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TESTING FOR THE PRESENCE OF FINANCIAL CONSTRAINTS IN U.S. AGRICULTURAL COOPERATIVES

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This paper addresses the issue of perceived financial constraints in agricultural cooperatives. Scholars and practitioners have suggested that financial constraints resulting from restricted residual claims and imperfect access to external sources of finance is the “Achilles’ heel” of agricultural cooperatives in an increasingly concentrated, tightly coordinated, and capital intensive food system (Vitaliano 1983, Cook, Holmstrom). Despite many theoretical arguments supporting the cooperative capital constraint hypothesis, available empirical evidence is found to be inconclusive. Previous applied studies, however, fail to account for the financing needs of cooperatives as they focus exclusively on the supply of risk capital. This study provides an alternative test of the cooperative financial constraint hypothesis with firm-level panel data econometric analysis of cooperative investment behavior.

Following the corporate (Fazzari, Hubbard and Petersen) and the farm (Barry, Bierlen and Sotomayor) financial constraint literature, this study examines whether agricultural cooperatives’ investment is constrained by the availability of capital by estimating neoclassical and cash flow augmented Q investment models. In these models, investment demand is measured by the Fundamental q approach (Gilchrist and Himmelberg). Additionally, the study attempts to identify what cooperative structural and financial management characteristics are correlated with credit rationing by means of several sample splits. That is, the investment equations are re-estimated separately for different sub-samples constructed on the basis of firm asset size, relative amount of permanent equity capital to net worth, and credit risk. Regression results suggest that U.S. agricultural cooperatives’ capital expenditures are significantly affected

by the availability of internal funds. Results also indicate that all cooperative sub-samples face binding financial constraints when making investment decisions, but some cooperatives appear to be less financially constrained than others.

The Cooperative Capital Constraint Hypothesis

According to the cooperative capital constraint hypothesis, agricultural cooperatives are unable to acquire sufficient risk capital to finance profitable investment opportunities. As a result, cooperatives may be insufficiently capitalized to make the necessary investments to grow and remain a viable organizational form. The following arguments summarize a vast array of theoretical and empirical literature and substantiate the claim that agricultural cooperatives are financially constrained:

1. Cooperative residual claims are restricted.
2. Cooperatives' vaguely defined property rights structure discourages members from contributing risk capital.
3. Equity capital acquisition in cooperatives is tied to member patronage (with consequent dependence on internally generated capital).
4. Cooperative equity capital is generally not permanent.
5. Cooperatives have limited access to external sources of funds.

The first argument in support of the capital constraint hypothesis is that cooperatives have restricted residual claims as only active producer-members may provide the cooperative organization with voting equity capital (Fama and Jensen). As a result, risk capital acquisition in the cooperative firm is limited by current members' number, wealth, and risk bearing capacity. This constraint becomes more pronounced (i) as the pool of potential equity capital suppliers to cooperatives decreases as a result of farm consolidation (Hoppe); (ii) as net farm income becomes more volatile and increasingly dependent on public policy support (Gardner); and (iii) as farmers face their own financial constraints due to imperfections in agricultural credit markets (Hubbard and Kashyap). In addition to being restricted to members, cooperative residual claims are non-transferable, preventing the emergence of a secondary market for cooperative equity securities. The inalienability of cooperative residual claims is at the roots of portfolio, horizon, and control problems (Jensen and Meckling).

A second argument supporting the cooperative capital constraint hypothesis is that the property rights allocation in cooperatives does not provide members incentives to invest risk capital. Because cooperatives return earnings to members in proportion to patronage rather than ownership, cooperatives generally pay zero or low dividend rates on equity capital. In addition, cooperative residual claims are not appreciable since they are non-transferable and redeemable at book value. Consequently, members derive benefits from the cooperative mainly through usage in the form of favorable prices and patronage refunds. "There is a free-rider problem because patrons share in the return on cooperative equity capital whether or not they invest in the cooperative" (Knoeber and Baumer, p. 31). Free-rider behavior causes members to underfinance the cooperative by increasing their patronage relative to investment. In addition to the free-rider problem, portfolio and horizon problems further reduce members' incentives to contribute risk capital (Cook and Iliopoulos).

The third argument is that cooperatives depend on internally generated capital and earnings from non-member business as sources of equity capital. As there are few incentives for direct member investment, cooperatives rely primarily on patronage-based methods for acquiring equity capital including retained patronage refunds and per unit capital retains. Dependence on internally generated capital is not necessarily a handicap to cooperatives given that retained earnings is also the main source of finance in IOFs (Myers and Majluf; Brealey, Myers and Marcus). Some authors suggest, however, that the cooperative's ability to generate earnings might be constrained by user ownership (Staatz) and low market share in high margin, value added industries (Rogers).

The fourth argument substantiating the cooperative capital constraint hypothesis is that equity capital recorded on the cooperative balance sheet is not permanent because retained patronage refunds and per unit capital retains are generally allocated to individual members' accounts. Allocated equity accounts represent a claim against the cooperative akin to non-interest bearing debt. This claim is redeemable subject to the discretion of the board of directors. Because redeeming equity is a cash outlay to the cooperative, a large portion of its equity capital stock is not permanent and long-term growth cannot be sustained (Caves and Petersen).

