Risk, Profitability, and Efficiency in Agricultural Cooperatives under Allocated and Unallocated Equity.

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Risk, Profitability, and Efficiency in Agricultural Cooperatives under Allocated and Unallocated Equity.

Abstract

Today, more agricultural cooperatives have experienced a surge in their unallocated equity or equity held at the cooperative level as retained earnings. Key factors contributing to this rise are soaring non-member business and various tax deductions available to cooperatives. Many agricultural cooperatives directors and managers are questioning the sustainability of such a change in equity structure. The purpose of this research is to explore how this change in equity structure has impacted agricultural cooperative’s efficiency, profitability, and risk exposure. The study discovered a positive relation between averaged efficiency indices and the allocated equity to total asset ratio and the unallocated equity to total asset ratio. Higher profitability lifted the average allocated equity to total assets ratio as well as the unallocated to total assets ratio. The higher the business risk, the greater the equity cushion that the firm employs. Higher financial risk implies higher borrowing, hence a lower proportion of equity. Furthermore, larger cooperatives can afford to accept a lower level of equity than smaller firms of comparable business risk.

Key Words: Allocated Equity, Unallocated Equity, Business Risk, Financial Risk, Efficiency
Introduction

Cooperatives are largely capitalized by the equity investment and patronage business conducted by their members. Raising this allocated equity, equity with a member’s name on the equity that was derived from patronage business, can serve as an incentive for co-op members to conduct business with the co-op to ensure it is well capitalized and in turn a viable business. Today however, more agricultural cooperatives, for various reasons such as surging non-member business and various tax deductions, have seen a spike in their equity coming from other sources.

As a result, the unallocated equity or equity held at the cooperative level as retained earnings has surged. Many agricultural cooperatives are questioning the sustainability of such a change in equity structure. The purpose of this research is to explore agricultural cooperative’s efficiency, profitability, and risk has evolved along with this change in equity structure. Doing so should provide agricultural cooperative managers and directors a better understanding of the impact of equity structure on the financial performance of their co-op.

Over time, agricultural cooperatives’ equity has evolved from largely being held as allocated equity (retained patronage with a member’s name on the equity) to unallocated equity (retained savings with the cooperative’s name on the equity). In 1985, about 15% of agricultural cooperatives’ equity was held as unallocated equity with the remaining 85% as allocated equity. Since then, the unallocated share of equity has risen to more than 40% for the median agricultural cooperative (Reynolds 2013).

Cooperatives in some states are legally obligated to build unallocated equity to a specified level. Others permit unallocated reserves for such purposes as covering possible losses. Building unallocated equity is also helpful in relationships with creditors. Unallocated equity
reassures these lenders, because it reduces the pressures placed on the board for equity redemption of allocated equity. Some cooperatives build unallocated reserves to reduce cash outflows during periods of inflation. Unallocated equity can be thought of as permanent risk capital.

If the potential for adverse outcomes is high, equity levels are expected to be correspondingly high. Price and output instability are observable causes of risk among firms. They are affected by a variety of factors that include the firm efficiencies, changing quality of managerial decisions, interest rate fluctuations, technological changes, business risk, financial risk, and policy etc. (Parliament et.al 1991). First, industry effects are beyond the control of a director or manager. However firm effects such as efficiency, profitability, risk and solvency are controllable and their effect is the result of managerial decisions and director policy. For example, a board of directors’ choice of how much of equity to have determines the solvency measurement through the income distribution and equity redemption decisions. These decisions can affect profitability (Boyd et.al 2007). In addition, boards of directors implement recommendations by a manager to close or sell off underutilized assets. This affects the efficiency measurement.

To meet the purpose of this study, an annual time series of agricultural cooperatives’ financial records from 2005 through 2010 from the CoBank data base are used. Specifically: to estimate technical efficiency, allocative efficiency, scale efficiency, and overall efficiency indices; to estimate profitability indices; to quantify business risk and financial risk; to explain agricultural cooperatives’ equity structure using efficiency, profitability, risk, and location; and to divulge the findings to cooperative managers, board members, policy makers, the public, and the research community via publications, presentations, and outreach activities.
Data

Annual time series financial records from 2005 through 2010 were obtained from the CoBank data base. The CoBank data base contains complete balance sheet and income statement data, taken from audited financial statements. To estimate efficiencies, input and output quantity data or indices and firms’ input and output prices or indices are required. Dollar values of expenses and the annual sales are adjusted for inflation by converting to 2005 constant dollars.

