# Role of Financial Variables in Explaining the Profitability of North Dakota Farm Supply and Grain Marketing Cooperatives

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## Abstract

This paper examines the profitability of a balanced sample of 58 North Dakota farm supply and grain marketing cooperatives over the period 2003–2007. Our findings reveal that increased liquidity tended to allow farm supply cooperatives to operate more efficiently, but reduced the efficiency of cooperatives which provide farm supply and grain marketing services. These results suggest strategies for cooperatives during times of illiquidity and other credit constraints for achieving profitability objectives.

**Key words**: liquidity, solvency, cooperative, agribusiness marketing.

Increased working capital requirements associated with commodity grain market volatility have impacted farm supply and grain marketing cooperatives throughout the United States. Working capital requirements associated with margin calls, and interest expenses associated with larger credit lines, have changed (Mark et al., 2008; Westhoff, 2008). These conditions may have decreased the efficiency with which cooperatives use inputs to produce outputs.

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For example, a sample of 58 North Dakota agricultural input supply and grain marketing cooperatives experienced decreases in liquidity, as measured by the current ratio, between 2002 and 2007 (McKee, 2008). The current ratio for this group declined from 1.66 (e.g., 1.66 units of current assets to 1 unit of current liabilities) in 2002 to 1.35 in 2005, then increasing to 1.43 in 2006. At the same time, more profitable firms made relatively greater use of external financing—debt capital—in order to conduct their operations. It is possible, therefore, that managers of the most profitable agricultural input supply and grain marketing cooperatives in North Dakota sacrificed liquidity and increased leverage in order to achieve or maintain profitability. It is unclear whether this working capital constraint enabled cooperative managers to improve their profitability.

The objective of this paper is to measure the relationship between two financial ratio variables, the current ratio and the ratio of gross margins to total assets, and profitability for farm supply and grain marketing cooperatives in North Dakota. Given that increased working capital requirements associated with margin calls and interest expenses have decreased the liquidity of many farm supply and grain marketing cooperatives between 2003 and 2007, and many firms increased their debt, this time period presents a natural experiment in which to consider the importance of liquidity and solvency to profitability.

## Literature Review

Financial ratios have been widely used to study the determinants of profitability of cooperatives. Boyd et al. (2007) provide an extended literature review but some important papers include Hazledine (1989); Lerman and Parliament (1990); Barton et al. (1993); Baourakis et al. (2002); Kenkel et al. (2002); and Soboh et al. (2009). Boyd et al. (2007) tested for the effect of financial variables on profitability. The authors studied whether liquidity, asset size, risk (measured by the standard deviation of return on equity for each co-op), the ratio of assets to equity, net profit margin, asset turnover, the times interest earned ratio, and total assets affected lagged average return on equity and derived conclusions on the characteristics of management decisions which could be made to improve the profitability of farm supply and grain marketing cooperatives.

Financial data do capture some benefits that accrue to members of farm supply and grain marketing cooperatives, but it is worth noting some constraints to their use. For example, prices paid to members for their grain, measured as the cost of goods sold in grain marketing cooperatives, partially measures a significant benefit for cooperative members. Use of financial ratios to evaluate the performance of cooperatives is not an outcome of economic theory (Sexton and Iskow, 1993).

Agricultural marketing cooperatives are vertically integrated businesses, linking the production and marketing steps of the food marketing chain under the ownership of the agricultural producer. Sexton and Iskow indicate that favorable pricing or other benefits can be used to transfer financial benefits to cooperative members, making the use of financial ratios, based solely on the performance of the cooperative, inadequate for describing how profitable the vertically integrated system is.

Despite these constraints, financial data can convey accurate information about the profitability of the cooperative under certain circumstances. For example, to the extent non-pooling grain handling and input supply cooperatives are examined, and only competitive prices are considered, no residual benefit from vertical integration exists. In addition, financial data which describe the cost of inputs obtained in competitive markets can be used to measure the profitability of firm production. Boland and Akridge (1999) found that the use of financial ratios such as asset efficiency, solvency, and liquidity included price effects whereas efficiency measures such as allocative, productive, and technical efficiency were able to remove the price effect and focus on the impact on input or quantity usage in a more pure efficiency measure. However, there was significant and positive correlation between the financial ratios and the efficiency measures for the local fertilizer cooperatives in their data. Finally, conversations between the authors and lenders to cooperative businesses indicated that financial institutions may require cooperatives to act as profit maximizing entities in order to maximize the likelihood that cooperatives will repay their loans.

### *Liquidity is an Important Determinant of Profitability*

Liquidity management is commonly used in the agribusiness literature to assess the financial performance of cooperative firms (for example, see Barton et al., 1993; Kenkel et al., 2002; Richards and Manfredo, 2002; Boyd et al., 2007). Liquidity ratios measure the short-term solvency of a firm. High liquidity reflects an ability to repay debts and is valuable for obtaining debt capital. It also reflects a management team's disposition for using its cash and other short-term assets efficiently.

