Access to Capital and Firm-Level Investment Behavior in Food Industries: A Comparison of Cooperatives and Publicly Traded Firms

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Abstract: This paper compares investment behavior of agricultural cooperatives and publicly traded firms in the food industry. The importance of financial constraints is examined by exploring whether ownership structure affects investment sensitivity to cash flow using a panel data approach based on the Q-theory of investment.

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Introduction

Agricultural cooperatives have played an important economic role in the United States. They face, however, increasing survival challenges in light of the agroindustrialization process. In particular, many scholars suggest that imperfect access to capital is the "Achilles' heel" of farmer-owned cooperatives in an increasingly concentrated and tightly coordinated food system. According to this "capital constraint hypothesis," agricultural cooperatives are unable to acquire sufficient risk capital to finance profitable investment opportunities. In other words, cooperatives may be insufficiently capitalized to make the necessary investments to grow and remain a viable organizational form.

The following arguments summarize the theoretical literature and substantiate the claim that agricultural cooperatives are financially constrained: (i) cooperative residual claims are restricted; (ii) cooperatives' vaguely defined property rights structure does not provide members incentives to invest; (iii) equity capital acquisition in cooperatives depends on internally generated capital; (iv) cooperative equity capital is generally not permanent; and (v) cooperatives have limited access to external sources of funds. Because the pool of potential equity investors is restricted to current member-patrons, who have inappropriate incentives to invest due to free rider, portfolio and horizon problems, cooperatives are believed to be "equity capital starved" (Vitaliano). In addition, cooperatives may face credit constraints due to informational asymmetries, non-permanency of allocated equity capital, and over-reliance on CoBank debt capital (Cook).

Despite convincing theoretical arguments supporting the cooperative capital constraint hypothesis, the empirical evidence is not conclusive. Two distinct, but related, approaches are identified in the empirical literature: growth studies and empirical tests of the cooperative *equity* constraint hypothesis. Growth studies have found that cooperatives experienced higher growth rates than comparable corporations in the 1970s (Chen *et al.*) 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.*). Several studies conducted in the 1980s and early 1990s suggest that cooperatives do not borrow more than comparable investor-owned firms (e.g., Lerman and Parliament, Royer, Hind). However, these empirical studies focus exclusively on the supply of capital and, consequently, fail to address a more fundamental question – is the supply of risk capital enough to finance the demand for investment funds?

This study attempts to fill this void in the literature by examining the capital constraint hypothesis with an econometric analysis of firm-level investment behavior in food industries. In particular, we examine whether ownership structure differences affect access to capital and, consequently, the investment sensitivity to financial variables, particularly cash flow. In order to do so, we collect comparable accounting data from two sets of firms with operations in food industries – agricultural cooperatives and publicly traded firms – for the years 1991 through 2000. Comparing investment behavior between cooperatives and public corporations in the same industry is informative because, *a priori*, public corporations are generally not financially constrained as they have unrestricted residual claims and access to public equity markets. Stronger sensitivity of investment to cash flow, therefore, is expected in cooperatives. The next section lays out the theoretical framework for the empirical analysis of firm investment decisions in U.S. food industries.

Theoretical Framework: The Q Investment Model

The roots of the Q theory of investment are commonly traced to the pioneering work of James Tobin. According to Tobin, firm investment opportunities are summarized by the market value of its capital stock. In particular, firm investment expenditures are positively related to average q – also known as Tobin's q – defined as the ratio of the financial value of the firm (V_t) to the replacement cost of its existing capital stock,

(1) $$Q_t^A = V_t / p_t K_t,$$

where p_t is the relative price of investment goods to the price of output and K_t is the capital stock at time t.