The final argument is that agricultural cooperatives have limited access to outside sources of finance. Because cooperative residual claims are restricted to members and cannot be marketed, access to public equity markets is not a viable option unless the firm changes its organizational form (Hart and Moore). Cooperatives also lack access to adequate sources of debt capital because they do not possess enough net worth or collateralizable assets. Favorable access to loan capital notwithstanding, applied research conducted in the 1980s found that cooperatives experience higher after-tax long term borrowing costs than other business forms (Vitaliano 1980).

Despite such theoretical arguments in support of the cooperative capital constraint hypothesis, the available empirical evidence is not conclusive. Two distinct, but related, approaches are identified in the empirical literature examining the cooperative capital constraint hypothesis: growth studies and empirical tests of the cooperative *equity* constraint hypothesis.

Cooperative growth studies are part of an extensive applied literature evaluating the economic performance of user-owned organizations in comparison to investor-oriented firms (IOFs) and other organizational forms. Asset or sales growth is commonly used as an alternative performance measure in addition to economic efficiency, financial ratios, and firm survival (Schrader et al.). Growth studies have found that cooperatives experienced higher growth rates than comparable IOFs in the 1970s (Chen, Babb and Schrader) and that the long-term growth rate of seven large North American cooperatives is not constrained by size, but is "low, perhaps even zero" (Fulton et al., p. 258).

In two separate empirical studies, Lerman and Parliament examine the cooperative equity constraint hypothesis by comparing the capital structure of cooperatives relative to IOFs. Cooperatives are viewed as "equity bound" and, consequently, are expected to be more leveraged than comparable IOFs. In the first paper, Lerman and Parliament (1993a) observe that cooperatives do not borrow more than comparable IOFs. In the second paper, Lerman and Parliament (1993b) study the financing of asset growth among agricultural cooperatives. Contrary to theoretical expectations, cooperative equity capital is not statistically different from the national average of non-financial corporations between 1973 and 1983, and is higher than the national average after 1984 when IOFs became increasingly leveraged. Lerman and Parliament's results have been confirmed by other studies of cooperative financial performance (Hind, Royer).

Based on these findings it might be concluded that agricultural cooperatives are not financially constrained – they grow as fast and are as leveraged as comparable IOFs. However, one must be careful in reaching conclusions because these studies are not designed to directly test the cooperative capital constraint hypothesis. The objective of growth studies is to evaluate the relative performance of organizational forms or the effects of equity management practices on cooperative growth. However, evidence of sluggish cooperative growth is often interpreted as a consequence of financial constraints. The same argument applies to studies of cooperative capital structure. As noted by Lerman and Parliament (1993b, p. 439), “the observation of high equity financing proportions among the sample of cooperatives does not, however, unambiguously resolve the hypothesis of equity constraints in cooperatives.” Perhaps more importantly, the methodologies applied in previous research do not account for the financing needs of cooperatives, i.e., the demand for investment funds. Previous empirical studies focus exclusively on the supply of capital and, consequently, fail to address a more fundamental issue – is the supply of risk capital enough to finance the demand for investment funds? This study is designed to fill this void in the literature and test the cooperative capital constraint hypothesis with panel data econometric analysis of U.S. agricultural cooperatives’ investment behavior.

The Q Theory of Firm Investment

The empirical analysis of the cooperative capital constraint hypothesis is based on the Q theory of investment and its subsequent extensions including the effects of informational imperfections on firm investment behavior. Departing from the static nature of the neoclassical model of investment (Jorgenson), the Q theory is explicitly derived from the firm’s dynamic profit maximization problem. Let profits for firm i at any time t (Π_{it}) be determined by its capital stock (K_{it}) and an stochastic variable (σ_{it}), assuming all other production inputs are “maximized out” in that they are already utilized at their optimum levels. Assume further that capital is the only quasi-fixed input as net increments to the firm’s capital stock are subject to adjustment costs represented by the convex function C( ). The firm’s optimization problem is thus to choose investment to maximize its market value given by:

(1) $$V_{it} = E_{it}\{\sum_{s=t}^{\infty} \beta_i^s [\prod(K_{is}, \sigma_{is}) - C(I_{is}, K_{is}, \tau_{is}) - p_s I_{is}]\},$$

subject to the capital accumulation constraint given by

(2) $K_{is} = I_{is} + (1 - \delta_i)\, K_{i,s-1}$,

where δ_i represents the firm's constant rate of capital depreciation. In this formulation of the firm dynamic optimization problem, i and t denote the firm and time period respectively, E_{it} is the expectations operator with a subscript indicating the information available to the i^{th} firm at time t, I_{it} denotes investment (capital expenditures), and β_i^s is the discount factor adopted by the i^{th} firm. New capital resulting from investment is expected to become productive within the year.

