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Cooperative Mergers and Acquisitions: The Role of Capital Constraints

Timothy J. Richards and Mark R. Manfredo

Several explanations for merger activity exist for publicly traded firms, but none consider the unique aspects of cooperatives. This study develops a test for the hypothesis that cooperative consolidation occurs primarily in response to capital constraints associated with a lack of access to external equity capital. An empirical model estimates the shadow value of long-term investment capital within a multinomial logit model of transaction choice in a panel data set of the 100 largest U.S. cooperatives. The results substantially confirm the capital-constraint hypothesis. Thus, the primary implication is that internal growth may be a more viable alternative to consolidation if new forms of cooperative financing are developed.

Key words: capital structure, cooperative, discrete choice, joint ventures, mergers, multinomial logit, strategic alliances

Introduction

A large number of studies address both the motivations for mergers, acquisitions, and other activities as well as their impact on firm value (Jensen and Ruback).[1] While a unifying theory of the ultimate causes of mergers and acquisitions does not exist, most studies suggest that publicly traded firms engage in these activities to increase the value of the combined firm relative to the individual firms through economies of scale or through operational or financial synergies (Jensen and Ruback; Lewellen; Post; Scherer). Managerial hubris has also been suggested as a motivating factor, even if the intent of managers of acquiring firms is not malicious (Roll). Still other studies explain merger and acquisition activity as a consequence of more macroeconomic influences—following "merger waves" or as a response to industry shocks (Golbe and White; Linn and Zhu; Mitchell and Mulherin; Gort; Post). Today, long after the conglomerate merger wave of the 1960s (Hubbard and Palia), mergers and acquisitions continue at a rapid pace, particularly among agribusinesses.

While the bulk of this activity occurs among publicly traded firms, closely held companies, mutual insurance firms, and cooperatives are not immune. In fact, because these firms must often compete with publicly traded firms within their own industries, efficiency-driven consolidation typically spreads across organizational forms as a natural

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Timothy J. Richards is Power Professor of Agribusiness and Mark R. Manfredo is assistant professor, both in the Morrison School of Agribusiness, Arizona State University East, Mesa, Arizona. Financial and data support from the Rural Business Cooperative Service–USDA is gratefully acknowledged. All opinions, results, and conclusions are the authors' and do not necessarily represent those of the USDA.

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[1] For brevity, we refer to "mergers and acquisitions" throughout the paper in reference not only to these two activities, but to strategic alliances and joint ventures as well.

consequence of the process of creative destruction. However, non-publicly traded firms in industries without such competitive pressures have also experienced large numbers of mergers and acquisitions (see figure 1), so their cause remains an open question.

In particular, cooperatives present a unique problem because cooperatives are not formed to generate and retain profits, but rather to provide members with market access or other economic benefits that make their primary businesses more profitable. Because they lack an overt profit motive and cannot logically cede control to outside equity investors, most cooperatives do not issue publicly traded stock.[2] Equity financing of cooperative organizations is facilitated through member contributions to the cooperative (Cobia) or through retained "patronage refunds." Without a clear mandate to maximize the value of the cooperative, therefore, it is not clear whether the factors observed to drive mergers and acquisitions among publicly traded firms are necessarily those that cause similar behavior among cooperatives.

Cooperatives' lack of access to equity markets and their mandate to return all profits to their owner-members, however, can create one unique motivating factor—namely, cooperatives tend to operate under conditions of severe capital constraint, typically relying on bank financing or bond issuance for the bulk of their capital needs. These conditions are similar to those experienced by publicly traded firms decades ago. In fact, Veblen (1924) first recognized that the merger wave of the 1890s was in large part facilitated by the development of new financial instruments which allowed acquiring firms to build a capital base greater than the value of their own assets. By valuing a firm's earning potential, its goodwill, or other intangible factors, firms were able to issue preference shares or debt instruments in excess of the value of existing assets, thus lifting a credit constraint that prevented expansion (Hake). Hubbard and Palia provide empirical evidence showing this theory explains the performance of merging firms during the 1960s conglomerate merger wave. This earlier lack of financial instruments did not reappear during the merger and acquisition wave in the 1980s because external capital markets had developed sufficiently to overcome these internal capital deficiencies. Similarly, Fluck and Lynch theorize that conglomerate mergers are a mechanism for firms to fund projects with positive net present values which could not be financed internally, thereby allowing the firm to circumvent a capital constraint.

This study seeks to test the hypothesis that capital constraints are a prime motivating factor behind cooperatives seeking to merge with, acquire, form a joint venture with, or create a strategic alliance with another. Therefore, after adequately controlling for all other factors that can explain cooperative merger and acquisition activity, there should be a positive correlation between the severity of a cooperative's capital constraint and the probability it will merge with another cooperative or another publicly traded firm—one that is less capital constrained. Consequently, the objectives of this analysis are first, to identify the factors that explain ownership transactions among cooperatives, and second, to determine whether capital constraints are indeed a factor driving mergers, acquisitions, strategic alliances, and joint ventures. The study begins with a description of a conceptual model of cooperative consolidation drawing from many branches of this disparate literature to form a set of testable hypotheses.

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[2] Although cooperatives are assumed to maximize the sum of producer surplus and consumer (member) surplus instead of profit, we show below that their behavior is observationally equivalent to a for-profit firm in a competitive industry. Consequently, measures of profitability are valid indicators of cooperative performance.