Subsequent theoretical work shows that the adjustment cost technology and firm value maximizing behavior lead to a positive correlation between investment and marginal q (Lucas and Prescott). Marginal q is defined as the expected present value of future profits from additional investment – that is, the "shadow price" of capital. Let profits for firm i at any time t (Π_{it}) be determined by its capital stock (K_{it}) and a stochastic variable (σ_{it}), assuming all other production inputs are "maximized out" in that they are already utilized at their optimum levels.[1] Assume further that capital is a quasi-fixed input such that net increments to the firm's capital stock are subject to adjustment costs represented by the convex function $C(I_{it}, K_{it}, \tau_{it})$. Adjustment costs are usually assumed to be increasing in investment (I_{it}), decreasing in capital (K_{it}), and also affected by exogenous technology shocks (τ_{it}). In addition, the firm's existing capital stock is a function of previous investment expenditures, which introduces the capital accumulation constraint

[1] This derivation of the Q model is based on Gilchrist and Himmelberg (1995) and Hubbard (1998).

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

where δ_i represents the firm's constant rate of capital depreciation.

The firm's optimization problem is thus to choose investment to maximize its market value

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

subject to the capital accumulation constraint (2). E_{it} is the expectations operator with a subscript indicating the information available to the ith firm at time t; and β_i^s is the discount factor adopted by the ith firm. New capital resulting from investment is expected to become productive within the year. The first-order condition of this maximization problem yields the marginal q specification

(4) $p_t + C_I(I_{it}, K_{it}, \tau_{it}) = q_{it}$,

where

(5) $$q_{it} = E_{it}\left\{\sum_{s=0}^{\infty}\beta_i^s\left(1-\delta_i\right)^s\left[\Pi_K\left(K_{it+s},\sigma_{is}\right)-C_K\left(I_{it+s},K_{it+s},\tau_{is}\right)\right]\right\}$$

The right-hand side in equation (4) is marginal q, which is defined in equation (5) as the expected discounted value of profits from new capital investment. The intuition is that 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 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. The tradition in the Q theory literature is to follow Hayashi and to specify C as

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

where α is the slope of the adjustment cost function and a_i represents a firm-specific effect. Note that α affects the speed with which investment responds to exogenous shocks. Partially differentiating equation (6) with respect to investment, substituting the resulting $C_I(I_{it}, K_{it}, \tau_{it})$ into equation (4) and solving for I_{it}/K_{it} yields the investment equation

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

where ε_{it} is an optimization error. Therefore, under the conditions assumed by the Q theory, investment should be solely determined by contemporaneous marginal q. It is important, however, to note that this specification of the investment equation is a representation of a model under frictionless capital markets that should explain investment for firms with low premium in the cost of external relative to internal financing.

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. However, Tobin's q constructed from financial market data is only 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 equals the rents from existing capital stock. As a result, the empirical Q investment model is commonly represented by

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

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 (8) is the most popular explicit model of firm investment behavior, but the model's empirical

performance has been unsatisfactory both in terms of the statistical significance of marginal q and the model's overall explanatory power. In addition, the estimated coefficient for marginal q is in general too low, translating into an unrealistically high adjustment cost parameter (α). More importantly, variables such as liquidity and output are consistently found to be statistically significant when included in the Q investment model specification. The role of liquidity – that is, financial constraints – in firm investment behavior is explored in the next section.

Previous Empirical Studies of Financial Constraints

The influential applied work by Fazzari, Hubbard and Petersen is at the roots of an extensive empirical literature examining the consequences of informational imperfections in financial markets on the firm's investment decision. The analytical underpinning of these contemporary models of capital market imperfections is found in economic models relaxing the neoclassical perfect information assumption. This school of thought is known as the Economics of Information, which recognizes "that information is imperfect, that obtaining information can be costly, that there are important asymmetries of information, and that the extent of information asymmetries is affected by actions of firms and individuals" (Stiglitz, p. 1441).

The introduction of information problems in formal economic models has important ramifications to the study of capital markets and the theory of finance. In their study of credit markets with information asymmetries between borrowers and lenders, Stiglitz and Weiss show that an increase in the interest rate charged by a lender causes borrowers to increase the average risk of their investment projects. In doing so, the resulting increased overall risk of the lender's loan portfolio may outweigh the gains from a higher interest rate. Consequently, the lender may maximize profits by simply restricting the supply of loans to borrowers leading to excess demand in credit markets. In light of this result, Greenwald, Stiglitz and Weiss (p. 194) argue, "many

firms face credit constraints; thus it is the availability of credit, not the price which they have to pay, which restricts their investment."

