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Claudia Parliament

Zvi Lerman

Dana Huseby

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

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Claudia Parliament

Zvi Lerman

Dana Huseby

Claudia Parliament and Dana Huseby are, respectively, Associate Professor and former Graduate Student (now with General Mills), Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, MN 55108. Zvi Lerman is Lecturer in the Department of Agricultural Economics and Management, Hebrew University, Rehovot, Israel 76100.

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RISK AND EQUITY IN AGRICULTURAL COOPERATIVES

Abstract

This research examines the effects of risk-related factors on the proportion of equity held by agricultural cooperatives. The empirical analysis indicates that capital structure is significantly affected by the level and variation of profitability, commodities handled, and market function. The proportion of equity is not affected by size or pooling. Contrary to expectations, the results indicate an inverse relation between profit variability and the proportion of equity. Cooperatives rely on profit for equity accumulation through retained earnings. If this source of equity is unstable, the cooperative may not be able to generate sufficient equity causing the estimated inverse relationship.

The purpose of this research is to analyze factors affecting the proportion of equity in the capital structure of agricultural cooperatives. Insofar as equity capital provides a measure of protection against adverse business outcomes, equity holdings are expected to depend on the risk faced by a cooperative. If the potential for adverse outcomes is high, equity levels are expected to be correspondingly high.

Risk can be defined in the business context as the uncertainty of future outcomes that arises from variations in the economic environment (Brealey and Myers). Price and output instability are observable causes of risk among firms. They are affected by a variety of factors, both observable and unobservable, which include the efficiency of labor, changing quality of managerial decisions, weather, pest infestation or natural disasters, interest rate fluctuations, and policy or technological changes. All these factors combine to produce variability in earnings, which is an accepted measure of risk for firms. The greater the potential swings in earnings, the higher the risk faced by the firm.

Equity capital provides a cushion or a buffer that can absorb the swings in earnings. With little equity, a firm facing a large period loss at the bottom of a fluctuating performance curve may be unable to meet its obligations and will be forced into dissolution. If a firm holds a sufficient amount of equity, however, the period losses can be absorbed by

its equity capital and the firm will continue operating, although its owners will be that much poorer. It is accordingly argued that firms faced with high risk should maintain a higher proportion of equity in order to absorb the potential extreme downswings in their performance (Brealey and Myers).

This general reasoning is not restricted to investor-owned firms and it is equally valid for the user-owned cooperatives. If extreme downswings in a cooperative's performance are not absorbed by its equity capital, the cooperative will be forced into dissolution, causing damage to its owner-patrons due to discontinuation of services and loss of their equity; alternatively, the cooperative may be saved by infusion of new equity capital, thus imposing an additional "cost" on its members. Both unpleasant circumstances may be avoided if the level of equity capital in a cooperative is matched to its risk level.

The rationale for using variability in earnings as the standard risk measure is that it incorporates the effect of changing prices and output, as well as a variety of firm-specific unobservable factors. Risk, however, may also be affected by some structural factors that can be explicitly identified and examined. One of these structural factors is size. It is usually believed that larger size confers a measure of safety or stability to a firm. Banks and other creditors may place greater trust in the repayment capacity of large firms assuming they represent less of a credit risk and are more diversified (Sporleder, Malick, and Tough). Therefore large cooperatives may be able to borrow proportionately more than small cooperatives and function with a lower proportion of equity capital.

The commodity handled by a cooperative and its primary function - whether marketing or input supply - may also influence risk. The wide swings in grain prices caused by changes in global demand may cause a grain-marketing cooperative to be riskier than a cooperative that handles frozen vegetables in relatively stable markets. Cooperatives

functioning as suppliers of farm inputs may face greater risk due to the required risky investment in inventories than cooperatives primarily serving as marketing agents with flowthrough sales. A recent study indeed demonstrated that the proportion of debt (the complement of the proportion of equity) varied significantly across cooperatives handling different commodities and performing different functions (Lerman and Parliament).

A structural factor specific to cooperatives is the distinction between pooling and nonpooling marketing cooperatives. Members in a pooling cooperative sign contracts pledging their output to the cooperative. This producer commitment eliminates a portion of management and marketing uncertainty in a pooling cooperative, which reduces risk exposure. Pooling cooperatives have previously been estimated to operate on smaller proportions of equity than nonpooling cooperatives (Sporleder, Malick, and Tough).