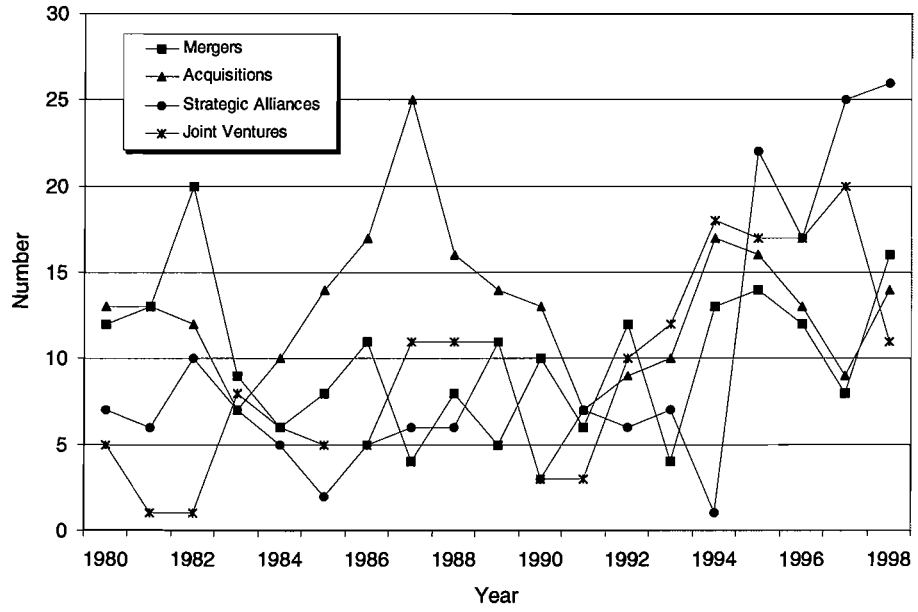

Figure 1. Cooperative merger and acquisition activity, 1980–1998

Economic Model of Cooperative Mergers and Acquisitions

Despite the depth of both empirical and qualitative studies on merger and acquisition activity, a well-defined, general theory of its underlying causes still does not exist.[3] However, existing studies do provide solid guidance in defining the fundamental factors likely to be important in explaining merger and acquisition activity. These factors can be broadly classified into two groups, depending largely upon whether the focus is at the firm or industry level: (*a*) structural or microeconomic, and (*b*) time series or macroeconomic.

Structural or microeconomic analyses follow the theory of corporate finance in defining a set of variables intended to explain the probability that a firm will merge with or acquire another firm.[4] This "market for corporate control" approach explains mergers and acquisitions as a means by which parties external to the firm may be able to unlock unrealized value through a takeover (Jarrell, Brickley and Netter; Jensen 1986, 1988; Jensen and Ruback).

The second approach, which views merger and acquisition activity more as a cyclical phenomenon, explains such transactions as being driven by "merger and acquisition waves" and macroeconomic factors (Weston and Jawien; Linn and Zhu; Resende; Golbe and White; Mitchell and Mulherin). Accordingly, studies of this general class tend to use time-series methods where the objective lies more in characterizing the shape of the cycle than in seeking the underlying cause of each type of activity. Because mergers and

[3] For an extensive review of the literature, see Post.

[4] This study considers the initiator of the transaction, or the acquiring firm, rather than the target for two reasons. First, the motivations driving each are likely to be significantly different. Second, the decision of the target is likely to be constrained by need and not subject to a welfare-maximizing decision process as the empirical model assumes.

Table 1. Determinants of Merger and Acquisition Activity

Reason for Consolidation	Variable Name/Description	Hypothesized Sign [a]
Cost Reductions	*ASSET TURNOVER RATIO*	+
Revenue Enhancement	*SALES GROWTH RATE* (%)	+
Profitability	*RETURN ON ASSETS* (%)	?
Extent of Capital Constraint	*CURRENT RATIO*	+
	DEBT-TO-ASSET RATIO	–
Macroeconomic Variables	*GDP GROWTH RATE* (growth rate of real GDP, %)	?
	T-BILL YIELD (30-year T-bond yield, %)	–
	AGRIBUSINESS M&A (total mergers and acquisitions in agribusiness industry, both cooperatives and non-cooperatives)	+
	VALUE OF AG OUTPUT (growth rate of U.S. agricultural output)	?
	S&P500 INDEX GROWTH RATE (%)	+
Value of Capital Constraint	λ_c (shadow value of capital constraint facing a cooperative–estimated)	+

[a] The hypothesized sign indicates the expected effect of each explanatory variable on the probability of observing each particular type of consolidation activity.

acquisitions are likely due to both internal or firm-specific factors and other factors that are more economy- or industry-wide, any comprehensive model of merger and acquisition activity should include elements of both.

This section outlines a series of variables intended to capture each type of effect on merger and acquisition activity, beginning with microeconomic factors. Table 1 provides a summary of the micro- and macroeconomic determinants and the expected signs of their marginal impact on the probability that a cooperative chooses some type of consolidation activity.

Perhaps the most common reason for a merger or acquisition is the search for synergy—the desire to create a whole that is greater than the sum of its parts. Potential sources of incremental cash flow gains resulting from synergies include revenue enhancement through more market power (Comanor; Scott; Perry and Porter), cost reductions through economies of scale, lower internal transactions costs (Williamson), or improved managerial performance in general (Hay and Liu). In this study, opportunities for synergy are measured as the total asset turnover ratio, a key indicator of asset management efficiency, in addition to more direct measures of growth and profitability.