The effects of information problems on equity markets are analyzed by Myers and Majluf. The authors show that asymmetric information between managers and investors regarding the profitability of a new investment project causes conflicts of interest between existing shareholders and potential providers of new investment finance. This potential conflict of interest is not relevant if the firm generates enough internal funds to finance the new project investment. However, if the proposed project requires access to external finance, the firm may forego positive net present value projects as a result of these conflicts of interest. Under these circumstances, the firm's investment and financing decisions are interdependent. Because of the differential costs of internal and external sources of finance, Myers and Majluf propose a "pecking order" theory of corporate finance.

The general implication of theoretical studies in the Economics of Information tradition is that the presence of information problems in capital markets leads to a cost wedge between external finance and internally generated funds. Hubbard shows the supply curve of finance is a horizontal segment up to the firm's total net worth (W_0) but is upward-sloping beyond W_0 as the firm needs to access external funds to finance investment projects. Furthermore, the slope of the supply curve of finance is proportional to the marginal 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" (pp. 194-5). In addition, holding information costs constant, an increase in net worth causes a shift of the supply of funds schedule

to the right. This finding provides a theoretical underpinning to the inclusion of proxy variables for changes in net worth (e.g., cash flow) in the standard Q investment equation.

Additionally, firm characteristics – such as size, dividend policy, leverage, and close relationship with bankers, among others – may be a source of firm heterogeneity with respect to information costs. When firms face negligible information costs, an increase in net worth independent of changes in investment opportunities has no effect on investment. For firms facing high information costs, however, an increase in net worth leads to greater investment (Hubbard). As a result, financial constraints are hypothesized to be more severe – and the sensitivity of investment to cash flow more pronounced – for "high information cost" firms when compared to "low information cost" firms.

A variety of empirical applications are based on the analytical underpinnings offered by the Economics of Information School, including applied studies investigating the relationship between capital constraints and firm investment. Empirical studies of capital market imperfections affecting firm investment behavior examine firm-level panel data in which firms are grouped into "high information cost" and "low information cost" categories. This tradition dates back to Fazzari, Hubbard and Petersen, who use a large panel of U.S. manufacturing firms to analyze the interdependence of investment and financing decisions. The authors identify "high information cost" firms on the basis of a priori information on observed net income retention practices. They hypothesize, "if the cost disadvantage of external finance is large, it should have the greatest effect on firms that retain most of their income" (p. 158). They test this theoretical proposition by estimating a Q investment equation with cash flow as a proxy for net worth. Their empirical results consistently indicate a substantially greater sensitivity of

investment to cash flow in firms with a high net income retention rate. The authors conclude that financial effects are important determinants of corporate investment.

Hoshi, Kashyap and Scharfstein examine the interdependence of financing and investment decisions in a sample of Japanese firms. The authors distinguish firms in the sample on the basis of membership in a *keiretsu* – i.e., Japanese industrial groups with direct links to large banks. They suggest that firms belonging to a *keiretsu* are "low information cost" as a result of attenuated information asymmetries with providers of finance. In contrast, independent firms are expected to face greater costs when raising external funds. This proposition is examined following Fazzari, Hubbard and Petersen's strategy of adding a cash flow variable in the Q investment equation. Empirical results support the fact that investment by firms with a close relationship with a bank is less sensitive to cash flow than independent firms.

Blundell, Bond, Devereux and Schiantarelli estimate the expanded Q model of investment for a panel of 532 U.K. manufacturing companies over the period 1975-86. Their empirical results suggest that average q is a significant factor in the explanation of corporate investment, but its effect is small. In addition to average q, they find cash flow and output variables significantly affect corporate investment. The results indicate that U.K. corporations may be financially constrained, but the authors do not explore the firm heterogeneity in the sample.