The following input indices are calculated. Input expenses included capital and labor. Information for expense items other than capital and labor was not available. Seasonally adjusted average hourly earnings for manufacturing sector (Bureau of Labor Statistics, U.S. Dep. of Labor) and gross domestic product chain type price deflator (Bureau of Economic Analysis, U.S. Dep. of Commerce) were used to transform labor expenses to labor input. Capital expenses were defined as the sum of annual depreciation, total assets times seasonally adjusted bank prime loan rate (Board of Governors of Federal Reserve System), and rents and leases.

The following output indices are calculated. Output sales included, three product categories; grain sales, farm input supply sales, and other product sales. Producer price index of crude foodstuff and feedstuff (Bureau of Labor Statistics, U.S. Dep. of Labor), producer price index for crude materials for further processing (Bureau of Labor Statistics, U.S. Dep. of Labor), producer price index for finished goods (Bureau of Labor Statistics, U.S. Dep. of Labor), and chain type gross domestic product price deflator (Bureau of Economic Analysis, U.S. Dep. of Commerce) were used to transform grain sales, farm input supply sales, and other product sales into output levels.
Efficiencies

To estimate efficiencies, input and output quantity data or indices and firms’ input and output prices or indices are required. This study used Färe procedures to estimate overall efficiency and its’ components namely, technical efficiency, allocative efficiency, and scale efficiency. Input prices faced by cooperatives can be represented as \( w = (w_1, w_2, \ldots, w_n) \in \mathbb{R}^+ \). Similarly, output prices faced by cooperatives can be represented as \( p = (p_1, p_2, \ldots, p_m) \in \mathbb{R}^+ \). The transformation set formed by the \( n \times k \) input matrix \( (X) \) and \( m \times k \) output matrix \( (Y) \) can be written as follows:

(1) \( S^i = \{(x, y) : y \leq Yz, Xz \leq x, z \in \mathbb{R}^+ \} \).

Note that the transformation set corresponds to a total product curve under constant returns to scale, and it shows the minimum feasible inputs for given levels of outputs. Overall efficiency represents the minimum cost of producing output vector \( y_i \), given input prices and a constant returns to technology and can be measured as:

(2) \( \rho_i = \frac{C_i(w, y, S^c)}{w_i x_i} \).

The denominator \( w_i x_i \) is the cost the \( i^{th} \) cooperative incurred to produce the output vector \( y_i \). The numerator is the minimum cost of producing outputs given prices and constant returns to scale technology and can be determined by the following linear program (LP):
(3) \( C_i(w, y, S_c) = \text{Min } w_i x_i \)

\[
\text{s.t.} \\
\sum_{k=1}^{K} x_{nk} z_k \leq x_{ni} \\
\sum_{k=1}^{K} y_{mk} z_k - y_{mi} \geq 0 \\
Z_k \geq 0
\]

Where \( Z_k \) is the intensity of use of the \( k^{th} \) cooperative’s technology. The subscript \( k \) represents the number of cooperatives, \( i \) denotes the cooperative of interest, \( n \) is the number of inputs, and \( m \) is the number of outputs. The intensity variables (\( z \)'s) construct the frontier technology set. The solution of this LP problem is divided by the cooperative’s actual cost to determine overall efficiency. Technical efficiency for each cooperative can be measured using the following LP:

(4) \( \text{Min } \lambda_i \)

\[
\text{s.t.} \\
\sum_{k=1}^{K} x_{nk} z_k \leq \lambda_i x_{ni} \\
\sum_{k=1}^{K} y_{mk} z_k - y_{mi} \geq 0
\]
The firm is technically efficient if $\lambda_i = 1$. If $\lambda_i < 1$, the firm is technically inefficient. Allocative efficiency examines whether a firm is using the optimal input mix. Allocative efficiency ($\gamma_i$) can be determined by dividing the minimum cost under variable returns to scale technology by the actual cost adjusted for technical efficiency:

\[ \gamma_i = \frac{C_i(w, y, S_v)}{w_i \lambda_i x_i}. \]

The minimum cost under variable returns to scale technology is solved by the following LP:

\[ \min \sum_{k=1}^{K} w_i x_{ni} \]

s.t.

\[ \sum_{k=1}^{K} x_{nk} z_k \leq x_{ni} \]

\[ \sum_{k=1}^{K} y_{mk} z_k - y_{mi} \geq 0 \]

\[ \sum_{k=1}^{K} z_k = 1 \]

