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*Journal of Cooperatives*

*Volume 35* *2020* *Page 74 - 101*

# Trade Credit Use in Agricultural Cooperatives: Pricing and Firm Performance

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 *"This work was supported in part by the USDA National Institute of Food and Agriculture Multistate project NC1177 Agricultural and Rural Finance Markets in Transition." "This work was supported in part by the USDA National Institute of Food and Agriculture Multistate project NC1177 Agricultural and Rural Finance Markets in Transition."*

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**Abstract**

Retail prices of products sold by agricultural input cooperatives are set according to a variety of factors, which may include the cost of offering products on trade credit. A sample of over 300 total pricing decisions for six inputs sold by input cooperatives to their members is used to analyze whether that trade credit volumes and the cooperative's own financial needs tend to affect retail input price changes. We find that increased trade credit, at levels observed in this sample, tended to increase price inflation. The net combined effect on price inflation reflects upward pressure due to increasing risk associated with trade credit and downward pressure from an increase in through-put quantity. We find no effect on price inflation related to a firm's internal need for funds as measured by liquidity or solvency measures. Finally, our results suggest that co-ops may not be pricing products using a "cost plus" approach, but rather based on their local market conditions and the need to drive sales. We discuss these results in the context of the role of the cooperative.

**Keywords**: cooperatives, retail price, marketing, trade credit, liquidity

## Introduction

Agricultural retailers fulfill an important role as intermediaries in financing producers' purchases through the extension of trade credit: an arrangement where the farmer purchases and uses agricultural inputs such as seed, nutrients, crop protectants, and fuel with financing provided by the retailer. The expectation is that the farmer makes payment at harvest. Trade credit may become an increasingly important source of financing in sustained low-margin environments, when producers' access to capital from traditional lenders is costly and restricted as well as when cash flow management tightens due to timing of operations and unexpected market conditions. From the retailer perspective, trade credit can be advantageous as a mechanism to create a competitive advantage in the marketplace and to generate financing income and margins on potentially more sales than without trade credit. Particularly in competitive and/or low-margin periods, agricultural retailers face an incentive to 'bundle' the sales and financing of production inputs to prevent erosion of sales or perhaps to gain a competitive advantage. However, trade credit creates a cost to the firm: the use of liquidity to finance sales on credit competes with the firm's internal need to fund short and longer-term investments. Trade credit may expose the cooperative to default risk.

Firms offering trade credit must balance the costs and benefits of doing so, and a primary balancing mechanism relates to the pricing of trade credit goods.

Whether the retail input supply cooperatives' pricing structure responds to changes in their own internal need for funds and trade credit conditions is an empirical question and the primary focus of this paper.

**Literature: Trade Credit as a Pricing Mechanism**

Farm input supply cooperatives provide trade credit to their members when on-farm liquidity is good and as well in circumstances where liquidity concerns are not robust. Trade credit facilitates a cooperative's profitability by meeting producers' short-term liquidity and financing needs not met from outside the cooperative system, particularly in periods of constrained liquidity. Cooperatives have an incentive to provide credit on sales as a risk management strategy to individual producers and to facilitate the organization's purchasing volumes.

*Trade credit*

Applying trade credit to the sales transaction has been widely employed by vendors since the 1980s (Emery, 1984; Lee & Stowe, 1993; Petersen & Rajan, 1997; Smith, 1987). Trade credits are used to expand product sales, enhance buyer/seller relationships, and serve as an integral part of marketing strategies (Hill, Kelly, & Venkiteshwaran, 2015; Petersen & Rajan, 1997; Wilson & Summers, 2002). Firms that use trade credit range from small retailers/wholesalers to large corporate entities. The implementation of the trade credit process oftentimes serves as an alternative financing option for firms experiencing cash flow issues or when access to conventional operating capital tightens (Hermes, Lensink, Lutz, & Thu, 2016; Wilson & Summers, 2002).

The prevalence of trade for short term credit needs is reported to be nearly 80 percent for wholesale transactions in the UK (Seifert, Seifert, & Protopappa-Sieke, 2013). Conversely, Tirole (2010) surmises that nearly 80 percent of product offerings are facilitated via trade credit terms in U.S. firms. Elliehausen and Wolken (1993) conclude that many non-financial U.S. firms may have up to 15 percent of their accounts payable financed by trade credit offerings. Barrot (2016) concludes that because of trade credits, accounts payable are substantially greater (up to triple) in amount than bank financing funds and as much as 15 times greater than commercial paper commitments on the cumulative balance sheets of non-bank (financial U.S.) businesses. Together, these figures suggests that a targeted trade credit strategy may be a critical consideration in a firm's overall business financing process (Fabbri & Klapper, 2016; Hill, Kelly, &, Venkiteshwaran, 2015; Petersen & Rajan, 1997).