Although cooperatives with high turnover ratios may have little to gain from combining with another, they may also be better able to utilize a larger asset base, so the net effect on the likelihood of a merger is expected to be positive. Growth is measured as the annual rate of increase in sales. Fast-growing cooperatives may be more likely to merge or make an acquisition simply because they regard buying into another market as a means of assuring future growth. The study measures profit using return on assets. Unprofitable cooperatives may need the human, financial, or marketing resources of another firm in order to survive. Therefore, profitability likely exerts a negative influence on the probability of consolidating, but sales growth may have a positive effect.

A cooperative's ability to take advantage of opportunities for synergy, however, depends upon the state of its balance sheet. Adelaja, Nayga, and Farooq include various financial ratios to test their "liquidity hypothesis," and other ratios to test a "leverage hypothesis"—both intended to measure the adequacy of a firm's capital base. However well these variables capture the *extent* of a capital constraint facing a firm, they do not measure its *value*.

Consider two cooperatives having equal current and debt-to-equity ratios, both clearly inferior to the average for the industry. Suppose further that one of these cooperatives has a very low growth rate and low returns to capital. It is highly leveraged and barely solvent, but still manages to provide service to its existing members. Compare this firm to the second firm, whose poor liquidity and high leverage ratios are caused not by poor performance, but by rapid growth amidst inadequate capital. In this case, the shadow value of the capital constraint is likely to be very high and would represent a source of unrealized value for a potential merger partner. In the former case, the shadow value of its capital would likely be low, and it would consequently be a poor merger candidate. Therefore, the shadow value of a cooperative's capital, holding the extent of leverage constant, is likely to exert a positive impact on the probability of consolidation.

Proxies for the adequacy of a cooperative's capital stock include measures of liquidity (current ratio) and leverage (debt-to-asset ratio). More liquid (higher current ratio) cooperatives have a greater ability to buy into another, so this effect is expected to be positive. On the other hand, the higher a cooperative's debt-to-asset ratio, the less likely it will be able to afford a merger or acquisition, and so this effect is more probably negative. Below, we account for the cost of obtaining more debt capital by including the yield on long-term government bonds among our macroeconomic factors.

Macroeconomic trends are also likely to fuel expectations of future growth opportunities and profitability. Sectoral cycles in the number of consolidation transactions suggest there are somewhat predictable patterns in activity—patterns commonly referred to as "merger and acquisition waves" (Golbe and White; Resende; Linn and Zhu). Holding firm-specific factors constant, periods of clustered merger and acquisition activity imply a higher probability of initiation of some form of merger or acquisition by a business.

These merger and acquisition waves, however, may simply be reflections of the cyclical behavior of macroeconomic variables which are the true underlying causes of merger and acquisition activity. Gort notes that merger and acquisition waves arise as a response to structural changes (shocks) in the macroeconomy such as increased foreign competition, deregulation, changes in disposable income, and aggregate stock market performance. Such disturbances can also cause a greater dispersion of value estimates among potential investors, increasing the likelihood an acquirer will overvalue a firm relative to the current owners' reservation price.

Of course, macroeconomic shocks affect different sectors of the economy in a variety of ways. For example, if an industry is experiencing rapid, scale-intensive technological change, the ability of smaller, formerly profitable firms to survive may be challenged, requiring them to merge horizontally or to acquire others in their industry in order to reduce costs and operate on a more efficient scale (Chan et al.). Such responses may also be defensive, or strategic in nature. If a firm adopts a strategy of rapid investment and acquisition to increase its productive capacity for the purpose of preempting entry or investment by rivals, then this may cause other firms in the industry to consolidate in

order to reduce costs to compete at the new, lower cost structure (Schenk; Jensen 1986). Thus, restructuring by one firm may cause similar changes among others.

These macroeconomic factors are measured using four variables. First, the interest rate on long-term government bonds (30-year U.S. Treasury bonds) provides a measure of the cost of capital. Because most cooperative mergers or acquisitions are likely to be financed by debt capital, we expect this effect to be negative. Second, the growth rate of gross domestic product (GDP) serves as a measure of overall economic activity.

Third, the growth rate of U.S. agricultural output is included because, as a first approximation, firms are more likely to perceive opportunities for expansion in a growing market. Gort, however, provides three reasons why growth should be negatively related to the probability of a merger: (*a*) the capacity to support a larger number of firms rises with growth, (*b*) the need to prevent competition falls with growth, and (*c*) rapidly growing demand allows firms to exploit economies of scale without merging. Consequently, the net effect of growth is indeterminate.

Fourth, merger and acquisition waves among non-cooperatives, driven largely by cycles in stock market prices, may cause mergers and acquisitions among cooperatives. If their publicly traded rivals are using inflated stock values to merge horizontally and increase market share, cooperatives in the same industry may be forced to do likewise. The effect of merger waves is captured here by including the total number of mergers and acquisitions in the agribusiness industry each year, both cooperatives and non-cooperatives. This variable is expected to have a positive impact on the likelihood of observing a merger or acquisition. The indirect effect of aggregate stock market performance on the choice of merger and acquisition activity is measured by including the annual rate of appreciation of the S&P 500 share index.