Schaller studies the role of financial constraints in the investment behavior of a sample of 212 Canadian firms. The author explores the effects of firm age as an alternative a priori criterion to separate "low information cost" from "high information cost" firms. He argues that "mature" firms may face lower information costs when accessing external sources of finance than "young, liquidity constrained" firms. The empirical results suggest that young firms pay a

higher price for new equity financing than mature firms and their investment spending is more sensitive to cash flow.

In addition to the Q theory of investment, the Euler equation approach also serves as the basis for empirical studies of financial constraints resulting from imperfect capital markets. For example, Whited includes the effect of a debt constraint in the Euler equation of investment and observes that this "greatly improves" the Euler equation's performance in comparison to the standard specification. According to Whited (p. 1451), "the evidence suggests that difficulties in obtaining debt finance have an impact on investment." The author also examines two different measures of financial distress as a priori criteria to distinguish financially constrained from non-constrained firms. Regression results based on a large panel of U.S. corporations indicate the unconstrained Euler equation is violated for firms likely to face binding debt constraints, whereas it is not rejected for unconstrained firms.

Bond and Meghir use a panel of 626 U.K. companies to estimate dynamic investment models based on the Euler equation. Unconstrained firms are identified by the payment of positive dividends and the issue of zero new shares in two successive periods. The authors find that the standard specification of the Euler equation model applies only to firms that are a priori financially unconstrained. However, "a persistent result is that current investment is positively related to lagged cash flow," which suggests some firms in the sample are financially constrained (p. 216).

Hubbard, Kashyap and Whited use an estimation strategy based on the Euler equation representation of the firm's investment behavior to analyze firm-level panel data collected from Compustat. The chosen sample split procedure is based on dividend payout rates, with "high payout" firms hypothesized to be less financially constrained than "low payout" firms. The

authors are unable to reject the standard frictionless investment model for firms with high dividend payouts, but the model is "easily" rejected for firms deemed a priori to be financially constrained.

A significant breakthrough in the applied literature testing for the existence of capital market imperfections is provided by Gilchrist and Himmelberg. In particular, the authors propose an alternative proxy variable to measure firm investment opportunities instead of Tobin's average q. Their alternative measure of marginal q is "Fundamental q" as it is based on observed firm fundamentals, including sales and cash flow. More specifically, they 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. They estimate the Q model of investment with both Tobin's q and Fundamental q using firm-level panel data collected from 470 U.S. manufacturing firms. When comparing the results from estimating the benchmark investment model using Tobin's q versus Fundamental q, the authors find that "Fundamental q provides very plausible estimates of adjustment costs and implied speeds of adjustment" (p. 566). In contrast, Tobin's q is a poor proxy of investment opportunities and tends to overstate the sensitivity of investment to cash flow, especially for unconstrained firms.

After establishing the validity of the Fundamental q approach, the authors examine the role of cash flow in the augmented Q investment equation. They investigate three alternative sample splits to discern financially constrained from unconstrained firms in the sample: dividend policy, firm size and participation in public debt markets. Regression results show that large firms and firms with access to public debt markets are not financially constrained, but small firms with no bond rating or a commercial paper program are found to have excess sensitivity of

investment to cash flow. However, low dividend payout firms do not show a higher cash flow coefficient as compared to high dividend payout firms.

The importance of Gilchrist and Himmelberg's work – in particular, the Fundamental q approach to measuring investment demand – is twofold. First, it appears to be a better proxy for marginal q than Tobin's q, as it does not rely on the conditions set forth by Hayashi. Second, with 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. Based on the Fundamental q approach, Bierlen estimates Q machinery investment equations for a sample of 395 Kansas farms during the period 1973-92. The investment equations are estimated for two asset sizes and three six-year time regimes. Empirical results suggest that cash flow and sales are significant determinants of farmers' investment behavior. In addition, larger farmers suffer from less credit rationing than smaller farmers and credit rationing becomes more intense during the 1981-86 agricultural credit crisis. The author concludes that the Q theory results support the interdependence of financial and investment decision-making in Kansas's agriculture.