With the widespread use of trade credit across business sectors, the overarching benefits from the seller side are support of customer relationships, product sale enhancements, and revenue generation. Buyers tend to benefit from trade credits by having non-conventional credit access, financial stability during liquidity-constrained periods, plus the consistency of product availability. As a marketing strategy, acceptance of the trade credit model supports suppliers: this approach serves as both a liquidity contributor allowing for continued business operations (during financial stress) and the ability to offer a stability factor that will sustain the customer dyad (Cunat, 2006). The bottom line is that a strategy of maintaining customers is more beneficial than acquiring new customers within economic downturns.

*Trade credit and input marketing*

The use of trade credit by input supply cooperatives has not been examined in the literature. However, the broader trade credit literature is clear about the major motivations for its use that are relevant to this analysis: to facilitate transactions; to mitigate capital market constraints; and to capitalize on a competitive advantage in the marketplace. Particularly relevant in the agricultural context is the transactional view of trade credit: matching the timing of payments with the timing of receipts of goods or services results in large one-time payments and impairs cash flow in seasonal industries such as agricultural production.

Trade credit is an important service input supply cooperatives provide member-producers, particularly during times of constrained access to capital to finance short-term input needs. Trade credit practices facilitate sales volume benefits at the cooperative level, but may come at a cost to the cooperative in terms of repayment risk and competition for internal needs for funds. These trade-offs suggest there is a cost to offering the trade credit, and this cost is bundled with the good (associated with the trade credit). Data from retail input supply cooperatives in Nebraska and Iowa are used to investigate the relationship between retail prices of goods commonly sold with trade credit and factors related to a firm's internal need for funds (liquidity and leverage) which change a firm's trade credit sales.

Trade credit is a mechanism that allows firms to sell and deliver products and services to buyers where payment for these items is delayed. While trade credit itself has a stated price (i.e., the firm may charge a finance fee to reflect the riskiness of credit or length of payment period), the true price or cost is bundled with the good or service being sold, and the bundled price reflects the need to compete in a market for the good. In this way, product pricing is dependent on credit. Further, the need for credit depends on the relative availability of credit between sellers and buyers. Chevalier and Scharfstein (1996) model the link between mark-ups and liquidity constraints. One of their findings relevant to this analysis is that price mark-ups are higher during recessions and lower during periods of economic growth. This result derives from relative liquidity constraints of firms, with financially constrained firms engaging in a greater mark-up of prices than less-constrained ones.

Smith (1987) argues that trade credit and its terms reflect information asymmetry between sellers financing buyers of varying default risk and who are making non-salvageable investments. In this context, information asymmetry is the motivation for varying trade credit terms and rates, which are screening devices that equilibrate activities. Buyers and sellers both optimize over trade credit terms: buyers select among firms offering trade credit by maximizing the return to borrowing based on an interest rate and borrowing cost; a seller extends trade credit to maximize its return subject to the rates and the probability of buyer default, revealed through the buyer's choice of financing costs. The asymmetric information motivation for trade credit contrasts with the view of trade credit as a financial tool, whereby buyers are passive and sellers use trade credit as a pricing strategy to exploit or mitigate a firm's relative liquidity constraints through price mark-ups on trade credit goods (Chevalier & Scharfstein, 1996; Schwartz, 1974).

**Conceptual Framework**

The retail price of a good is a function of the quantity sold and costs related to supplying the good (production costs). In turn, production costs are related to the wholesale cost of the good to the retailer and the cost of credit extended in marketing the good to farmers. Thus, the retail price of good $i$ n any period $t$ can be expressed as a relationship between the marginal cost of the good (the wholesale price, $MC_{i,t}$) and a markup, $\propto_i$, the firm may charge related to supplying it:

$$p_{i,t} = f\left(\propto_{i,t}, MC_{i,t}\right)$$

(**Error!**

**Bookmark**

**not defined.**1)

For good $i$ the retail price change between periods $t-1$ and $t$, assuming no structural wholesale prices changes or shocks, is related via the markup, $\propto_{i,t}$ , of the price in the earlier period. This retail price change is:

$$p_{i,t} = \propto_{i,t-1} p_{i,t-1}$$ (**Error! Bookmark not defined.**2)

The mark-up factor, $\propto_{i,t-1}$ is a function of changes in quantity sold, changes in input costs, changes in the cost of credit extended in marketing the good, and changes in firm-specific factors. These changes are firm distinctive and time varying.

Elements of the price markup factor $\propto_{i,t}$ relate to credit costs. In a perfectly efficient credit market, patrons of the cooperative are able to borrow money from any source. However, the transactions costs of obtaining operating credit from commercial lenders for a single purchase make obtaining trade credit from the cooperative an attractive option. The costs of issuing credit are assumed to be factors under management control, and managers consider the probability of nonpayment and the consequences of credit risk to the financial condition of the cooperative. The non-zero expected costs of non-payment induce the firm to add a cost to the retail price of inputs, effectively raising the price for a transaction obtained through trade credit to be greater than the cash purchase price.