Mergers and acquisitions are also likely driven by more firm-specific valuation measures. Commonly, friendly mergers and acquisitions among cooperatives are completed at book value, despite the apparent superior value of one of the merger partners.[5] One usual practice in empirical studies is to measure whether a publicly traded firm is undervalued by estimating Tobin's Q, or the market value of a firm's equity relative to its replacement cost. This study develops a proxy variable for Tobin's Q in cooperatives that measures the *shadow value* of the capital constraint facing a cooperative. A cooperative with a high implicit valuation of its internal capital would likely regard the value of capital obtained as a result of a merger as equal to its own shadow value which, if above the shadow value of the target firm, represents a strong incentive to merge.

Hubbard and Palia argue that development of capital markets was largely responsible for the decline in post-conglomerate merger returns between the 1960s and 1980s. We suspect firms in the 1960s were in a situation very similar to the experience of cooperatives today. Cooperatives are notoriously capital constrained, so mergers and acquisitions may arise because the target firm serves as a pool of underutilized capital, suggesting the shadow value of a cooperative's capital stock is likely to exert a significant, positive effect on the probability of initiating a merger or acquisition. The next section describes the procedures used in estimating this value and testing its impact on the decision to consolidate.

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[5] The apparent irrationality in this practice is consistent with the cooperative principle of "cooperating with each other," so taking advantage of any ownership-arbitrage opportunity is beyond consideration.

The Econometric Model

According to the foregoing discussion, cooperative managers implicitly follow a two-stage decision process in evaluating a merger or acquisition opportunity. First, they determine the marginal value of additional capital to their cooperative, and second, they determine how this will affect their decision to consolidate with another firm. The econometric model compresses this process into a simultaneous realization of the value of any capital constraint and the probability of choosing each type of transaction. To accomplish this, the decision process is modeled using a multinomial logit approach.

Prior to estimating the discrete choice model, however, it is first necessary to derive an expression for the value of the capital constraint facing each cooperative. For a profit-maximizing firm, the shadow value of capital is defined simply as the marginal contribution to profit from an incremental unit of capital. However, cooperatives do not maximize profit per se, but rather the sum of surplus earned by their members both as customers and owners of the cooperative. Taking a producer-cooperative as an example, a cooperative's objective function includes both its own profit and the profit its members derive from selling their output to the cooperative. Define this objective in general terms as the sum of member producer surplus (π_m) and cooperative profit (π_c) from purchasing a quantity of farm output x_0 at a price p_x subject to a farm-output supply curve defined by $p_x(x)$ and sold by the cooperative after processing or handling as output y at a price, p_y, incurring a fixed cost of F (Fulton):

$$(1) \qquad \max_x W = \max_x \left[\pi_m + \pi_c\right] = \max_x \left[p_x x_0 - \int_{x=0}^{x=x_0} p_x(x)\,dx + p_y y - p_x x_0 - F\right].$$

Whether in a competitive or imperfectly competitive industry structure, the value of farm output drops out so that the solution to this problem of vertical integration clearly requires the price paid for member output to equal the marginal value product from the cooperative level: $p_x = p_y(\partial y/\partial x)$.[6]

Without loss of generality, we can extend this simple example to allow a more complex technology at the cooperative level and apply the same logic. Specifically, the optimal input decision from a cooperative's perspective is the one that maximizes cooperative profit alone—whether the input is purchased from the member or not. Therefore, an expression for the shadow value of capital is derived by treating capital as a fixed factor in a dual restricted profit function framework.[7] Of the many candidates for a suitable functional form for the restricted profit function, the Generalized Leontief (GL) (Diewert) has many desirable attributes and has been used in several empirical applications with acceptable results (see Lopez for an example). In particular, the GL form offers the benefits of linear homogeneity without normalization, while both symmetry and convexity can be tested and imposed.[8] Further, because it is a flexible functional form,

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[6] This is true because cooperative owners have an interest in both profits and favorable prices, so cooperatives must maximize the sum of producer and consumer surplus. This outcome is commonly known as the "competitive yardstick effect" of cooperative behavior (Fulton; Schmiesing). A reviewer notes that Royer and Bhuyan obtain a different result under the assumption the cooperative is "active" in the sense that it can control the amount of member input, whereas we assume the more typical "passive" case.

[7] Alternatively, a restricted dual revenue function could be used, but this would not represent a significant change from our current approach.

[8] Convexity in prices requires the Hessian to be positive semi-definite, while concavity in a single quasi-fixed input requires the second derivative to be nonpositive (Lopez).

it approximates any arbitrary alternative. The profit function (1) for a representative cooperative can be written in more detail (suppressing time subscripts for simplicity) as follows (Morrison):

$$\pi_c(\mathbf{p}\,|\,K_c, \gamma, \alpha) = \sum_{i=1}^{N}\sum_{j=1}^{N} \gamma_{ij}(p_{ic}p_{jc})^{1/2} + \sum_{i=1}^{N} \alpha_i p_{ic} K_c^{1/2} + \varepsilon_{1c}, \tag{2}$$
$$c = 1, 2, 3, \ldots, C,$$

where C is the total number of cooperatives, $\mathbf{p}$ is a vector of N netput prices ($p_{ic} < 0$ for inputs, $p_{ic} > 0$ for outputs), K_c is a fixed factor, and ε_{1c} is an i.i.d. random variable. This function is estimated over all cooperatives (c) and time periods as written above.