The first-order condition for maximizing equation (1) with respect to investment yields the Marginal q specification:

(3) $p_t + C_I(I_{it}, K_{it}) = q_{it}$,

where

(4) $$q_{it} = E\{\sum_{s=0}^{\infty} \beta_i^s (1-\delta_i)^s [\Pi_K(K_{i,t+s}, \sigma_{i,t+s}) - C_K(K_{i,t+s}, \tau_{i,t+s})]\}\ .$$

The right-hand side in equation (3) is Marginal q, which is defined in equation (4) as the expected discounted value of profits from new capital investment – that is, the "shadow price" of capital. The firm maximizes its market value by equating the marginal benefits of an additional dollar of investment (Marginal q) to the concomitant marginal costs given by the relative price of investment and the marginal adjustment cost. To obtain an estimable specification for the Q investment equation, a functional form for the adjustment cost function, C, must be introduced. This study follows Hayashi and specifies C as being linearly homogeneous in investment and capital:

(5) $C(I_{it}, K_{it}) = (\alpha/2)\, [I_{it}/K_{it} - a_i - \tau_{it}]^2\, K_{it}$,

where α is the slope of the adjustment cost function, a_i represents firm-specific effects, and τ_{it} is the technology shock. Partially differentiating equation (5) with respect to investment and substituting the resulting $C_I(I_{it}, K_{it})$ into equation (3) yields the investment equation:

(6) $I_{it}/K_{it} = a_i + (1/\alpha)\, q_{it} + \tau_{it} + \varepsilon_{it},$

where ε_{it} is an optimization (or expectations) error.

Under the conditions assumed by the Q theory of investment – in particular, that capital markets are frictionless – external and internal sources of funds are perfect substitutes. As a result, financial variables play no role in capital spending. The Q theory predicts that capital spending only responds to Marginal q, a measure of future investment opportunities. Since Marginal q is unobservable, Tobin's Average q is commonly used as a proxy variable in empirical studies based on the Q theory of investment. Tobin's q constructed from financial market data is an appropriate measure of Marginal q under certain conditions – including competitive product and factor markets, homogeneity of fixed capital, linearly homogeneous production and adjustment cost technologies, and independent investment and financing decisions (Hayashi). Under these conditions, the value of the firm reflects the economic rents from existing capital stock. As a result, the empirical specification of the Q investment equation is commonly represented by:

(7) $I_{it}/K_{it} = a_i + b\, Q_{it} + \tau_{it} + \varepsilon_{it},$

where $b = (1/\alpha)$ and Q_{it} is the tax-adjusted value of Tobin's q.

In his survey of the empirical investment literature following the advent of the Q theory, Chirinko observes that equation (7) is the most popular explicit model of firm investment behavior. Yet the empirical performance of the model has been unsatisfactory both in terms of the statistical significance of Marginal q and the model's overall explanatory power.

Furthermore, financial and capacity variables are consistently found to be statistically significant when included in the Q investment model specification.

The Role of Financial Variables in the Investment Equation

Introducing informational imperfections in capital markets extends the neoclassical Q theory of investment. By relaxing the perfect capital market assumption, Modigliani and Miller's irrelevance proposition is rejected – that is, investment and financing decisions might affect one another. Stiglitz and Weiss' model of credit markets with asymmetric information show that an increase in the interest rate charged by a lender causes borrowers to increase investment projects risk. As a result, the lender maximizes profits by simply restricting the supply of loans to borrowers leading to credit rationing. Myers and Majluf demonstrate that asymmetric information between managers and outside investors regarding the profitability of an investment project causes the firm to forego positive net present value projects. Under these circumstances, the firm's ability to invest is affected by its capital structure.

Asymmetric information models find that the presence of information problems in capital markets lead to a cost wedge between external finance and internally generated funds. As a result, the supply curve of finance is a horizontal segment up to the firm's total net worth but is upward-sloping beyond that point as the firm seeks external funds to finance investment projects. In addition, these models posit that the slope of the supply curve of finance is proportional to information costs between the firm and suppliers of external funds. In other words, "in the presence of incentive problems and costly monitoring of managerial actions, external suppliers of funds to firms require a higher return to compensate them for these monitoring costs and the potential moral hazard associated with managers' control over the allocation of investment funds" (Hubbard, p. 194). Holding information costs constant, an increase in net worth causes a shift of the supply of funds schedule to the right.

This argument provides the theoretical underpinning for including proxy variables for changes in net worth (e.g., cash flow) in the standard Q investment equation. Consequently, the benchmark Q model of investment presented in the previous section may be expanded as follows:

(8) $I_{it}/K_{it} = a_i + b\ Q_{it} + c\ CF_{it} + \tau_{it} + \varepsilon_{it}$,

where CF_{it} represents cash flow for the i^{th} firm at time t. Despite recent debate (Kaplan and Zingales, Gomes), a positive and statistically significant cash flow coefficient in the investment equation is often interpreted as evidence of financial constraints.