This research is designed to examine empirically the effects of risk-related factors on the proportion of equity held by agricultural cooperatives. Although it may be accepted that equity holdings vary among cooperatives, the effect of various risk-related factors on cooperative equity has yet to be examined. After a brief review of the sources of equity capital for cooperatives, the methodology will be outlined, the database described, and the results summarized.

Equity Capital in Cooperatives

Cooperatives and investor-owned firms obtain equity capital through direct investment by members and from retained earnings (Cobia and Brewer). The initial funds for starting a cooperative are traditionally raised by direct contribution from members through the purchase of shares. Yet direct investment generates the smallest percentage of equity among cooperatives (Kane). Cooperatives are unable to raise equity easily through

the sale of stock because the returns to cooperative owners are based on patronage, not investment (Schrader). As a result, there is no market mechanism to raise equity through the sale of stock on an ongoing basis (Staatz).

The alternative method of raising equity is through the retention of earnings, whereby a portion of net income is added to the equity capital rather than paid out in dividends. A firm's profitability or net income thus has a direct effect on equity accumulation. Higher profitability is expected to be associated with a higher proportion of equity.

Although the retention of earnings is a method of rasing equity common to both cooperatives and investor owned firms, cooperatives have devised a unique twist by allocating some of these retained earnings to their members based on patronage. These "allocated patronage refunds" are eventually distributed back to the members through a revolving fund or equity redemption program (Cobia, Royer, and Ingalsbe). They can be viewed accordingly as a pool of "deferred dividends" that the cooperative employs temporarily as a component of its equity capital. The allocated earnings are a major source of equity for agricultural cooperatives: the top 100 cooperatives average 50% of their equity in the form of allocated patronage refunds (Kane).

Analysis

The theoretical considerations outlined above suggest that the proportion of equity capital held by a cooperative may be functionally represented in the form

$$EQ/TA = f(\text{profitability, size, firm risk, commodity risk, function, pooling}) \quad (1)$$

where EQ/TA is the ratio of equity to total assets. The arguments in this functional specification are the risk-related variables discussed previously. The only exception is the

profitability variable, which acts as a source of equity by generating retained earnings. According to the theory, the proportion of equity in a cooperative is expected to increase with increases in profitability and with increases in the two risk variables; it is expected to decrease with increases in size. Regarding the variables "function" and "pooling", marketing cooperatives are expected to maintain a lower proportion of equity than supply cooperatives, and cooperatives that pool are expected to operate with lower proportions of equity than nonpooling cooperatives. In both categories, the expected differences are attributable to differential risk, as discussed previously.

Data

The model is estimated using a complete cross-section time-series database of annual financial statements for 61 agricultural cooperatives for the years 1973 to 1987. The cooperatives included in the analysis are those that responded to a request for financial statement data sent to the cooperatives listed in the *Directory of Farmer Cooperatives* published by the USDA Agricultural Cooperative Service (Jermolowicz and Kennedy).

The cooperatives in the database are classified into categories based on commodities handled: cotton, dairy, fruit and vegetables, grain, rice, sugar, and farm inputs. A separate category includes cooperatives that handle both farm inputs and grain (farm inputs/grain category). Another category consists of diversified cooperatives that are involved with a wide variety of commodities, including farm inputs and processed foods. The cooperatives are also classified by their primary function: supply, marketing, or mixed (supply and marketing). The marketing cooperatives are further classified based on whether or not they pool. The distribution of cooperatives by commodity and function is provided in Table 1.

TABLE 1: Distribution of Cooperatives by Commodity and Function

Commodity	Number of cooperatives by commodity	Number of pooling cooperatives	Function	Number of cooperatives by function
Cotton	2	2	Marketing	
Dairy	11	0	Marketing	
Fruit and Vegetables	15	9	Marketing	
Grain	5	0	Marketing	
Rice	1	1	Marketing	
Sugar	4	2	Marketing	38
Farm Inputs	9	0	Supply	9
Farm Inputs/Grain	10	0	Mixed	
Diversified	4	0	Mixed	14
Total	61	14		61

Variables

The dependent variable EQ/TA in model (1) is calculated as the ratio of total equity to total assets for each cooperative in each year. The use of this ratio instead of the actual equity capital controls for the strong positive correlation between equity and size and allows comparison for cooperatives of different size. Cooperative size is then measured by the cooperative's total assets in each year.