Allocative efficiency is determined by dividing the minimum cost from the above LP by the actual cost multiplied by technical efficiency. Scale efficiency ($\theta_i$) is determined by:

\[ \theta_i = \frac{C_i(w, y, S_c)}{C_i(w, y, S_v)}. \]
Scale efficiency is estimated by dividing the minimum cost from model (3) by the minimum cost from model (6). Overall efficiency is the product of scale, allocative, and technical efficiencies. This relationship can be shown by using equations (2), (4), (5), and (7).

\[ P_i = \frac{C_i(w, y, S_c)}{w_i x_i} = \lambda_i \gamma_i \theta_i \]

**Methodology**

The theoretical considerations suggest that the proportion of equity capital held by a firm is a function of efficiency and risk-related factors (Parliament et.al 1991):

AEqTA = f (efficiency, business risk, financial risk, size) ……………Model 1 and

RETA = f (efficiency, business risk, financial risk, size) ……………Model 2

where AEqTA is the ratio of Allocated Equity (a member’s name on the equity) to Total Assets and RETA is the ratio of Retained Earnings (a co-op name on the equity) to Total Assets. Financial theory indicates that the higher the business risk, the greater the equity cushion that the firm employs. The higher financial risk implies higher borrowing, hence a lower proportion of equity. Larger firms can afford to accept a lower level of equity than smaller firms of comparable business risk.

The dependent variable AEqTA in model 1 developed as the ratio of Allocated Equity to Total Assets for each cooperative and averaged over time. The dependent variable RETA in model 2 developed as the ratio of Retained Earnings (unallocated equity) to Total Assets for each cooperative and averaged over time. The use of those ratios instead actual allocated equity capital and retained earnings controls for the strong positive correlation between equity and size and allows comparison for cooperatives of different size.
Independent variables were averaged technical efficiency (TE), averaged allocative efficiency (AE), averaged scale efficiency (SE), averaged overall efficiency (OE), averaged return on assets (ROA) ratio, the Coefficient of Variation of ROA ratio (ROACV), and the Coefficient of Variation of Return on Equity ratio (ROECV) to represent business risk and financial risk respectively. The Coefficient of Variation of ROA captures the variability associated with the pure business decisions of the firm before the effects of financing decisions. Higher financial risk implies higher borrowing, hence a lower proportion of equity. Averaged total sales (TSale) in million dollars used to account size variability among cooperatives. We used five regional dummies to isolate regional differences across cooperatives. D1, D2, D3, D4, and D5 represent Midwest, the Great Plains, Atlantic, South, and West respectively.

Model (1) \( \overline{AEqTA} = f(\overline{TE}, \overline{AE}, \overline{SE}, \overline{OE}, \overline{ROA}, \overline{ROACV}, \overline{ROECV}, \overline{TSale}, D1, D2, D3, D4) \)

Model (2) \( \overline{RETA} = f(\overline{TE}, \overline{AE}, \overline{SE}, \overline{OE}, \overline{ROA}, \overline{ROACV}, \overline{ROECV}, \overline{TSale}, D1, D2, D3, D4) \)

Summary statistics of independent and dependent variables for cooperatives presented in table 1. The average Allocated Equity to Total Assets ratio was 0.2412 with a standard deviation of 0.0074. The average Retained Earnings to Total Assets ratio was 0.2459 with a standard deviation of 0.0036. The average Total Sales in million dollars was $75.8815 with a standard deviation of $151.96. The average Coefficient of Variation of Return on Assets and the average Coefficient of Variation of Return on Equity were 2.1052 and 1.4817.
Results

The estimation results indicated that the proposition of both the allocated and the unallocated equity in a cooperative’s capital structure is affected by overall efficiency. The estimated coefficients of the linear regression models 1 and 2 presented in table 2. As we have expected, the estimated coefficient on averaged overall efficiency variable was statistically significant and positive in models 1 and 2. Increase averaged overall efficiency increases averaged total allocated equity to total assets ratio and averaged retained earnings to total assets ratio.

As we have expected, the estimated coefficients on averaged scale efficiency variable was statistically significant and positive in model no. 1 which averaged total allocated equity to total assets is the dependent variable. Increase averaged scale efficiency increases averaged ratio of allocated equity to total assets. On the other hand, in model 2 which is averaged retained earnings to total assets ratio is the dependent variable, the estimated coefficient on averaged scale efficiency was negative and statistically significant. Contrary to expectations, the estimated coefficient on the averaged allocative efficiency variable was negative in models 1 and 2, but coefficients were not estimated to be statistically different from zero.

Contrary to expectations, however, the estimated coefficient on the averaged technical efficiency variable was negative in models 1 and 2 which dependent variables were averaged allocated equity to total assets ratio (AEqTA) and averaged retained earnings to total assets (RETA) ratio.