Bierlen and Featherstone use 1976-92 data from 405 Kansas commercial farms and find that debt level is the strongest determinant of credit constraints. In particular, the investment-cash flow coefficient is more pronounced for high-debt farms, especially during the 1980s credit crisis. In addition, the authors observe that the sensitivity of investment to cash flow is also more severe in young-operator and small-size farms. They suggest, "an option to increase the financial stability of young [farmers] is to shift some of their risk to other parties through outside equity" (p. 434).

Another applied study of financial constraints in the U.S. farm sector based on the Fundamental q approach is found in Barry, Bierlen and Sotomayor. Their empirical test of farm

credit constraints is based on a sample of 118 Illinois farms over the period 1987-94. The findings from regression analysis lend further support to the hypothesis that U.S. farmers face binding financial constraints when making investment decisions. Additionally, the authors use two alternative sample splitting criteria to group farms in "low information cost" and "high information cost" categories: age of farmer and application of a credit scoring model developed by researchers at the University of Illinois. Contrary to the authors' expectations, older farmers are found to be more credit constrained than younger farmers. However, the result for the credit scored groups are consistent with the hypothesis that "high information cost" farmers are more financially constrained than "low information cost" farmers.

More recently, Benjamin and Phimister examine whether differences in the structure of farm credit markets in France and the U.K. affect the sensitivity of investment to financial variables. Whereas in France the vast majority of funds to farmers is provided by a cooperative bank (Credit Agricole), non-specialist commercial banks dominate agricultural credit markets in the U.K. Based on a sample of 446 U.K. farms and 331 French farms, the authors estimate Euler equation, and inventory and machinery investment models. Empirical results indicate that there were sharp differences in the pattern of investment sensitivity to cash flow depending on the amount and quality of collateral available.

After reviewing the extensive applied literature examining the effects of capital market imperfections on firm investment behavior, Hubbard (p. 193) outline the principal findings of these studies: "(1) all else being equal, investment is significantly correlated with proxies for changes in net worth or internal funds; and (2) that correlation is most important for firms likely to face information related capital-market imperfections." In addition to facing information asymmetries with lenders, agricultural cooperatives are characterized by restricted residual

claims. Taken together, these arguments suggest that cooperatives are likely to face financial constraints when making investment decisions. In contrast, the unrestricted residual claim characteristic of common stock is the most effective means of "generating large amounts of wealth from residual claimants on a permanent basis" in order to finance organization specific assets (Fama and Jensen, p. 312). It is, therefore, reasonable to expect that publicly traded firms be *a priori* financially unconstrained. The following section investigates the investment behavior of cooperatives and publicly traded corporations in the food industry.

Econometric Model and Data

In this section we introduce the empirical model used to investigate the interdependence of financing and investment decisions in the U.S. food industry. A panel data set allows comparing agricultural cooperatives and publicly traded corporations and testing the hypothesis that cooperatives are more financially constrained. The employed econometric model follows the Q theory of investment and specifically the fundamental q approach of Gilchrist and Himmelberg. The investment equation is given by

$$I_{it} = \frac{1}{\alpha} q_{it} + \eta_i + \nu_t + \beta CF_{it} + \varepsilon_{it} \tag{9}$$

where α is the slope of the adjustment cost function, q is marginal q, η_i and ν_t are firm and time specific effects, respectively, CF_{it} is cash flow, and ε_{it} a random error. Under the condition of perfect capital access, we would expect that cash flow does not have an influence on investment, i.e. $\beta = 0$.