Profitability and firm risk in the context of investor-owned firms are measured by the rate of return to equity (ROE) and the standard deviation of ROE over time, respectively. Some cooperative researchers advocate against the use of ROE-based measures because of the unique nature of the allocated equity component. As explained previously,

the allocated retained earnings in cooperatives are not permanent equity capital and are eventually revolved out as part of equity redemption programs.

To soften the possible conceptual difficulties with the exclusive use of ROE in a study of cooperatives, three measures of profitability are calculated: the ratio of before-tax net profit to equity (ROE), the ratio of before-tax net profit to sales (margin on sales), and the before-tax dollar profit. All three profitability measures are calculated from the panel data for each cooperative in each year. A separate analysis shows that the three profitability measures are uncorrelated (Table 2A) and therefore all three can be used in regression analysis. To avoid proliferation of variables, a composite profitability index is created by converting the three profitability measures to ranks and forming an average profitability rank score for each cooperative. This rank score is used as the profitability variable in model (1).

Firm risk is represented in the usual way by variability of earnings of each cooperative over time. Again, to avoid exclusive reliance on ROE-based risk, three measures of earnings variability are calculated: the variability of the before-tax net profit to equity, the variability of the before-tax net profit to sales, and the variability of the absolute before-tax profit. Both net profit to sales and net profit to equity are percentage values and their variability is accordingly calculated as the standard deviation over the time period 1973-1987. The variability of the absolute profit is calculated as the coefficient of variation, which is the standard deviation of profit divided by mean profit over the period 1973-1987. The use of the coefficient of variation of profit standardizes the variability measure by the magnitude of the profit. Here again a separate analysis shows that the correlation between the three measures of firm risk is not pronounced (Table 2B) and therefore, in principle, all

three measures may be included in regression analysis. A composite firm risk index is created by converting the three firm risk measures to ranks and forming an average risk rank score for each cooperative. This index is used as the firm risk variable in model (1).

TABLE 2: Coefficients of Correlation Between Alternative Profitability and Risk Measures of Cooperatives (significance levels in parentheses)

A. Profitability measures

	Mean Profit to Equity	Mean Profit
Mean Profit to Sales	0.204 (0.12)	0.155 (0.23)
Mean Profit to Equity		0.049 (0.71)

B. Risk measures

	Standard Deviation of Profit to Equity	Coefficient of Variation of Profit
Standard Deviation of Profit to Sales	0.298 (0.02)	0.222 (0.09)
Standard Deviation of Profit to Equity		0.068 (0.60)

The variable representing commodity-related risk in model (1) is measured by the variability of sales in each of the nine commodity categories over time. Thus, the commodity-related effect in the model is not represented by a categorical variable ("commodity group"), but by a continuous variable calculated for each commodity group separately. While profit depends on firm-specific factors such as management decisions and human capital and therefore provides an appropriate measure of firm risk, sales variability is viewed in this study as a characteristic of the risk associated with the commodity handled by the cooperative. To standardize for the magnitude of sales, commodity risk is calculated as the coefficient of variation of sales of all cooperatives within a particular commodity category over the period 1973-1987. Table 3 ranks the commodity categories in the order of decreasing risk as measured by the coefficient of variation of sales. Separate analysis shows that the correlation of the commodity-risk variable with the firm-risk variable is not significantly different from zero, so that both variables may be used in the estimation of the model.

The calculation of the two risk measures is made possible by the availability of sufficiently long time series for each cooperative (15 years of data). This is a particular strength of the database used in this research and distinguishes the present analysis from the previous study of Sporleder, Malick, and Tough which examined factors affecting equity capital.

Function and pooling in model (1) are represented by categorical variables, associating one of three functions (marketing, supply, or mixed) to each cooperative and classifying it as pooling or nonpooling. Both the function category and pooling status are determined based on information provided in annual financial statements.