Research in the general economics literature supports the idea of increased profitability with decreased liquidity. Kehoe and Levine (2001) model the effect of liquidity constraints on asset holders. They find that these assetholders experience greater persistence of shocks, whereas asset holders facing constraints on leverage instead of on liquidity experience no long-run effects from short-run shocks. In this case, managers may choose risk management strategies which tend to increase efficient use of resources. Oliveira and Fortunato (2006) and Hoshi, Kashyap and Scharfstein (1991) indicate that investment in firms with information problems in

capital markets is much more sensitive to liquidity levels than for firms which provide relatively more information to capital markets. Evans and Jovanovic (1989) describe the extreme case of this when concluding that liquidity constraints bind decisions of entrepreneurs attempting to enter a given product market, forcing the entrant to bear the risks associated with their new venture. Hence, in cases of information problems, firm managers have incentives to operate as efficiently as possible in order to preserve cash flow for future periods.

With regard to the food economy, Boland, Golden, and Tsoodle (2008) found that liquidity was a significant variable in determining profitability of 45 family-owned food firms over the 1993 to 2002 time period. Schumacher and Boland (2005) found similar results with regard to the variance in profitability for over 400 vertically integrated food businesses and agribusinesses operating in the retail supermarket, wholesale grocery, restaurant, and food processing industries for the 1982 to 2003 time period. Dorsey and Boland (2009) found that liquidity was a significant variable in measuring the performance of vertical integration (described as integration within the food economy) and diversification (described as integration outside the food economy) strategies for firms in these same four sectors over the 1982 to 2006 time period. Clearly, the current ratio is an important variable in explaining the performance of firms in the food economy. This suggests that a certain level of liquidity is essential to the operation of a business, but that excessive liquidity tends to reduce efficiency.

### *Solvency is an Important Determinant of Profitability*

Solvency has also been used as an indicator of financial performance (Baourakis et al., 2002; Boyd et al., 2007) and research has shown it affects the profitability of agricultural cooperatives. Hailu et al. (2005) estimate the influence of solvency on the ability of a sample of Canadian agricultural cooperative to achieve cost-minimization. In the case of agricultural cooperatives, a team of user-directors and of General Manager or Chief Executive Officer balances the member's preference for financial returns from investment in the cooperative with management's preference for spending money on projects beneficial for management, such as perquisite consumption and cross-subsidizing poorly performing projects. This is the agency problem. Hailu et al. (2005) found that firm and industry characteristics must be accounted for in determining whether increased solvency generates statistically significant agency costs, which could come in the form of means for managers to make expenditures which increase their personal benefits and ignore owner preferences. Based on their analysis, only one of the cooperatives in their sample suffered from increased agency costs due to increased leverage. Alternatively, a study of farm supply and marketing cooperatives by Featherstone and Al-Kheraiji (1995) found that increased debt led to increased costs of

production. Schumacher and Boland (2004), Boland, Golden, and Tsoodle (2008), and Dorsey and Boland (2009) have found that solvency is a significant variable in explaining the financial performance of firms in the four segments of the food economy (e.g., processing, wholesale grocery, retail supermarket, and restaurant). Thus, solvency is a logical variable to use when explaining profitability.

## Methodology

Based upon the literature review, the importance of liquidity and solvency factors on the profitability of a firm can be examined using profitability as an endogenous variable. This can be represented as:

$$(1) \qquad y = f(\mathbf{x})$$

where $\mathbf{x}$ is a vector of financial liquidity and solvency measures and $y$ is a measure of profitability. To examine the importance of financial liquidity and solvency measures, equation (1) can be represented econometrically as:

$$(2) \qquad y_{it} = \alpha_1 + \beta_{1,1} Liquidity_{it} + \beta_{1,2} Solvency_{it} + \beta_{1,3} Dummy + \varepsilon_{it}$$

Where $i$ denotes cooperatives and $t$ denotes years with $\varepsilon$ representing the error or the residuals. The construction and definition of the endogenous and exogenous variables presented in equation (2) is defined below.

Profitability, $y_{it}$, is measured as the ratio of local gross margin to local assets where gross margin is defined as sales less the cost of sales and local is defined as income or assets which pertain to the operations of the cooperative and the business locations it operates. Other measures used in previous studies such as return on local assets (income from local assets divided local assets) or return on equity (return on local income divided by equity) were considered. However, a measure of local income was not available for these local cooperatives. Liquidity is the ratio of current assets to current liabilities. Solvency is the ratio of total assets, adjusted for current liabilities, divided by the value of member equity in the cooperative.