On the basis of the empirical specification laid out in equation (8), studies of capital market imperfections affecting investment behavior utilize firm-level panel data in which firms are grouped into "high information cost" and "low information cost" categories. Theory suggests that firms facing informational problems in capital markets are prone to experience credit rationing and binding financial constraints when making investment decisions. As a result, the *difference* between the estimated cash flow coefficients across sub-samples provides a stronger evidence of financial constraints in the sample. Fazzari, Hubbard and Petersen identify "high information cost" manufacturing corporations on the basis of *a priori* information on observed dividend payout policies. They estimate a Q investment equation with cash flow as a proxy for changes in net worth. Their empirical results – along with those of Hoshi, Kashyap and Scharfstein, Blundell et al., and Schaller, among others – indicate a substantially greater sensitivity of investment to cash flow in firms classified a priori as "constrained."

Subsequently, Gilchrist and Himmelberg propose an alternative proxy variable (Fundamental q) to measure firm investment opportunities instead of Tobin's q. The authors estimate a set of vector autoregression (VAR) forecasting equations based on the firm's fundamentals and use the estimates from the VAR system to construct Marginal q. The importance of Gilchrist and Himmelberg's work is twofold. First, Fundamental q appears to be a better proxy for Marginal q than Tobin's q because it does not rely on the conditions set forth by Hayashi. Second, using Fundamental q as a measure of Marginal q, the Q model of investment can be estimated for nonpublic firms for which market data is not available. Following Gilchrist and Himmelberg, the Fundamental q approach has been applied to the study of financial constraints in the farm sector (Bierlen and Featherstone, Barry, Bierlen and Sotomayor, Gutierrez). This paper utilizes the Fundamental q approach to examine the investment behavior of another set of privately held firms – agricultural cooperatives.

The Sample and Research Procedures

Empirical testing of the cooperative capital constraint hypothesis is based on a firm-level panel data set of U.S. agricultural cooperatives. The data set used in this study is consistent, as the data provider collects and standardizes financial data for all firms included in the sample. This centralized approach ensures accurate comparisons among cross-sectional units throughout the study period. In addition, the majority of the cooperatives in the sample produce audited annual financial reports certified by a CPA firm and prepared under Generally Accepted Accounting Principles (GAAP).

The data set includes annual accounting information of 1,271 U.S. agricultural cooperatives during the years 1991-2000 (Table 1). When compared to the 1999 cooperative statistics published by the USDA Rural Business–Cooperative Service (RBS), the sample represents 36 percent of the total number of U.S. agricultural cooperatives. The firms in the sample generated $93.7 billion in sales and had $44.4 billion in assets in 1999, which correspond respectively to 81 and 93 percent of the totals reported by RBS. The sample includes local farm supply and grain marketing cooperatives, processing cooperatives with operations in manufacturing industries, agricultural production and service cooperatives, wholesale trade cooperatives, and cooperatives involved in transportation and warehousing activities.

<Insert Table 1>

The panel is, however, not balanced as the number of firms varies throughout the study period (Table 1). In order to construct a balanced panel, firms with less than 10 years of data for the variables of interest are dropped from the sample. This procedure reduces the number of cooperatives in the sample to 597. In addition, firms with large discontinuities in the reported book value of their physical capital stock are also excluded from the sample. Large discontinuities in net fixed assets are often caused by mergers, acquisitions, asset divestitures, and data errors. This criterion removes 90 firms from the sample, leaving a final sample of 507 firms.

The data used in constructing measures of the variables included in the specification of the investment equation is obtained from agricultural cooperatives' financial statements. There exist a variety of problems associated with translating accounting information into economic variables, including data reporting biases (Watts and Zimmerman). Nevertheless, the approach taken here is similar to that of other researchers who have estimated investment equations based on publicly available accounting data of IOFs (e.g., Fazzari, Hubbard and Peterson, Blundell et al.).

The dependent variable in the model is investment (I_{it}), measured as capital expenditures for the construction and acquisition of physical assets (property, plant and equipment). Data on agricultural cooperatives' capital expenditures are not available as few cooperatives actually report capital expenditures. As a result, cooperative investment must be inferred from changes in physical assets between subsequent years. This study follows Hoshi, Kashyap and Scharfstein and measures cooperative investment as the change in the stock of depreciable capital (net fixed assets) from the previous year plus capital depreciation during the year.

The explanatory variables in the estimable investment model are cash flow and marginal profitability of capital. Cash flow (CF_{it}) in IOFs is obtained by adding non-cash cost items, such as depreciation and amortization, to income after interest and taxes and before extraordinary items (net income). In the computation of agricultural cooperative cash flow, it is not only important to distinguish between cash and non-cash items, but also to recognize sources and uses of cash that are unique to cooperative organizations. The net income series in our data set is consistent among pooling and non-pooling cooperatives as pool distributions are included as an item in "cost of goods sold" in the computation of pooling cooperatives' net income. However, the cooperative net income series includes gains or losses on asset sales and sundry after-tax extraordinary items. Additionally, there are sources of cash flow that are unique to cooperatives, including cash and non-cash patronage income, per unit capital retains and retained patronage refunds. This study computes cooperative cash flow as the sum of net income, depreciation and amortization, but deducts non-cash patronage income, patronage dividends paid in cash, net retirements of allocated equity (including retains revolved), gains or losses on asset sales, and after-tax extraordinary items from cooperative net income.