TABLE 3: Ranking of Commodities by Sales Risk (in descending order)

Risk Rank	Commodity	Coefficient of Variation of Sales
1	Grain	152.692
2	Farm inputs/grain	138.161
3	Dairy	121.758
4	Fruit and vegetables	113.128
5	Farm inputs	111.349
6	Cotton	100.290
7	Sugar	87.518
8	Diversified	53.556
9	Rice	33.083

Regression Model

The functional model (1) can be specified as a linear regression model describing the panel data in the form

$$(EQ/TA)_{itj} = \alpha + \beta_1 PROFIT_{it} + \beta_2 SIZE_{it} + \beta_3 FIRM\ RISK_i + \beta_4 COMMODITY\ RISK_j + \beta_5 FUNCTION_i + \beta_6 POOL_i + u_{it} \quad (2)$$

The subscript i identifies the cooperative, i = 1,...,61; the subscript t indicates the year in the time series, t = 1973,...,1987; and the subscript j stands for the commodity category, j = 1,...,9. The underlying assumption of model (2) is that the regression coefficients β_i and the intercept term α are homogeneous across cooperatives.

The variables in the model (2) are as described in the preceding subsection and their definitions are summarized in Table 4. The two risk variables representing cooperative risk FIRM $RISK_i$ and commodity risk COMMODITY $RISK_j$ do not carry a time subscript, because they are based on summary statistics (standard deviations and coefficients of variation) for the period 1973-1987. The function and pooling classification of the

individual cooperatives was not observed to change over time, and these categorical variables are therefore independent of t.

TABLE 4: Definition of Variables in Regression Models (2) and (3)

Model (2): panel data	
$(EQ/TA)_{itj}$	Ratio of equity to total assets for cooperative i in year t by industry j
$PROFIT_{it}$	Profitability of cooperative i in year t: average rank score of (i) before-tax profit to sales, (ii) before-tax profit to equity, and (iii) dollar profit for cooperative i in year t
$SIZE_{it}$	Total assets of cooperative i in year t (in $ billions)
FIRM $RISK_i$	Risk measure of cooperative i: average rank score of (i) standard deviation of profit to sales, (ii) standard deviation of profit to equity, and (iii) coefficient of variation of dollar profit for cooperative i over the period 1973-1987
COMMODITY $RISK_j$	Commodity-related risk measure for commodity j: coefficient of variation of sales across all cooperatives handling commodity j over the period 1973-1987
$FUNCTION_i$	Categorical variable with values "marketing", "mixed", or "supply" assigned to each cooperative i
$POOL_i$	Categorical variable with values "pooling" or "nonpooling" assigned to each cooperative i
Model (3): data averaged over time	
$\overline{(EQ/TA)}_{ij}$	Mean equity to total assets ratio for cooperative i by industry j
$\overline{PROFIT}_i$	Mean profitability of cooperative i
$\overline{SIZE}_i$	Mean total assets of cooperative i (in $ billion)
FIRM $RISK_i$	As in model (2)
COMMODITY $RISK_j$	As in model (2)
$FUNCTION_i$	As in model (2)
$POOLED_i$	As in model (2)

Time-series cross-section data are usually prone to strong serial correlation. The panel data in this research are no exception, producing a Durban-Watson statistic of 0.3 for the OLS regression based on model (2). To avoid the difficulties associated with serial correlation in OLS analysis of panel data, model (2) is summed over time and is restated in the usual way (Hsiao) in terms of mean variables over the period 1973-1987 for each cooperative i:

$$\overline{(EQ/TA)}_{ij} = \alpha + \beta_1\overline{PROFIT}_i + \beta_2\overline{SIZE}_i + \beta_3 FIRM\ RISK_i + \beta_4 COMMODITY\ RISK_j + \\ + \beta_5 FUNCTION_i + \beta_6 POOL_i + u_i \qquad (3)$$

Here the variables averaged over time for each coop are denoted by a superior bar. The variables that do not depend on the time index t in the original model (2) remain unchanged.

Model (3) is estimated to determine the effect of continuous variables and categorical variables on the proportion of equity held by a cooperative. The estimation is performed using the General Linear Models procedure in the SAS/PC package.