If data on specific outputs and inputs are available, the parameters of (2) can be more efficiently estimated by applying Hotelling's and Shephard's lemmas to (2) and estimating a system of output supply and input demand equations. However, our interest here lies in the shadow value of capital. Taking the derivative of (2) with respect to K_{ct} provides an expression for the shadow value of capital for each cooperative in each time period:

$$\lambda_{ct} = \frac{\partial \pi_{ct}}{\partial K_{ct}} = \frac{1}{2}\sum_{i=1}^{N} \alpha_i p_{ict} K_{ct}^{-1/2}, \tag{3}$$
$$c = 1, 2, 3, \ldots, C, \quad t = 1, 2, 3, \ldots, T,$$

which is a firm-specific measure of the value of the individual cooperative's capital constraint. The variable K_c is defined as the ratio of long-term debt to total debt so that a higher proportion of long-term debt relative to total debt in a cooperative's capital stock represents a higher value of K_c, and thus less of a constraint. This definition is appropriate because, first, cooperative equity-redemption policies mean that measures of equity are poor measures of a cooperative's capital stock and, second, long-term debt is regarded as the key component of a cooperative's permanent capital. Defined this way, the value of λ_c is expected to be nonnegative if the capital constraint is binding. The effect of capital constraints on a cooperative's choice of consolidation activity is tested by substituting this expression for λ_c in the multinomial logit model described next, thus collapsing the two-stage conceptual approach to a single econometric model.

The alternative choices include participation in either a merger, an acquisition, a strategic alliance, or a joint venture. Further, although some cooperatives are involved in more than one merger or acquisition in any given year, there are too few of these multiple-activity observations to permit efficient estimation of a count-data model. Rather, a multinomial logit model is used to describe the choice among discrete alternatives. Assume an expression for the latent "desire to consolidate" shows the utility from consolidating as the sum of a deterministic (V_{rt}^c) and a random component (ε_{rt}^c) such that:

$$U_{rt}^c = V_{rt}^c + \varepsilon_{rt}^c = \beta_{r0} + \sum_j \beta_{rj} X_{rjt}^c + \varepsilon_{rt}^c, \tag{4}$$
$$c = 1, 2, 3, \ldots, C, \quad r = 1, 2, 3, \ldots, R, \quad t = 1, 2, 3, \ldots, T,$$

where X_{rjt}^c is a scalar of attributes of both choice r and chooser c, including the expression for the shadow value of capital given in equation (3) above. The probability of choosing alternative r in time period t depends upon the realization of ε_i^c:

$$P^c(r|\beta) = P\left(U^c_{rt} - \beta_{r0} - \sum_j \beta_{rj} X^k_{rjt} > \varepsilon^c_{rt}\right), \quad r = 1, 2, 3, \ldots, R, \quad c = 1, 2, 3, \ldots, C, \tag{5}$$

or, assuming the error terms are i.i.d. extreme value, the probability of choosing r becomes:

$$P(r|\beta) = \frac{\exp(\beta_r \mathbf{X}_{rct})}{\sum_j \exp(\beta_j \mathbf{X}_{rct})} \tag{6}$$

for each alternative.

When estimating multinomial logit models, it is necessary to normalize the response coefficients of one choice to zero ($\beta_i = 0$) so the remaining parameters are defined as incremental to that case. Because there are many years for each cooperative wherein no activity occurs, we define this state as the "base case." Further, unobserved sectoral-heterogeneity is accounted for in the pooled time-series, cross-section data by estimating (6) in a fixed-effects framework. With this assumption, each component of $\mathbf{X}_r$ has a common effect across all cooperatives, but the intercept varies by a cooperative's industrial sector, e.g., dairy, input supply, cotton, grain, diversified, fruit and vegetable, sugar, or meat and poultry. Finally, most of the financial-performance measures are likely to be endogenous. Therefore, the multinomial logit model is estimated using lagged values of each so they are predetermined and uncorrelated with the equation errors when no serial correlation is present.

Data Sources and Methods

To explain the financial motivations behind cooperative merger and acquisition activity, this study requires two separate data sets: financial data for all agricultural cooperatives and a qualitative chronicle of their transactions. These data come from a variety of sources. First, descriptions of each transaction (names, dates, type of transaction, and transaction value) are taken from publicly available records for the sample period 1980–1998. The Food Institute provides profiles of all mergers and acquisitions in the food and beverage industry in its *Food Business Mergers and Acquisitions* publication. This information is then combined with reports of activity among cooperatives, derived from the U.S. Department of Agriculture (USDA) publication *Rural Cooperatives*, and from a wide variety of trade media accessed via the Lexis-Nexis database.

Having identified cooperatives involved in these transactions, USDA officials then merge the qualitative "activity" data with detailed financial data obtained from the USDA/Rural Business Cooperative Service's *Top 100 Cooperatives* database.[9] In total, data describing 88 cooperatives were generated, but because some are removed due to their combining with another cooperative, and some are created anew, the final data set consists of an unbalanced panel of 1,308 observations distributed across nine different agricultural sectors.

Sector-specific output prices for the capital shadow-value estimates are published in the U.S. Department of Labor/Bureau of Labor Statistics *Producer Price Index* database;

[9] Because these data include firm-level measures of financial performance, they are in ratio form so that individual cooperatives cannot be identified in the database. USDA officials merged our qualitative data with the financial ratio data.