In the construction of investment and cash flow series, the variables are first deflated by the GDP Implicit Price Deflator. Subsequently, investment and cash flow are normalized by the firm's capital stock in the beginning of the year to eliminate scale effects. Capital stock is generally measured at replacement cost with the perpetual inventory method (Salinger and Summers). However, this method depends on the availability of the firm's annual capital expenditures, which is not available in our data set. Consequently, capital stock is measured as net property, plant and equipment (i.e., net fixed assets). This book value measure of the capital stock differs from the replacement cost measure, as reported net fixed assets is sensitive to the accounting depreciation schedule adopted by each firm in the sample.

The marginal profitability of capital (Q_{it}), a measure of investment demand, is constructed from the estimates of a bivariate VAR system of order 3. This study follows Gilchrist and Himmelberg's method and includes cash flow, as previously defined (CF_{it}/K_{it}), and the ratio of sales over capital (S_{it}/K_{it}) in the VAR system. In the estimation of the VAR forecasting system with the cooperative panel data set, all variables are first-differenced in order to eliminate fixed-firm effects (Holtz-Eakin, Newey and Rosen). Additionally, the model includes time dummies to account for aggregate shocks. The VAR system is estimated with the generalized method of moments (GMM) estimator. The use of GMM is necessary in this context as it is a heteroskedasticity robust estimator that accommodates the presence of endogeneity in the model (Mátyás). The instrument list includes lags 2 to 4 of CF_{it}/K_{it} and S_{it}/K_{it}, as any lagged values beyond the first lag are valid instruments (Griliches and Hausman). The estimates of the VAR are then used to construct Fundamental q (F_{it}), defined as:

(9) $$F_{it} = [c' - (I - \lambda A)]^{-1} X_{it},$$

where X_{it} is a vector containing CF_{it}/K_{it} as the j^{th} element and S_{it}/K_{it}, c is a conformable vector of zeros with a 1 in the j^{th} row, I is the identity matrix, λ is a constant representing the discount factor and the depreciation rate, and A is the matrix of VAR coefficient estimates. Given the order of the VAR and the lags involved in constructing model variables, the initial 5 years of the panel cannot be used in estimating the investment model. The investment model is, therefore, estimated for the years 1996-2001.

It is a common practice in the empirical investment literature to exclude from the sample firms with extreme values of investment, cash flow, Tobin's Q or other variables of interest. This study utilizes an alternative procedure to treat outliers in that observations are "winsorized" if the value of the variable exceeds pre-determined cutoff values (Cleary). This approach reduces the impact of extreme observations in the regression analysis and allows the use of a larger number of observations than would be possible if these extreme observations were deleted from the sample. Summary statistics for the balanced panel of 507 firms is shown in Table 2.

<Insert Table 2>

Construction of Sub-Samples

This study investigates three alternative sample splits to discern financially constrained from unconstrained firms in the balanced panel: firm size, permanent equity capital, and credit risk. The justification for using the size variable as a sample splitting criterion is that small firms are more likely to face financing constraints because they are typically younger, less well-known, and hence more vulnerable to capital market imperfections induced by information asymmetries and collateral constraints (Schaller). This study uses total assets to measure the size of cooperative firms. As firm size is a continuous variable, the sample splitting criterion is whether total assets for a given cooperative is above or below a pre-determined cutoff value. In order to identify a subset of firms that face binding capital constraints with high probability, a firm is identified as constrained if its size falls below the 25th percentile in 1991. In doing so, the size criterion distinguishes between 127 small firms and 380 large firms. Summary descriptive statistics for sub-samples are shown in Table 3. The average size for the 380 large firms is $38.3 million, whereas the average size for the 127 small firms is slightly above $2 million.

<Insert Table 3>

Another criterion to distinguish potentially financially constrained cooperatives from unconstrained cooperatives is to examine the amount of permanent equity capital relative to total net worth. Permanent equity capital is defined as the sum of common stock, preferred stock and unallocated equity and is intended to measure the amount of "true" equity capital held by agricultural cooperatives. The rationale for using this criterion is that cooperatives with relatively high amounts of permanent equity might have more favorable access to external sources of finance. Additionally, cooperatives with low amounts of permanent equity need to constantly redeem allocated equity to member-patrons, which is a source of cash outlays that decreases the volume of internally generated capital available for investment. Since permanent equity capital is a continuous variable, the sample splitting criterion is based on a pre-determined cutoff value. A firm is classified as "low permanent equity (PEK)" if it falls below the 25th percentile. This criterion identifies 127 "low PEK" firms and 380 "high PEK" firms. "Low PEK" firms have on average 15 percent of permanent equity and 83 percent of allocated equity relative to total net worth (Table 3). In contrast, "high PEK" firms have on average net worth consisting of 47 percent of permanent equity and 51 percent of allocated equity. Unallocated equity is the largest component of permanent equity capital in both sub-samples, as U.S. cooperatives have in general relatively low amounts of common and preferred stock (USDA).