As we have expected, the estimated coefficient on averaged return on assets (ROA) ratio was statistically significant and positively related to averaged allocated equity to total assets ratio.
as well as the ratio of retained earnings to total assets. Increase profitability increases allocated equity as well as retained earnings. Business risk is defined as the inherent variability in the operating performance of the firm, independent of the way the firm chooses to finance its operations. Its level is influenced by external factors, such as price variability for outputs and inputs, uncertain availability and quality of inputs, and yield variability, as well as by internal factors, such as investment decisions and management skills.

The empirical analysis indicated that the level of equity in a cooperative’s capital structure is not only affected by a cooperative’s level of profitability, but by a cooperative’s year to year variability of returns or business risk. The estimated coefficient on coefficient of variation of ROA was positively related to averaged allocated equity to total assets ratio and was statistically significant. The estimated coefficient on coefficient of variation of ROA or business risk was negatively related to averaged retained earnings to total assets ratio and was not statistically different from zero. The estimation results indicated that the proportion of allocated equity in a cooperative’s capital structure was affected by business risk, thus the proportion of unallocated equity was not affected by business risk.

Financial risk is defined as the added variability of net returns to the owners of equity that results from the use of debt. Higher financial risk implies higher borrowing, hence a lower proportion of equity. The estimated coefficient on coefficient of variation of return on equity (ROE) ratio was statistically not different from zero and negatively related to averaged allocated equity to total assets ratio. The estimated coefficient on coefficient of variation on ROE was statistically significant and positively related to averaged retained earnings to total assets ratio. The size of cooperatives, as measured by averaged total sales in million dollars, is estimated to have a negative effect on a cooperative’s averaged allocated equity to total assets ratio and
averaged retained earnings to total assets ratio. It is usually believed that larger size confers a measure of stability to a firm. Creditors may place greater trust in the repayment capacity of large firms assuming they represent less of a credit risk and more diversified. Large cooperatives may be able to borrow proportionately more than small cooperatives and function with a lower portion of equity capital.

The estimated coefficients on D1 (Midwest), D2 (Great Plains), D3 (Atlantic), and D4 (South) positively related to averaged allocated equity to total assets ratio and statistically significant. The estimated coefficients on D1 and D2 negatively related to averaged retained earnings to total assets ratio and statistically significant. The estimated coefficient on D3 positively related to averaged retained earnings to total assets ratio and statistically significant. The estimated coefficient on D4 negatively related to averaged retained earnings to total assets ratio and statistically not different from zero.

Conclusions

Today, more agricultural cooperatives, for various reasons such as surging non-member business and various tax deductions, have seen a spike in their equity coming from other sources. As a result, the unallocated equity or equity held at the cooperative level as retained savings has surged. Many agricultural cooperatives are questioning the sustainability of such a change in equity structure. The purpose of this research is to explore agricultural cooperative’s efficiency, profitability, and risk has evolved along with this change in equity structure. Doing so should provide agricultural cooperative managers and directors a better understanding of the impact of equity structure on the financial performance of their co-op.
Annual time series financial records from 2005 through 2010 were obtained from the CoBank data base. The CoBank data base contains complete balance sheet and income statement data, taken from audited financial statements.

The study discovered a positive relation between averaged efficiency indices except technical efficiency and dependent variables in the model 1 which is the allocated equity to total assets ratio and the model 2 which is the retain earnings to total assets ratio. Increase profitability increased the average allocated equity to total assets ratio as well as the retain earnings to total assets ratio. Financial theory indicates that average allocated equity to total assets ratio is an increasing function of business risk. The higher the business risk, the greater the equity cushion that the firm employs. Higher financial risk implies higher borrowing, hence a lower proportion of equity. Furthermore, larger firms can afford to accept a lower level of equity than smaller firms of comparable business risk.
References:


Table 1: Summary Statistics of Dependent and Independent Variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Averaged Allocated Equity to Total Assets Ratio</td>
<td>0.2412</td>
<td>0.0074</td>
</tr>
<tr>
<td>Averaged Retained Earnings to Total Assets Ratio</td>
<td>0.2459</td>
<td>0.0036</td>
</tr>
<tr>
<td>Averaged Technical Efficiency</td>
<td>0.4091</td>
<td>0.0086</td>
</tr>
<tr>
<td>Averaged Allocative Efficiency</td>
<td>0.9015</td>
<td>0.0289</td>
</tr>
<tr>
<td>Averaged Scale Efficiency</td>
<td>0.9053</td>
<td>0.0235</td>
</tr>
<tr>
<td>Averaged Overall Efficiency</td>
<td>0.3661</td>
<td>0.0095</td>
</tr>
<tr>
<td>Averaged Total Sales in million dollars</td>
<td>75.8815</td>
<td>151.9601</td>
</tr>
<tr>
<td>Averaged Return on Assets</td>
<td>6.1680</td>
<td>1.9755</td>
</tr>
<tr>
<td>Coefficient of Variation of ROA</td>
<td>2.1052</td>
<td>1.6879</td>
</tr>
<tr>
<td>Coefficient of Variation of ROE</td>
<td>1.4817</td>
<td>0.8053</td>
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</table>
Table 2: Estimated Coefficients of Regression Models.