Table 2. Summary Statistics of Variables Used in the Estimation Procedure

Variable	Mean	Std. Dev.	Mini-mum	Maxi-mum	No. of Obser-vations	Total No. of Co-ops
Asset Turnover Ratio	3.26	1.81	0.36	12.65	1,308	88
Return on Assets (%)	0.04	0.05	-0.20	0.45	1,308	88
Current Ratio	1.39	0.43	0.56	4.79	1,308	88
Sales Growth Rate (%)	0.05	0.21	-0.63	3.33	1,308	88
Debt-to-Asset Ratio	0.63	0.13	0.14	1.13	1,308	88
Long-Term Debt-to-Asset Ratio (*K*)	0.60	0.19	0.11	1.02	1,308	88
GDP Growth Rate (%)	0.07	0.02	0.03	0.12	1,308	88
S&P500 Index Growth Rate (%)	0.14	0.13	-0.10	0.34	1,308	88
T-Bill Yield (%)	0.07	0.03	0.03	0.14	1,308	88
Value of Ag Output ($ billion)	179.17	26.75	144.34	231.17	1,308	88
Agribusiness M&A (number)	87.48	23.87	56.00	157.00	1,308	88

Table 3. Number of Cooperative Consolidation Transactions by Time Period

Time Period	Mergers	Acquisitions	Strategic Alliances	Joint Ventures	Total Consolidations
1980–1984	21	33	22	13	89
1985–1989	13	60	23	28	124
1990–1994	14	47	13	30	104
1995–1998	20	27	56	43	146

input prices are taken from the same source, but are common across all cooperatives. Real interest rates, a measure of the cost of capital, come from the U.S. Federal Reserve Board. Leverage is measured by the total debt-to-asset ratio and the extent of a cooperative's capital constraint by a ratio of long-term debt to total debt. Other macroeconomic data (real gross domestic product) are from the U.S. Federal Reserve Board. The value of U.S. agricultural output comes from the USDA's *Agricultural Statistics* database, and S&P 500 stock index data are from Commodity Systems, Inc. The number of mergers and acquisitions among cooperatives and agribusinesses is from the transactions database which was assembled from the Food Institute's *Food Business Mergers and Acquisitions* data and other sources described above.

Table 2 provides a statistical summary of all variables used in the estimation procedure, and table 3 gives a breakdown of the number and type of consolidation transaction by time period.

If the shadow value of capital is estimated first, and then substituted into the discrete choice model as data, then the standard errors in the second stage will be inconsistent. In this study, however, both are estimated simultaneously by imbedding the expression for λ_c directly into the multinomial logit model and then estimating using maximum likelihood. In this way, consistent estimates of the shadow value, choice parameters, and their standard errors are obtained. Based on the data described here, the following section presents the econometric results and suggests some implications for future cooperative merger and acquisition activity.

Results and Discussion

Because the data consist of pooled time-series, cross-section observations for a number of cooperatives engaged in many different types of business, binary indicators to control for any unobserved heterogeneity between industrial sectors are included. All of the estimated results, therefore, are to be interpreted as conditional on the type of agricultural cooperative, whether dairy, input supply, cotton, grain, diversified, fruit and vegetable, sugar, or meat and poultry.[10]

The parameter estimates and standard errors are reported in table 4. The significance of λ_c is tested using a Wald test on expression (3) and the multinomial logit structural parameters. This expression also permits a test of whether the underlying profit function is concave in K. At the sample mean of each price ratio (over all cooperatives and time periods), the value of λ_c is 27.304 and its t-ratio is 4.476. Therefore, the shadow value of capital is positive, as hypothesized, and significantly different from zero at the 5% level. Further, given the shadow-value parameters in equation (3), the profit function is concave in K. This result also indicates that capital represents a binding constraint at the sample mean, but does not directly imply this constraint represents a significant factor in driving individual cooperatives to merge.

The importance of capital constraints in driving cooperative consolidation is evident from the estimation results in table 5. In particular, the choice elasticities provide support for the capital constraint hypothesis.[11] In general, the discrete choice model provides an acceptable fit to the data. At a 5% level of significance with 68 degrees of freedom, a likelihood-ratio test suggests rejecting the null hypothesis that all of the β parameters are equal to zero. A test of the primary hypothesis involves determining whether the probability of participating in any type of merger and acquisition activity rises in the shadow value of capital. If so, then cooperatives may indeed consolidate in order to address their lack of capital.

Table 5 presents the implied choice elasticities from the multinomial logit model. As is well known (Greene), the structural parameters of a multinomial logit model lack any intuitive content and may, in fact, differ in sign from the marginal effect.[12] With respect to firm-level financial performance variables, the results in table 5 are somewhat surprising; none have a statistically significant impact on the probability of some form of consolidation. This finding is likely explained by the presence of two competing effects. Whereas more efficient firms are more likely to be in a position to take over another, they are also less susceptible to being taken over if efficiency is used to create financial strength.

Among macroeconomic factors, the results reported in table 5 show that the decision to merge and form strategic alliances rises with interest rates. Although mergers typically do not require the firms to raise large amounts of capital (particularly for cooperatives because their mergers are usually conducted at book value), cooperative managers should nonetheless face incentives to make more efficient use of internal capital by merging when the cost of external capital is rising.

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[10] The precise association of each binary variable with a particular sector cannot be disclosed in order to protect the identities of the cooperatives in each. Four sectoral binary variable coefficients are estimated because there are too few observations in the smaller sectors for the full model to converge.