Funding trade credit is another component of the price markup factor. The balance sheet is the source of funds used to finance the trade credit. Trade credit availability is a function of the firm's sales volume, asset size, and substitutes for credit repayment in the firm (i.e., liquidity and profitability). Trade credit availability is also a function of the competing needs for funds in the firm, represented by cash, working capital, and leverage. Increasing demands on the substitutes for credit repayment and competing needs for cash within the firm may induce the cooperative to add a cost to the retail price of inputs purchased on trade credit, presumably making it a greater price than a similar cash transaction.

Markup on a retail good sold on trade credit in successive years can be expressed using average prices. Cooperatives charge an average retail cash price, $p_{i,t}^{A}$, for good *i* in year *t*, or an average retail credit price, $p_{i,t}^{C}$. The credit price is a function of the cash price, the maturity of the trade credit term, and an interest rate:

$$p_{i,t}^{C} = p_{i,t}^{A}\ e^{m_{i,t}} e^{r_{i,t}}$$

(**Error! Bookmark**

**not defined.**3)

where *m* is the annualized proportion of sales made using trade credit, and *r* is the implicit interest rate the cooperative charges a patron purchasing on credit, both of which are specific to the cooperative and time varying.

The retail credit price inflation rate relates the trade credit prices between two periods, and is expressed as:

$$price\_inf_{i,t}^{c} = ln\left(\frac{p_{i,t}^{C}}{p_{i,t-1}^{C}}\right).$$

(**Error! Bookmark not defined.**4)

A second group of factors are those that affect the internal implicit cost of funds. These factors include the shadow price of liquidity, which is dependent upon a cooperative's profitability, working capital, and leverage. The implicit cost of funds is higher for cooperatives with less liquidity, lower profitability, less working capital, and greater leverage. Cooperatives should be less inclined to increase the total amount of trade credit available when internal funds are needed to meet the firm's cash or loan repayment requirements.

Two research questions emerge from this framework. First, is there evidence of a relationship between a cooperative's use of trade credit and retail credit price inflation on trade credit products the cooperative supplies? Second, if there is, does this relationship manifest differently during periods of firm illiquidity? Using firm-level data from agricultural input supply cooperatives, this study examines empirically the relationship between cooperatives' use of trade credit and retail input price inflation. Also identified in this process are the co-op specific factors that may affect retail input price inflation, measures indicative of profitability, sales, capital investments, and the cooperative's internal need for funds.

**Data and Statistical Method**

To interpret the cooperatives' retail price behavior and trade credit use as well as whether product pricing seems to respond to the identified factors internal and external to the firm, a novel set of data from two sources is constructed. First, average retail prices and sales quantity data on input products sold to producers are obtained from 18 agricultural cooperatives operating in Nebraska and Iowa. Annual data are available for years 2014 through 2018. The input products are aggregated into six product groups: dry and liquid fertilizer products, anhydrous ammonia, gasoline, diesel, and propane. Most cooperatives in the sample sold all of these products. These data result in 374 input price-quantity observations of individual input supply products. For purposes of regression, the price-quantity data are categorized into product groups. However, the granularity of input product data within each group permits observation of retail price inflation rates and preserves the heterogeneity of pricing decisions across cooperatives.

Second, audited year-end cooperative financial data from the same cooperatives for the same time period are obtained. These data include information from the year-end income statement and balance sheet as well as information about trade receivables – the value of trade credit sales for the goods purchased by producers. When combined with the price and quantity data by product good categories, differences in financial conditions over time and across cooperatives can be analyzed to determine their contribution to pricing behavior. The analysis exploits a time period—2014 to 2018—in which commodity prices were relatively low and stable.

The variable of analysis is the change in the rate of retail price inflation, defined as the natural log of the ratio of the average retail price for product group $i$ between periods $t$ and $t-1$, expressed as:

$$y_{i,t} = price\_inf_{i,t}^{c} = ln\left(\frac{p_{i,t}^{C}}{p_{i,t-1}^{C}}\right).$$

(**Error! Bookmark not defined.**5)

These data contain observations of price changes for each of the six product groups.

A key interest is estimating the effect trade credit sales have on retail price inflation. Trade credit introduces costs to the cooperatives and influences repayment risk, which in turn could impact negatively a cooperative's financial condition. A weighted average of all sales on trade credit and contracted credit terms cannot be directly observed in the data. Absent transaction-level observations of the repayment terms (e.g. term length), a proxy variable that is the ratio of open trade credit at year-end to total sales is constructed:

$$m_{i,t} = \frac{trade\ credit_t}{total\ input\ sales_t}$$

(**Error! Bookmark not defined.**6)

The variable $m_{i,t}$ represents the proportion of total sales of the product goods that are considered as the outstanding trade credit. Normalizing by total sales of the same product goods, a measure of the relative use of trade credit across cooperatives is determined; this approach also applies across time.