In addition to firm asset size and relative amount of permanent equity capital, this study uses credit risk (Z-Score) as a sample splitting criterion. The Z-Score is a measure for predicting bankruptcy that lenders use in conjunction with other credit scoring techniques to assess the probability that a customer will not pay (Brealey, Myers and Marcus). Given the dependence of most agricultural cooperatives on borrowed capital as a source of external funds, the ability to access credit markets might distinguish financially constrained from non-constrained cooperatives. Z-Score is a continuous variable and sample splitting is based on a pre-determined cutoff value. A firm is classified as "high risk" if it falls below the 25th percentile in the Z-Score sample distribution. This criterion identifies 125 "high risk" firms and 382 "low risk" firms. "High risk" cooperatives have an average Z-Score of 4.05, whereas the average for the "low risk" sub-sample is 5.01 (Table 3). "High risk" cooperatives have relatively lower amounts of unallocated equity and permanent equity, in addition to being more leveraged and less liquid than "low risk" cooperatives.

Empirical Results

In this section, the empirical results from estimating the Q investment model for the sample of U.S. agricultural cooperatives are analyzed. The restricted and the cash flow augmented Q investment models are estimated with the GMM estimator. GMM is an instrumental variable technique that corrects the potential errors-in-variables bias introduced by Fundamental q.

Full sample empirical results lend support to the hypothesis that agricultural cooperatives are financially constrained (Table 4). The unrestricted Q model adds explanatory power to cooperative physical capital investment when compared to the restricted model without cash flow. The positive signs and high t-ratios on all estimated investment model parameters indicate that both Marginal q and cash flow are significant explanatory variables of cooperative physical capital investment. The fact that cooperative investment is significantly sensitive to cash flow suggests the presence of binding financial constraints in the full cooperative sample.

<Insert Table 4>

Since the magnitudes of parameter estimates are dependent on the levels of the variables included in the model, elasticities are better representatives of the sensitivity of investment to the explanatory variables. Elasticity estimates are calculated at the means of each independent variable. In the restricted model, the elasticity for the Fundamental q parameter is 0.322, i.e., investment expenditure is inelastic with respect to the marginal profitability of capital. In the unrestricted model, the elasticity estimate for Fundamental q is 0.162 and 0.208 for cash flow. In other words, a one percent change in the ratio of cash flow to capital is expected to prompt an increase in the ratio of investment to capital of approximately 0.2 percent. Using median values of investment and cash flow it is possible to compute how investment responds to changes in cash flow in nominal terms. Based on the GMM cash flow elasticity estimate, a one standard deviation change in cash flow equal to $106,285 will prompt an increase of $23,824 in capital expenditures. This calculation is extended to the 2,535 observations in the balanced panel. Results show that the incremental investment associated with an increase in cash flow is within the bounds of that cash flow in 93 percent of the total number of firm-years. This result suggests that incremental investment could have been fully financed by changes in cash flow and, therefore, is not necessarily financed by leveraged funds. This provides further evidence that cooperatives depend on internal funds to finance investment, which is consistent with the financial constraint interpretation of the role of cash flow in the investment equation.

In order to ascertain whether cooperative structural and financial attributes affect the magnitude and statistical significance of the sensitivity of investment to cash flow, the investment equations are estimated separately for each of the aforementioned sub-samples. In order to do so, the VAR forecasting system is estimated and parameter estimates are used in the construction of Fundamental q for each sub-sample. The investment equation is then re-estimated for the "constrained" and "unconstrained" sub-samples with the GMM estimator.

The results found in Table 4 show the effects of Fundamental q and cash flow on large and small cooperative investment behavior. All GMM parameter estimates are positive in the unrestricted model, as predicted by theory. Fundamental q parameter estimates are not statistically significant, whereas cash flow coefficients for both sub-samples are statistically significant. That is, cooperative investment does not appear to be affected by Marginal q, but it responds significantly to cash flow. This result suggests that both large and small cooperatives are financially constrained. Contrary to theoretical expectations, the sensitivity of investment to cash flow for the large cooperative sub-sample is found to be larger than the investment-to-cash flow sensitivity of small cooperatives. The null hypothesis that small and large cooperative cash flow coefficients are equal is probed with the t-test, which indicates that the null hypothesis of parameter equality should be rejected. It is, therefore, concluded that small cooperatives appear to be less financially constrained than large cooperatives.

In the regression of the investment model for the sub-samples based on permanent equity capital, the Fundamental q coefficient estimates are positive but not statistically significant (Table 4). The cash flow coefficient estimates, in turn, are positive and statistically significant for both sub-samples, indicating that high and low PEK cooperatives are financially constrained. The investment-to-cash flow sensitivity is found to be larger for the low PEK cooperatives, corroborating the theoretical prediction. The null hypothesis of cash flow parameter equality is rejected. It is concluded that high PEK cooperative firms are less financially constrained than low PEK counterparts when making investment decisions.