[11] The choice elasticities are defined as the proportionate change in the expected probability of observing $y_i = 1$ for an equiproportionate change in each regressor: $\varepsilon_{ij} = \nabla_{X_j} P(i|\beta)(X_j/P(i|\beta))$.

[12] The structural parameters and associated t-statistics are available from the authors upon request.

Table 4. Shadow Value of Capital Estimates

Variable	Coefficient	*t*-Ratio
$(p_y/K)^{½}$, where y = output, K = long-term debt-to-asset ratio	0.344	1.325
$(p_{x1}/K)^{½}$, where x_1 = fuel	0.304*	3.560
$(p_{x2}/K)^{½}$, where x_2 = power	3.067*	3.053
$(p_{x3}/K)^{½}$, where x_3 = labor	-0.965*	-3.201
Value of capital constraint (λ_c)	27.304*	4.476
No. of observations = 1,149		

Notes: An asterisk (*) denotes statistical significance at the 5% level. In this table, the value of λ is calculated from the other parameters, and its standard error is found using a Wald test on text equation (3). Note that these parameters and standard errors are estimated jointly with those in table 5 (below) in the multinomial logit model.

Table 5. Choice Elasticities for Consolidation Activities, Multinomial Logit Model

	Merger		Acquisition		Strategic Alliance		Joint Venture	
Variable	ε_{Mj}	*t*-Ratio	ε_{Aj}	*t*-Ratio	ε_{SAj}	*t*-Ratio	ε_{JVj}	*t*-Ratio
Asset Turnover Ratio	0.800	1.397	0.562	1.306	0.461	1.241	0.958	1.433
Return on Assets	-0.171	-0.668	0.090	0.681	-0.054	-0.652	-0.050	-0.650
Current Ratio	-0.431*	-1.992	0.050*	2.777	0.012*	2.370	-0.608*	-2.065
Sales Growth Rate	0.033	0.241	0.026	0.236	0.006	0.154	0.034	0.242
Debt-to-Asset Ratio	-1.306*	-2.280	-0.225*	-2.249	0.026	0.249	-1.321*	-2.284
GDP Growth Rate	0.145	0.972	-0.060	-0.752	-0.080	-1.050	2.081*	1.929
S&P500 Index Growth Rate	0.040	0.547	0.077	0.726	0.222	0.880	0.321	0.904
T-Bill Yield	0.291*	2.526	-0.083	-0.780	0.431*	2.342	-2.007	-1.815
Agribusiness M&A	0.372	1.613	0.162	1.340	0.029	0.476	0.597	1.698
Value of Ag Output	1.315*	3.306	-0.932*	-3.296	1.206*	3.297	-0.430*	-3.048
λ_c	0.012*	2.025	0.018*	2.328	0.016*	2.222	0.020*	2.402
No. of observations = 1,149								

Notes: An asterisk (*) denotes statistical significance at the 5% level. All elasticities are calculated from the structural multinomial coefficients and are evaluated at the mean of each variable and standard errors estimated via a Wald test procedure. We cannot disclose the precise association of each variable with the particular sector in order to protect the identities of the cooperatives in each.

Results from table 5 also provide some evidence showing cooperative mergers are more likely when the value of agricultural output is rising. Contrary to the argument of Gort, our findings indicate cooperatives appear to merge in order to support growth and to take advantage of prosperity, rather than as a means of restructuring and eliminating competition when the industry as a whole is shrinking. Such pro-cyclical expansion may also reflect the fact that cooperatives are merely extensions of individual members' businesses, expanding when the need to do so arises.

Somewhat weaker support is observed for the hypothesis that aggregate merger waves influence cooperative activity as well. Whether in response to a perceived need to compete with non-cooperative rivals, or driven by the same fundamental factors as other firms, the propensity of cooperatives to merge rises in the total number of aggregate agribusiness mergers and acquisitions.

Among the negative influences on cooperative mergers, the elasticity estimates in table 5 suggest more liquid and less leveraged cooperatives are more likely to merge, acquire, or form joint ventures. If a cooperative is earning a high return on assets, its managers may believe they are more likely to do well on their own and perceive little need for outside help. A high return on assets also suggests any agency problems are likely to be small. Indeed, while profitable cooperatives may generate a relatively large amount of cash, a high return on assets indicates this high rate of cash flow is based on a relatively small asset base and not the bloated, inefficient example described by Jensen (1988).

Similarly, a cooperative that accumulates a large amount of cash may simply not need to merge with another. Whereas mergers among publicly traded firms often occur when a large amount of cash can be obtained for a relatively low market price, this is rarely a consideration of cooperatives. With respect to leverage, however, the negative effect on the probability of a merger is understandable, given that the estimation procedure controls for the *value* of a firm's fixed capital as well as the absolute level. Cooperatives with relatively poor credit ratings make for less attractive suitors.

Of primary interest among all of these variables is the effect of a cooperative's capital constraint on the propensity to merge. Using the shadow value of the fixed level of capital available to each cooperative as a measure of this constraint, the results from table 5 offer some support for the main hypothesis of this study. With respect to the decision to merge, a 10% rise in the value of capital to a cooperative leads to a 0.12% rise in the probability of a merger. Although this elasticity is small, it is nonetheless of critical importance because of its implications for how cooperatives are capitalized. In particular, if capital starvation is indeed driving cooperatives to consolidate in the search for more capital, this at least partially explains why "new-generation cooperatives" tend to employ more innovative financing and ownership structures than do traditional cooperatives.

