4%
Wheat (bu)	357,500	16.8%	1,773,036	28.3%	4,530,938	25.6%
Soybeans (bu)	434,302	20.4%	1,025,092	16.4%	3,548,767	20.0%
Total (bu)	2,125,298	100.0%	6,257,369	100.0%	17,732,279	100.0%

Table 3. Correlation Matrix of Prices, Production, and Utilization (1980-2001)

	Corn Price	Wheat Price	Soybean Price	Corn Production	Wheat Production	Soybean Production	Corn Utilization	Wheat Utilization	Soybean Utilization
Corn Price*	1								
Wheat Price	0.83999	1							
Soybean Price	0.83816	0.73791	1						
Corn Production	-0.5873	-0.31502	-0.70907	1					
Wheat Production	0.17155	0.01356	0.02634	0.1854843	1				
Soybean Production	-0.4529	-0.29233	-0.59784	0.8534364	0.0311838	1			
Corn Utilization	-0.4031	-0.21113	-0.45694	0.686393	-0.253468	0.867146	1		
Wheat Utilization	0.14242	-0.0132	0.21958	-0.251029	0.279241	-0.206959	-0.04833	1	
Soybean Utilization	-0.4063	-0.24986	-0.50255	0.737404	-0.108447	0.960294	0.899538	-0.12729	1

*** Prices, production, and utilization reflect annual numbers**

Table 4. CRP Insurance Information for Effingham County, Illinois

County:		Effingham	
State:		IL	
Expected County Yield		120.3	
Maximum Protection Level ($/acre)		406.1	
Yield Election:		base premium	subsidy factor
	70%	0.0190	0.64
	75%	0.0260	0.64
	80%	0.0340	0.59
	85%	0.0450	0.59
	90%	0.0570	0.55

Table 5. Rankings for Coops with < $10 Million in Total Revenue

Strategy	ROA	*rank*	Sharpe's Ratio	*rank*	VaR @ 5%	*rank*	FDSDRA	*rank*
Cash Only	0.024	*8*	-0.034	*8*	-0.804	*10*	0.547	*8*
Futures	0.038	*7*	-0.012	*7*	-0.558	*3*	0.524	*7*
Put Options	0.238	*1*	0.455	*1*	-0.397	*1*	0.345	*1*
Revenue Swap	-0.064	*11*	-0.246	*11*	-0.776	*9*	0.610	*11*
Cash Only / Insurance	-0.006	*10*	-0.083	*10*	-0.879	*11*	0.572	*10*
Futures / Insurance	0.016	*9*	-0.064	*9*	-0.624	*8*	0.554	*9*
Put Options / Insurance	0.219	*2*	0.368	*2*	-0.469	*2*	0.389	*4*
Futures - TR	0.182	4	0.299	4	-0.599	5	0.374	3
Put Options - TR	0.169	5	0.261	5	-0.603	6	0.396	5
Futures - TR / Insurance	0.196	3	0.313	3	-0.590	4	0.364	2
Put Options - TR / Insurance	0.164	6	0.246	6	-0.603	7	0.412	6

Table 6. Rankings for Coops with Total Revenue > $10 Million & < $50 Million

Strategy	ROA	*rank*	Sharpe's Ratio	*rank*	VaR @ 5%	*rank*	FDSDRA	*rank*
Cash Only	0.013	*8*	-0.050	*8*	-0.879	*10*	0.551	*8*
Futures	0.035	*7*	-0.021	*7*	-0.582	*3*	0.533	*7*
Put Options	0.243	*1*	0.434	*1*	-0.420	*1*	0.353	*1*
Revenue Swap	-0.089	*11*	-0.438	*11*	-0.600	*4*	0.665	*11*
Cash Only / Insurance	-0.014	*10*	-0.086	*9*	-0.975	*11*	0.574	*9*
Futures / Insurance	-0.007	*9*	-0.115	*10*	-0.673	*9*	0.576	*10*
Put Options / Insurance	0.229	*2*	0.379	*2*	-0.476	*2*	0.379	*4*
Futures - TR	0.211	*3*	0.330	*4*	-0.637	*8*	0.366	*3*
Put Options - TR	0.192	*5*	0.290	*5*	-0.629	*7*	0.389	*6*
Futures - TR / Insurance	0.209	*4*	0.336	*3*	-0.613	*5*	0.353	*2*
Put Options - TR / Insurance	0.191	*6*	0.287	*6*	-0.621	*6*	0.387	*5*

Table 7. Rankings for Coops with Total Revenue > $50 Million

Strategy	ROA	*rank*	Sharpe's Ratio	*rank*	VaR @ 5%	*rank*	FDSDRA	*rank*
Cash Only	0.011	*8*	-0.064	*7*	-0.754	*10*	0.561	*8*
Futures	0.020	*7*	-0.070	*8*	-0.510	*3*	0.543	*7*
Put Options	0.198	*1*	0.402	*1*	-0.351	*1*	0.367	*1*
Revenue Swap	-0.085	*11*	-0.478	*11*	-0.543	*5*	0.677	*11*
Cash Only / Insurance	-0.010	*10*	-0.097	*9*	-0.810	*11*	0.579	*9*
Futures / Insurance	-0.004	*9*	-0.128	*10*	-0.567	*9*	0.583	*10*
Put Options / Insurance	0.181	*2*	0.329	*2*	-0.416	*2*	0.405	*4*
Futures - TR	0.158	*3*	0.272	*3*	-0.531	*4*	0.394	*3*
Put Options - TR	0.134	*6*	0.206	*6*	-0.566	*8*	0.423	*6*
Futures - TR / Insurance	0.152	*4*	0.259	*4*	-0.545	*6*	0.382	*2*
Put Options - TR / Insurance	0.137	*5*	0.215	*5*	-0.549	*7*	0.423	*5*