All cooperatives in these data supply a combination of petroleum, fertilizer and crop protection products; farm supplies; convenience items; grain marketing services; or a combination of all of these. Cooperatives which market other agricultural products such as value-added agricultural products (specialty grains, pasta, sugar), meat (bison, lamb), vegetables (potatoes) and other commodities are not represented. Information about the share of an individual cooperative's

business for each type of product or service was not available. Anecdotal evidence from observations by the authors and statements to the authors by certified public accountants who audit the financial statements of cooperatives indicated that cooperatives with relatively smaller total sales tend to specialize in the provision of petroleum, fertilizer and crop protection products, farm supplies, and convenience items. Larger cooperatives provide these same goods, together with grain marketing services, with a majority of sales resulting from the sale of grain marketing services.

However, Boyd et al.'s (2007) extensive literature review reported only one study that found a positive relationship between asset size and profitability. But because of the perceived importance of size, a dummy variable is included in this study to account for size. Because of the uniqueness of these data which represents one geographic region, we believe there is a reason to break up the data into two asset categories. In doing so, we are not assuming one category is more profitable than the other. In this analysis to differentiate the size of the firm and the composition of goods, all cooperatives which have sales of $10 million or less in any year were classified as cooperatives which specialize in petroleum, fertilizer and crop protection products, farm supplies, and convenience items. There are 22 cooperatives in this category, or 104 observations over five years. Cooperatives with sales greater than $10 million were assumed to provide these goods as well as grain marketing services, and therefore use a different technology to generate output. The second category had 36 cooperatives, or 186 observations. During the time period in this sample, six observations migrated from the first size category into the second. *Dummy* is a dummy variable representing firms with more than $10 million in sales as one.

## Description of the Data

Data for this study are obtained from balance sheets and income statements of 58 farm input supply and grain marketing cooperatives with headquarters in North Dakota for the years 2003 through 2007. A study using data only from North Dakota farm supply and grain marketing cooperatives has merit since the average sales volume of many states is larger than that of cooperatives in North Dakota. North Dakota is similar to Alabama, Mississippi, Oklahoma, and Texas in that there are many cooperatives with, on average, relatively small sales volumes. In 2001, average net sales per North Dakota cooperative were $10 million, ranking the state 35$^{th}$ of the sales from 45 states reported by the USDA (Kraenzle et al., 2003). In 2006, average net sales per North Dakota cooperative were $20 million, ranking 34$^{th}$ of the 47 states surveyed (DeVille et al., 2007).

The North Dakota farm supply and grain handling cooperative sector has been evolving in ways which reflect national trends. The number of grain marketing and farm supply cooperatives in North Dakota is following nationwide trend of declining numbers. In 2001, 210 farm supply and grain marketing cooperatives were in operation in North Dakota (Kraenzle et al., 2003). By December 2006, this number had declined to 197 (DeVille et al., 2007). In addition, some farm supply and grain marketing cooperatives in North Dakota have been growing very rapidly, however. In 2002, the largest North Dakota farm supply and grain marketing cooperative had sales of $74 million. By 2007, sales at the largest North Dakota cooperative were $219 million. This number is significantly less than larger cooperatives in Nebraska and Iowa and the largest cooperative in South Dakota had $1.2 billion in sales in 2008. In general, North Dakota has not seen the consolidation in local cooperatives relative to these states (Spencer 2001).

DeVille et al. (2007) observed 196 farm supply and grain marketing cooperatives operating in North Dakota in 2006. After removing data from cooperatives which had missing observations for years between 2003 and 2007, measures of liquidity, solvency, and profitability were calculated for 58 cooperatives. Table 1 provides the summary statistics.

**Table 1. Summary statistics of North Dakota farm supply and grain marketing cooperatives sample, 2003-2007**

| | Firms < $10 million | | | Firms > $10 million | | |
|---|---|---|---|---|---|---|
| | Observations | Mean | Std. Dev. | Observations | Mean | Std. Dev. |
| Profitability Ratio | 104 | 0.279 | 0.079 | 186 | 0.317 | 0.181 |
| Liquidity Ratio | 104 | 2.139 | 1.337 | 186 | 1.500 | 0.554 |
| Solvency Ratio | 104 | 0.265 | 0.112 | 186 | 0.424 | 0.177 |

These statistics reveal significant differences in financial performance between the two groups of cooperatives. Smaller cooperatives had an average current ratio of 2.14, as compared to 1.5 for larger cooperatives. The null hypothesis that the difference in the average current ratio was not significantly different from zero was rejected with 99% confidence, based on an equality of means test. In addition, the standard deviation for cooperatives with greater than $10 million in output was smaller than that for smaller cooperatives, suggesting that a common feature of smaller cooperatives is relatively high liquidity when compared with any single large cooperative. Smaller cooperatives also tended to have significantly less debt as a fraction of total assets than larger ones based on an equality of means test.