<table>
<thead>
<tr>
<th></th>
<th>(1) AEqTA</th>
<th></th>
<th></th>
<th>(2) RETA</th>
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<tr>
<td></td>
<td>Estimate</td>
<td>Std. Error</td>
<td>T-ratio</td>
<td>Estimate</td>
<td>Std. Error</td>
<td>T-ratio</td>
</tr>
<tr>
<td>TE</td>
<td>-0.87931**</td>
<td>0.21070</td>
<td>-4.17</td>
<td>-0.50763**</td>
<td>0.20660</td>
<td>-2.46</td>
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<tr>
<td>AE</td>
<td>-0.01480</td>
<td>0.11240</td>
<td>-0.13</td>
<td>-0.07331</td>
<td>0.11020</td>
<td>-0.67</td>
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<tr>
<td>SE</td>
<td>0.21772**</td>
<td>0.04748</td>
<td>4.59</td>
<td>-0.13344**</td>
<td>0.04655</td>
<td>-2.87</td>
</tr>
<tr>
<td>OE</td>
<td>0.95023**</td>
<td>0.23780</td>
<td>4.00</td>
<td>0.67598**</td>
<td>0.23320</td>
<td>2.90</td>
</tr>
<tr>
<td>ROA</td>
<td>0.0032229*</td>
<td>0.00177</td>
<td>1.82</td>
<td>0.0061643**</td>
<td>0.00173</td>
<td>3.55</td>
</tr>
<tr>
<td>ROACV</td>
<td>0.014385**</td>
<td>0.00401</td>
<td>3.59</td>
<td>-0.00095</td>
<td>0.00393</td>
<td>-0.24</td>
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<tr>
<td>ROECV</td>
<td>-0.01145</td>
<td>0.00792</td>
<td>-1.45</td>
<td>0.022845**</td>
<td>0.00777</td>
<td>2.94</td>
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<td>TSALE</td>
<td>-0.0000236*</td>
<td>0.00001</td>
<td>-1.67</td>
<td>-0.00002758*</td>
<td>0.00001</td>
<td>-1.99</td>
</tr>
<tr>
<td>D1</td>
<td>0.10921**</td>
<td>0.03375</td>
<td>3.24</td>
<td>-0.087106**</td>
<td>0.03310</td>
<td>-2.63</td>
</tr>
<tr>
<td>D2</td>
<td>0.13242**</td>
<td>0.03414</td>
<td>3.88</td>
<td>-0.12769**</td>
<td>0.03347</td>
<td>-3.82</td>
</tr>
<tr>
<td>D3</td>
<td>0.083178**</td>
<td>0.03636</td>
<td>2.29</td>
<td>0.11024**</td>
<td>0.03565</td>
<td>3.09</td>
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<tr>
<td>D4</td>
<td>0.12509**</td>
<td>0.04481</td>
<td>2.79</td>
<td>-0.02289</td>
<td>0.04394</td>
<td>-0.52</td>
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<tr>
<td>CONSTANT</td>
<td>-0.07133</td>
<td>0.11280</td>
<td>-0.63</td>
<td>0.38837**</td>
<td>0.11070</td>
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<td>R-Square</td>
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<td>F value</td>
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<td>P-value</td>
<td>0.00001</td>
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<td>0.00001</td>
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</tbody>
</table>

** Significant at 1% level and * significant at 5% level. AEqTA = Averaged Allocated Equity to Total Assets Ratio, RETA = Averaged Retained Earnings to Total Assets Ratio, TE = Averaged Technical Efficiency, AE = Averaged Allocative Efficiency, SE = Averaged Scale Efficiency, OE = Averaged Overall Efficiency, ROA = Averaged Return on Assets, ROACV = Coefficient of Variation of ROA, ROECV = Coefficient of Variation of Return on Equity, TSALE = Averaged Total Sales in million dollars, D1 = Midwest, D2= northern and southern plains, D3= Atlantic, D4= South.