Table 4 also provides parameter estimates for high credit risk and low credit risk cooperatives. All parameter estimates have the correct anticipated sign, that is, investment expenditures are positively correlated with both Fundamental q and cash flow. As the parameters for Fundamental q are not statistically significant in either of the two sub-samples, it is concluded that investment behavior is not affected by the marginal profitability of capital. Cash flow coefficients are statistically significant for both high credit risk and low credit risk cooperatives. This result suggests that both sub-samples are financially constrained. The cash flow coefficient for the low risk sub-sample is found to be smaller relative to the high-risk sub-sample, as expected from the theoretical discussion. On the basis of the t-test for parameter equality, it is concluded that high credit risk cooperatives are more financially constrained than low credit risk cooperatives.

In sum, the tests for excess sensitivity of investment to cash flow show that all the cooperative sub-samples face binding financial constraints when making investment decisions, but some cooperatives appear to be less financially constrained than others. In particular, small cooperatives, cooperatives with relatively high amounts of permanent equity capital, and low credit risk cooperatives are found to be less constrained than their large, low permanent equity capital, and high credit risk counterparts. The estimation of the investment model with sub-sample data provides further support to the financial constraint interpretation of cash flow in agricultural cooperative investment behavior.

Summary and Conclusions

It is commonly argued in the literature that agricultural cooperatives are financially constrained because they are unable to acquire sufficient risk capital to invest in productive assets. In this research we addressed the issue of capital constraints in agricultural cooperatives and examined whether physical capital investment is constrained by availability of finance. It was observed that cooperative investment responds positively and significantly to both the marginal profitability of capital and cash flow. When the cash flow variable was included in the investment equation with Fundamental q, there was a positive and statistically significant correlation between investment and cash flow for the full cooperative sample. In other words, cash flow appears to have influence on cooperative investment over and above its predictive content about the future profitability of capital.

In addition, the tests for excess sensitivity of investment to cash flow were extended to three a priori sample splitting criteria used to sort cooperatives into sub-samples of "constrained" and "unconstrained" firms. It was found that all cooperative sub-samples face binding financial constraints when making investment decisions, but some cooperatives appear to be less financially constrained than others. In particular, small cooperatives, cooperatives with relatively high amounts of permanent equity capital, and low credit risk cooperatives were found to be less constrained than their large, low permanent equity capital, and high credit risk counterparts.

Investment constraints arise in agricultural cooperatives as a result of free rider, horizon, and portfolio problems (Cook and Iliopoulos). Vaguely defined property rights emerge in cooperatives because residual claims are restricted to members, non-transferable, redeemable, and with benefit distribution proportional to usage rather than shareholdings. If agricultural cooperatives are to remain viable organizations in the 21st century, their leaders might need to revisit these restrictions on residual claims. This study does not empirically establish that the nature of cooperative residual claims causes financial constraints. Nor does it claim that eliminating restrictions on residual claims is a sufficient condition to ameliorating financial constraints in agricultural cooperatives. However, the theoretical analysis of the cooperative capital constraint hypothesis suggests that eliminating restrictions on residual claims might be a necessary condition for the attenuation of capital constraints in agricultural cooperatives.

Perhaps not surprisingly, cooperatives are adopting new organizational structures that relax some restrictions on traditional cooperative residual claims. Instead of demutualizing or converting to IOFs, as occurred with mutual firms in other industries, agricultural cooperatives seek to ameliorate capital constraints while maintaining user ownership and control. The survival and growth of agricultural cooperatives in responding to the challenges brought about by agroindustrialization will likely depend on the relative efficiency of such organizational innovations.

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Table 1. Selected Aggregate Data for the Panel of U.S. Agricultural Cooperatives, 1991-2000 (US$ Million)

Year	Number of Cooperatives	Sales	Total Assets	Net Worth	Net Income
1991	700	$32,050	$12,403	$5,086	$1,058
1992	880	$46,670	$18,967	$7,807	$1,460
1993	998	$51,744	$21,995	$9,266	$1,330
1994	1,184	$64,040	$26,012	$10,835	$1,995
1995	1,224	$86,765	$33,718	$12,856	$2,145
1996	1,241	$105,214	$39,318	$14,551	$2,588
1997	1,248	$113,334	$42,207	$16,086	$2,483
1998	1,251	$110,597	$48,416	$18,246	$2,081
1999	1,245	$93,655	$44,420	$17,634	$1,415
2000	1,150	$88,421	$41,510	$16,534	$1,175

Table 2. Summary Statistics for the Balanced Panel of 507 Agricultural Cooperatives, 1996-2000

Variable Acronym	Variable Description	Mean (St. Error)	Minimum Value	Median	Maximum Value
I_{it}	Investment (US$ Million)	1.944 (10.835)	-69.283	0.340	247.378
CF_{it}	Cash Flow (US$ Million)	1.549 (8.827)	-17.650	0.304	200.758
S_{it}	Sales (US$ Million)	65.720 (429.315)	0.056	9.655	12,239.000
K_{it}	Capital Stock (US$ Million)	6.883 (37.791)	0.026	1.352	833.203
I_{it}/K_{it}	Gross Investment / Capital Stock	0.34 (0.30)	-1.38	0.27	2.00
CF_{it}/K_{it}	Cash Flow / Capital Stock	0.28 (0.34)	-1.37	0.24	5.00
S_{it}/K_{it}	Sales / Capital Stock	10.27 (6.65)	0.25	8.89	30.00
F_{it}	Fundamental Q	0.92 (0.54)	-1.85	0.72	7.70

Note: Total number of observations in the panel is 2,535.