The marginal profitability of capital or marginal q, a measure of investment demand, is constructed from the estimates of a bivariate vector autoregressive (VAR) system using a vector of firm fundamentals ($\mathbf{x}_{it}$) that includes cash flow, as previously defined (CF_{it}/K_{it}), and the ratio of sales and lagged values thereof:

(10) $$\mathbf{x}_{it} = \mathbf{A}\mathbf{x}_{it-1} + f_i + d_t + u_{it}$$

Note that the inclusion of lagged values in $\mathbf{x}_{it}$ in (10) implies a VAR of higher order than one. Employing a projection of future profits based on the coefficients of the VAR **A**,

(11) $$q_{it} = [\mathbf{c}' (\mathbf{I} - \lambda\mathbf{A})]^{-1} \mathbf{x}_{it},$$

where $\mathbf{x}_{it}$ is a vector containing cash flow as the jth element, **c** is a conformable vector of zeros with a 1 in the jth row, **I** is the identity matrix, λ is a constant representing the sum of the discount factor and depreciation rate. This allows substituting q_{it} in (9) with the right hand side of (11).

Following Bierlen and Featherstone, the modified investment equation (9) and the VAR in (10) are estimated simultaneously using generalized method of moments (GMM) estimator accommodating heteroskedastic errors and endogeneity in the model. The instrument set includes lagged values of firm fundamentals such as net worth, net income, and depreciation. We note that any lagged values of the explanatory variables beyond the first lag are valid instruments (Griliches and Hausman). For estimation purposes all variables are first-differenced in order to eliminate fixed-firm effects (Holtz-Eakin, Newey and Rosen).

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 was obtained from CoBank, a financial services organization that collected and standardized the financial data for all cooperative firms included in the sample. In addition to the cooperative data, we collect comparable financial data from publicly traded firms with operations in the food industry from Compustat. This approach ensures accurate comparisons among cross-sectional units throughout the study period. The cooperatives and corporations in the sample produce audited annual financial reports certified by a CPA firm and prepared under Generally Accepted Accounting

Principles (GAAP), which contributes to the quality and integrity of the data set. The original data set contains annual accounting information from 131 agricultural cooperatives and 227 corporations comprising the years 1991 through 2000.

The construction of the variables included in the investment model is conducted as follows:

a) Investment (I_{it}) is defined 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 a result, investment is measured 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.

b) Cash flow (CF_{it}) in corporations 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. 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.

c) Normalization by capital stock. In the construction of variables, investment, cash flow, and instrumental variables are first deflated by the CPI. Subsequently, the variables are normalized by the firm's capital stock in the beginning of the year to eliminate scale effects and

to lower heteroskedasticity across firms in the sample. Following Kaplan and Zingales, capital stock is measured as the book value of property, plant and equipment (i.e., net fixed assets).

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 1996-2000. It is a common practice in the empirical investment literature to exclude from the sample firms with extreme values of investment, cash flow, sales or other variables of interest. The model can be sensitive to outliers, especially if firms have very low capital stock, which is used to normalize the variables in the model. We have applied outlier rules to the data and deleted outlier observations if they fall in the one percent tails of the respective variable's distribution.

Table 1. Summary Statistics: Median Values of Variables, 1996-2000

Variable	Corporations	Cooperatives
Total Assets ($ million)	330.66	29.78
Net Worth ($ million)	144.00	11.70
Capital Stock ($ million)	143.08	12.01
Investment ($ million)	14.14	1.09
Cash Flow ($ million)	30.09	1.55
Sales ($ million)	488.91	76.51
I/K	0.14	0.12
CFL/K	0.28	0.17
S/K	3.84	5.99
Equity to Asset Ratio	0.45	0.41
Leverage	1.24	1.41
Permanent Equity	0.97	0.15
Unallocated Retained Earnings	0.66	0.11
N	435	431

Summary statistics for the firm-level panel is shown in Table 1. The corporations in the sample are larger than the cooperatives in terms of assets, net worth, capital stock, and sales. They also invest relatively more and generate more cash flows. Corporations are less leveraged

and have higher median equity-to-asset ratio than cooperatives. In addition, 97 percent of corporate net worth is permanent while cooperatives rely more heavily on redeemable sources of equity capital. Note that unallocated retained earnings represent only 11 percent of cooperative total net worth.