Results

Table 5 lists the estimated regression coefficients for model (3). For this regression, the R-square is 0.41 and the F value is 5.35, which is significant at the 0.0001 level. The dependent variable - the mean equity to total assets ratio for each cooperative - varies from a low of 0.09 to a high of 0.80 with an average of 0.38 across cooperatives. This is statistically indistinguishable from the average equity to total asset ratio of a large sample of investor-owned firms handling comparable commodities that are reported on an annual basis in Robert Morris Associates' *Annual Statement Studies*. The corresponding ratio for these investor-owned firms over the same period 1973 to 1987 has an average of 0.38, same as

for the cooperatives in this study. The variability, however, is smaller, ranging from a low of 0.20 to a high of 0.53, due to the smoothing effect of the larger sample.

TABLE 5: Estimated Coefficients of Regression Model (3): Mean Equity to Total Assets Ratio as a Function of Profitability, Size, Firm Risk, Commodity Risk, Function, and Pooling

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		0.3225	2.95	0.005	0.1093
PROFIT		0.0026	2.31	0.025	0.0011
SIZE		-.0258	-0.32	0.753	0.0816
FIRM RISK		-.0035	-3.35	0.002	0.0010
COMMODITY RISK		0.0014	1.95	0.056	0.0007
FUNCTION	marketing	-.1348	-3.00	0.004	0.0449
	mixed	-.0714	-1.42	0.162	0.0503
	supply	0.0000	.	.	.
POOLED	nonpooling	0.0235	0.57	0.574	0.0415
	pooling	0.0000	.	.	.

$R^2 = 0.414$
Number of observations = 61
Mean of Dependent Variable = 0.3756
Minimum of Dependent Variable = 0.0862
Maximum of Dependent Variable = 0.8010

The estimation results indicate that the proportion of equity capital in cooperatives is affected by profitability and commodity risk, increasing with the increase in both these factors. Contrary to expectations, however, the estimated coefficient on the firm-risk variable is significantly negative, which implies that the proportion of equity is inversely related to variability of earnings in cooperatives.

The size of the cooperatives, measured by mean total assets, is not estimated to be a significant factor affecting a cooperative's proportion of equity. Although the coefficient is negative, as hypothesized, it is not estimated to be significantly different from zero, indicating larger cooperatives do not necessarily hold a lower proportion of equity capital.

The estimated coefficients on the function classifications indicate, as hypothesized, that supply cooperatives have higher proportions of equity than cooperatives acting as marketing agents. The estimated differential effects between the supply and marketing function are significant. Not unexpectedly, cooperatives performing both supply and marketing functions fall between the two other functions, but are not estimated to be significantly different from supply cooperatives.

Although the sign of the estimated coefficient on the pooling variable indicates the pooling cooperatives may have lower proportions of equity than nonpooling cooperatives, the coefficient is not estimated to be significantly different than zero. Contrary to the results of Sporleder, Malick, and Tough, pooling is not found to affect a cooperative's proportion of equity. The explicit risk factors incoportated in this analysis have apparently captured the explanatory power of pooling operations found in the previous research.

Conclusion

Equity holdings among agricultural cooperatives are found to be affected by risk-related factors. The empirical analysis indicates that the ratio of equity to total assets is affected by a cooperative's level and variation of profitability, the commodity handled, and the market function performed. In contrast, the proportion of equity capital is not found to be affected by the cooperative's size, or by whether or not the cooperative operates on a pooling basis.

With the exception of one variable, the directions of the estimated impacts are as hypothesized, with increases in profitability and commodity sales risk tied to higher proportions of equity. Increases in earnings variability, however, are estimated to have an inverse relationship on the proportion of equity. This result does not conform to theoretical considerations. Higher levels of earnings variability are expected to be matched with higher levels of equity. The explanation for this surprising result may rest with the cooperative's process of equity accumulation. Because equity in a cooperative is almost exclusively generated through retention of earnings, the stability of profits affects a cooperative's ability to accumulate equity. If the major source of equity is unstable, the cooperative may have difficulty accumulating sufficient equity, given its inability to raise equity through the sale of stock. This hypothesis can be tested in future comparative research of the factors affecting the proportion of equity and the composition of equity sources in investor-owned firms and user-owned cooperatives.

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