## Results

To examine the importance of liquidity and solvency on the profitability of the cooperative, equation 2 was estimated for a sample of 58 cooperative firms with 5 years of data from 2003-2007. Since the data represented cross sectional, time series data, alternative model specifications were considered for equation (2) including ordinary least squares (OLS), a one-way fixed effects model and a one-way random effects model. The random-effect assumption is considered appropriate when inferences on an entire population are desired, and the levels in the data represent only a sample from that population. Each level of a random effect contributes an amount that is viewed as a sample from a population of normally distributed variables, each with mean zero, and an unknown variance. One drawback to this method is that it does not generate any test of significance for the effects. In contrast, the one-way fixed-effects model rests on the assumption that the effects are fixed and that only the residual terms are random, drawn independently from a population with mean zero and unknown variance. An advantage to this method is that F-statistics can be estimated to test for the significance of the effects. After estimating all four models, a one-way fixed effect model was chosen as the appropriate choice because the fixed effects were significant for 31 of the 58 firms. Based on the absolute value of Akaike's information criterion (AIC), the one-way fixed effects model was preferred over a two-way fixed effects model.

The parameter estimates, standard errors, and hypotheses tests are shown in Table 2. The coefficients on liquidity and solvency are significantly different from zero while the dummy variable on size is insignificant. The parameter estimates are consistent with economic theory and the previous literature in that an increase in liquidity caused by more current assets (such as cash) relative to current liabilities (such as accounts payables) results in a decrease in profitability. In addition, an increase in the amount of assets relative to equity (e.g., financing these assets with debt) which is an increase in the solvency ratio (assets over total equity) leads to a decrease in profitability. There is no evidence of a size effect which is consistent with past studies.

**Table 2. Parameter Estimates, Standard Errors, and Hypothesis Tests for Equation (5) for a One-way Fixed Effects Regression Model**

| Variable | Parameter Estimate | Standard Error | T Value |
|---|---|---|---|
| Intercept | 0.408 | 0.092 | 4.43 |
| Liquidity | -0.062 | 0.025 | -2.44 |
| Solvency | -0.249 | 0.090 | -2.75 |
| Dummy | 0.008 | 0.028 | 0.27 |

$R^2 = 0.566$

The results of the regression indicate that changes in liquidity and solvency have statistically significant effects on the ratio of gross margin and assets, but the economic significance of these results depends on the size of the cooperative. Consider the median North Dakota farm supply and grain marketing cooperative in 2008. This median cooperative has $4.8 million in assets and gross margin of $1.3 million. In this model, the profitability is measured as a percentage, while the financial variables are measured as mixed numbers. Hence, the slope coefficients are changes in percentages. The application of these results to this cooperative indicates an increase of one unit in the current ratio decreases the ratio of gross margin to assets by 6.2%, which could be created by a decrease in gross margin of $297,500 (numerator) or an increase in assets of $1,425,000 (denominator).

A one unit change in the solvency ratio decreases the ratio of gross margin to assets by 24.9%, or a decrease in gross margin of $1,164,000 (numerator) or an increase in assets of $54.7 million (denominator). The change in the annual average current ratio observed in this group was smaller than one, however. The current ratio for the group of 58 cooperatives in this sample declined from 1.66 in 2002 to 1.35 in 2005, a change of 0.31 units. This change creates an estimated 1.9% increase in the ratio of gross margin and assets which could be created by an increase of $91,200 in gross margin (numerator) or a decrease in $314,700 of assets (denominator) for the median cooperative in this example.

## Conclusions

The results suggest a statistically significant, and potentially economically significant, relationship between the financial performance of North Dakota farm supply and agricultural marketing cooperatives, as measured by liquidity and solvency, and their profitability. North Dakota cooperatives which offer farm supplies and grain marketing services demonstrate a significant inverse relationship between profitability and liquidity and with solvency. These results support the hypothesis of cooperative managers using financial resources in ways which tend to reduce profitability.

We were unable to detect a statistically significant relationship between firm asset size and profitability which is consistent with the literature. This suggests no difference in the effect of credit availability on the profitability of North Dakota cooperatives, regardless of size.

We also conclude that the relatively low liquidity observed in farm supply and agricultural marketing cooperatives between 2003 and 2007 is important to increasing the profitability of cooperatives, but that increased profitability from decreased liquidity can be offset by increased solvency. Hence, sufficient access to

cash within a season, and maintaining a policy of restraint in acquiring long-term debt, generate conditions which tend to increase profitability. These conditions suggest that the increased working capital requirements associated with the commodity grain market volatility, through working capital requirements associated with margin calls and interest expenses associated with long-term debt, have not impaired the ability of farm supply and agricultural marketing cooperatives to remain profitable. This also suggests that these cooperatives are unable to profit from favorable changes in current asset value when unaccompanied by corresponding changes in current liabilities.

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