Empirical Results

The model introduced above was estimated for corporations and cooperatives separately imposing the cross equation restrictions implied by the projection of marginal q on firm fundamentals. A pooled regression across corporations and cooperatives was rejected at the 5 percent significance level using an appropriate Wald test. Regression results for the two relevant coefficients in the investment equation estimates are shown in Table 2. Results are based on the following instruments: lagged values 2 to 4 of cash flow and sales as well as net worth, net income and depreciation. Similarly to the explanatory variables in the investment model, instrumental variables are first deflated by the CPI and then normalized by the lag of net property, plant and equipment, a proxy for fixed capital.

Table 2: Estimation Results for Investment Equation

	Corporations	**Cooperatives**
	Cash Flow Augmented Model	
Alpha (Q)	0.328 (0.057)	0.668 (0.167)
Beta (Cash Flow)	-0.547 (0.483)	0.608 (0.022)
	Model Without Cash Flow	
Alpha (Q)	0.454 (0.000)	0.252 (0.092)

Note: P-values in parentheses

First we discuss the results of the model augmented with the cash flow variable. Both types of firms respond positively to marginal q as indicated by the sign of the coefficient alpha. In other words, food industry cooperatives and corporations invest more when the demand for

capital measured by marginal q is larger. The adjustment cost parameter (alpha) is lower for corporations compared to cooperatives which would imply that corporations react more quickly with investment to exogenous shocks than their cooperative counterparts. The P-value of the alpha estimate for the cooperative sub-sample is such that a statistical significant influence would be rejected at the 10 percent confidence level. Consequently, the data do not show marginal q to be a strong determinant of investment in the case of cooperatives. This finding, however, should be interpreted carefully given remaining uncertainties with respect to the measurement of marginal q in this specific empirical application.

Cash flow does have a significant influence on investment for cooperatives beyond the indirect influence on marginal q, but not for the case of corporations. In other words, the evidence suggests that cooperatives are financially constrained, whereas corporations are not. Therefore, our comparison of the investment behavior of cooperatives versus corporations provides support to the capital constraint hypothesis for cooperatives laid out in the introduction of this paper.

Given that the influence of cash flow is not statistically significant for corporations, we set beta equal to zero and re-estimate the model for corporations (Table 2). We observe that alpha is still positive and significant but larger than in the augmented model. Nevertheless, it still implies a quicker reaction of corporations to changing environments than the estimated alpha for cooperatives in the relevant augmented model. Just for information, we also report the estimate of alpha for model without cash flow for cooperatives. The substantially different coefficient would lead the analyst who just looks at this model to falsely believe that marginal q is a statistically significant and highly relevant determinant of investment. It is a reminder that the model with only marginal q is relevant only in the absence of capital constraints.

Summary and Policy Implications

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 this research we addressed the issue of capital constraints and examined the investment behavior of agricultural cooperatives and publicly traded corporations in the food industry. Empirical results lend support to the hypothesis that agricultural cooperatives are financially constrained. The augmented Q model adds explanatory power to cooperative physical capital investment when compared to the restricted model without cash flow. In addition, the cash flow coefficient is not statistically significant for a comparable sample of corporations. The fact that cooperative investment is significantly sensitive to cash flow suggests the presence of capital constraints in the cooperative sample.

These results have important implications to private and public policy regarding agricultural cooperatives. Investment constraints arise in agricultural cooperatives as a result of free rider, horizon, and portfolio problems, which in turn emerge because residual claims are restricted to members, non-transferable, redeemable, and with benefit distribution proportional to usage rather than shareholdings. If cooperatives are to remain a viable organizational form in the U.S. food industry, their leaders might need to relax restrictions on residual claims with some form of organizational change. In addition to restrictions on residual claims, limited access to external sources of funds was also identified as a potential determinant of financial constraints. The finding that cooperatives are constrained by capital availability when making investment decisions suggests a role for public policy in ensuring cooperatives have adequate access to capital markets, particularly to additional sources of equity capital. Public policy makers should

also attempt to eliminate some regulatory restrictions to cooperative organizational change if the objective is to mitigate cooperative financial constraints.

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