It remains, however, to determine if these results are robust across the other types of transactions, or if the capital-constraint effect is unique to mergers. Rather than merge, some cooperatives choose to consolidate through outright acquisitions of weaker rivals or vertical partners. Similar to the merger results, the results in table 5 show that leverage has a negative effect on the probability of acquiring another. Yet, unlike the merger case, more liquid cooperatives are more likely to acquire another, perhaps as expected. Further, among macroeconomic factors, only the value of agricultural output is significant. While higher interest rates are expected to have a negative impact on acquisitions, the lack of statistical significance may reflect the fact that the cost of higher interest is somewhat offset by the expectation of being able to charge higher prices in the future; i.e., if interest rates tend to rise with expected inflation, managers expecting to be able to raise prices in the future may acquire other firms to solidify their position in key markets. These elasticities also show that liquidity has a positive impact on the tendency of a cooperative to make an acquisition, but leverage has a negative effect. In particular, less liquid, highly leveraged cooperatives are less likely to make acquisitions. While cooperatives with a high proportion of debt to assets on their balance sheet may not have the ability to finance a buyout, more liquid cooperatives may be able to do so.

Whereas both mergers and acquisitions represent formal transactions which are likely to be driven by the desire to own the target firm, other transactions are typically less permanent and comprehensive. In fact, although joint ventures and strategic alliances

are common among both non-cooperatives and cooperatives alike, they are becoming particularly prevalent among cooperatives for the following reasons: (*a*) they are consistent with the fundamental principles of cooperation, (*b*) they do not require the transfer of ownership, (*c*) they are more flexible as to duration and commitment, and (*d*) they require less capital. Nonetheless, many of the statistically significant factors are similar to those influencing mergers and acquisitions.[13]

With respect to strategic alliances, the estimates in table 5 show that interest rates, the value of agricultural output, and the shadow value of capital exhibit similar positive influences as in the case of mergers. Clearly, strategic alliances will be more attractive the more costly formal acquisition transactions become. Like cooperative acquisitions, the probability of forming a strategic alliance rises in liquidity, but strategic alliances are unaffected by leverage.

Interest rates, the value of agricultural output, and the shadow value of capital are all significant determinants of the decision to form a joint venture, but there are some important differences between this case and the determinants of strategic alliances. Specifically, strategic alliances do not necessarily imply a specific commitment of capital, but rather a sharing of critical organizational competencies with another firm. Aggregate economic performance is important to the incentive to form a strategic alliance; when expected growth rates are high, more potential enterprises are likely to become viable, and so corporate capital budgets are more likely to reach their limits. Also contrary to the other forms of consolidation, interest rates reduce the probability of a joint venture because a higher cost of capital is likely to reduce the incentive to invest in *any* new venture as fewer potential investments are able to meet higher hurdle rates. Similar to all of the other transactions, however, capital constraints remain a consistent determinant of the likelihood a cooperative will form a joint venture.

Indeed, these results suggest the emergence of a common theme in the analysis of each type of transaction. Whether the consolidation is a merger, acquisition, strategic alliance, or joint venture, each represents a relatively novel and flexible means of overcoming capital constraints which are typical of cooperative organizations.

Conclusions and Implications

This study has sought to determine whether the capital constraint faced by cooperatives has fomented the recent growth of cooperative mergers, acquisitions, joint ventures, and strategic alliances. Using a sample of the 100 largest U.S. agricultural cooperatives, this research finds that a higher shadow value of capital increases the probability of a cooperative's decision to merge, acquire, form a joint venture, or create a strategic alliance. In addition, the econometric estimates indicate consolidation among agricultural cooperatives tends to follow "merger waves" throughout the non-cooperative agribusiness sector—perhaps driven by the need to match efficiencies gained by their non-cooperative rivals choosing to consolidate.

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[13] A reviewer suggests that the rising popularity of strategic alliances and joint ventures may lead to spurious correlation among other trending variables in our data. However, the multinomial logit model is estimated only after differencing, or using growth rates for the nonstationarity series in our data—namely GDP, stock prices, and agricultural output.

Among other macroeconomic factors, higher interest rates and higher value of agricultural output lead to a greater probability a cooperative will merge or form a strategic alliance with another, but a lower probability a cooperative will choose to form a joint venture. With respect to internal factors, the profile of a consolidating cooperative describes an efficient, minimally leveraged organization which is less liquid than average. Without access to publicly traded stock to serve as currency in a merger or acquisition, it is not surprising that capital adequacy is an important determinant of the likelihood of consolidation.

Other implications of this research are clear. First, for cooperatives to remain a viable business form, their managers should recognize the significant impediment to growth and competitiveness presented by the lack of access to public equity markets. Therefore, managers need to take advantage of innovative means of financing that address both the need of cooperative members to retain control and their need for external sources of capital. Second, a rapid rate of consolidation among efficient cooperatives should be viewed in a positive light as a means by which the cooperative sector can remain competitive with non-cooperative rivals, rather than as an indication of weakness or desperation.

Future research may consider the relative importance of market power versus efficiency motives for consolidating (Jensen and Ruback). Although this study shows that profitable cooperatives are no more likely to merge than others, separating these two motives may produce different results. Additional research may also contribute to our understanding of merger and acquisition activity by using more detailed data that will allow for more refined measures of each area of financial performance, or by including more "qualitative" factors which allow for managerial hubris or unique situations.

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