Table 3. Summary Statistics for the Balanced Panel of 507 Agricultural Cooperatives, by Sub-Samples, 1996-2000

Variable	***Small Cooperatives***	***Large Cooperatives***	***Low PEK Cooperatives***	***High PEK Cooperatives***	***High Credit Risk Cooperatives***	***Low Credit Risk Cooperatives***
	Mean (St. Error)	**Mean (St. Error)**	**Mean (St. Error)**	**Mean (St. Error)**	**Mean (St. Error)**	**Mean (St. Error)**
I_{it}/K_{it}	0.36 (0.29)	0.33 (0.30)	0.31 (0.27)	0.35 (0.31)	0.29 (0.30)	0.35 (0.30)
CF_{it}/K_{it}	0.30 (0.30)	0.28 (0.36)	0.32 (0.47)	0.27 (0.29)	0.30 (0.53)	0.28 (0.25)
S_{it}/K_{it}	11.37 (7.15)	9.90 (6.44)	8.92 (7.04)	10.72 (6.45)	7.46 (6.12)	11.19 (6.56)
Total Assets	$2,030,007 ($1,086,985)	$38,336,898 ($198,054,621)	$33,031,228 ($189,537,515)	$27,975,964 ($166,000,763)	$28,261,150 ($94,446,824)	$29,563,321 ($190,874,304)
Unallocated Equity (%)	36.33 (28.66)	28.49 (18.92)	11.74 (13.98)	36.71 (20.65)	24.76 (20.36)	32.31 (22.25)
Allocated Equity (%)	51.70 (34.61)	61.13 (27.63)	82.77 (22.31)	50.74 (27.61)	64.17 (28.17)	57.00 (30.12)
Permanent Equity (%)	47.30 (33.94)	36.58 (26.33)	14.81 (19.25)	47.43 (26.76)	32.01 (26.75)	41.64 (29.05)
Z-Score	5.49 (4.13)	4.53 (5.38)	4.19 (2.59)	4.97 (5.70)	4.05 (8.76)	5.01 (3.06)

Table 4. Effects of Fundamental q and Cash Flow on Cooperative Investment, 1996-2000

The dependent variable is the investment-capital ratio (I_{it}/K_{it}), where I_{it} is investment in physical assets and K_{it} is beginning-of-period capital stock. Explanatory variables include Fundamental q, constructed from estimates of a bivariate VAR (3) forecasting system, and (CF_{it}/K_{it}), which is the cash flow-to-capital ratio. All variables are first-differenced to eliminate firm-fixed effects. The equations are estimated with fixed year effects, which are not reported. The instrument set includes lags 2 to 4 of (CF_{it}/K_{it}) and (S_{it}/K_{it}). Standard errors of parameter estimates appear in parentheses.

Independent Variable and Summary Statistics	***Full Sample***	***Small Cooperatives***	***Large Cooperatives***	***Low PEK Cooperatives***	***High PEK Cooperatives***	***High Credit Risk Cooperatives***	***Low Credit Risk Cooperatives***
	Q Investment Model						
Fundamental q (Standard Error)	0.119** (0.048)	0.072 (0.067)	0.143** (0.065)	0.055 (0.053)	0.150** (0.065)	0.145 (0.172)	0.051 (0.035)
Wald Statistic (P-Value)	13.331 (0.020)	4.995 (0.416)	9.617 (0.087)	5.113 (0.402)	7.247 (0.203)	3.517 (0.621)	15.270 (0.009)
	Augmented Q Investment Model						
Fundamental q (Standard Error)	0.124* (0.048)	0.032 (0.059)	0.064 (0.067)	0.026 (0.060)	0.086 (0.067)	0.025 (0.148)	0.006 (0.035)
Cash Flow (Standard Error)	0.253* (0.067)	0.161** (0.072)	0.324* (0.105)	0.363* (0.092)	0.172** (0.083)	0.612* (0.160)	0.162** (0.065)
Wald Statistic (P-Value)	13.231 (0.021)	5.421 (0.367)	8.906 (0.113)	4.936 (0.424)	8.071 (0.152)	3.954 (0.566)	15.061 (0.010)
Number of Observations	2,535	635	1,900	635	1,900	625	1,910

* Coefficient estimates are statistically significant at 1% confidence level.
** Coefficient estimates are statistically significant at 5% confidence level.