Beyond trade credit, the marginal effects of a cooperative's financial conditions and operational outcomes—e.g., leverage, investments in fixed assets, sales, and earnings—are potentially important factors to understanding cooperatives' retail pricing decisions. Based on evidence from the literature, an incorporation (McKee & Kagan, 2019) of the following firm- and time-variant covariates and controls are incorporated into the modelling effort: the log of the proportional change in quantity sold across periods; the log of property, plant, and equipment as a ratio of total assets; the log of total sales; the ratio of earnings as measured by earnings before interest, taxes, depreciation, and amortization

(EBITDA) to current assets this period; the ratio of working capital to total assets; the ratio of average trade credit sales to total sales; the square of the trade credit ratio; and the ratio of debt to total assets. A binary variable, $Illiquid,$ identifies periods of firm-level illiquidity, where a current ratio of less than 1.4 indicates a lower-quartile measure. The illiquidity term is interacted with the firm's current-period (debt-to-asset ratio (DTA), property, plant and equipment (PPE) ratio, and trade credit ratio to capture the marginal effects on price inflation arising from weak liquidity conditions within the firm.

These covariates and controls generate the following general empirical model:

$$y_{i,t} = \alpha_0\ Int_i + \alpha_1 T + \alpha_2 Fert_i + \beta_1 ln\left(\frac{q_{i,t}}{q_{i,t-1}}\right) + \beta_2 ln\left(\frac{PPE_{i,t}}{Assets_{i,t}}\right) + \beta_3 ln\left(Sales_{i,t}\right) + \beta_4\left(\frac{EBITDA_{i,t-1}}{Curr\ Assets_{i,t-1}}\right) + \beta_5\left(\frac{Working\ Capital_{i,t-1}}{Assets_{i,t-1}}\right) + \beta_6 m_{i,t} + \beta_7 {m_{i,t}}^2 + \beta_8\left(\frac{Debt_{i,t}}{Assets_{i,t}}\right) + \partial_0 Illiquid_{i,t} + \delta_1 Illiquid\ x\ DTA_{i,t} + \delta_2 Illiquid\ x\ PPE\ ratio_{i,t} + \delta_3 Illiquid\ x\ m_{i,t} + \epsilon_{i,t},$$

(**Error! Bookmark not defined.**7)

where $Int_i$ is a product-group dependent intercept, *T* is an annual time trend controlling for time-invariant differences in input price inflation, and $Fert_i$ allows a separate response for fertilizer products. Firm-level fixed effects were included in an initial estimation of this model to control for time-invariant differences in cooperative pricing behavior; none were found to be statistically significant in this sample and were omitted.

The model is estimated using pooled OLS regression. The relatively small number of cooperatives in the sample renders panel analysis incomplete. To answer the research questions, the following hypotheses are tested. Regarding research question 1, the relationship between a cooperative's use of trade credit and product price inflation is captured in the sign and significance of $\beta_6$, $\beta_7$, and $\delta_3$. For research question 2, the effect of periods of firm illiquidity on retail price inflation, the sign and significance of $\delta_0$, $\delta_1$, $\delta_2$, and $\delta_3$is observed. In essence, this study seeks to identify whether sales (via retail sales prices) is an instrument of risk management and benefits generation.

**Results**

Table 1, panel A, summarizes input retail sales for the study cooperatives, including pricing and quantity, between 2014 and 2018. The data show no clear trajectory in pricing for any of the six input groups. In general, the average retail price for each input declined between 2014 and 2017, then increased in 2018. Data summarized in panel B of table 1 shows the contemporaneous changes in the financial condition of cooperatives in the sample. Liquidity, measured as the ratio of current assets to current liabilities, declined during the period. Likewise, the ratio of long-term debt to total assets increased on average, signaling greater leveraged positions during this time.

Changes to trade credit and the cooperative's overall financial condition occurred at the same time prices adjusted. As a percent of input sales, trade credit receivables also changed. In 2015 (the earliest year for which trade credit data are available in the sample) trade credit was 7.55 percent of input sales, then 6.24 percent, 8.54 percent and 9.06 percent in 2016, 2017, and 2018, respectively. The change in this percentage was moderately significant between 2016 and 2018 (p=0.066), which is evidence that trade credit availability was adjusted to facilitate sales, and further, that an increasing fraction of sales were not immediately paid for, on average. There was also movement in average bad debt expense as a percent of trade receivables during this period, increasing from 0.06 percent in 2016 (the first year with bad debt data in the sample) to 0.33 percent in 2018, a weakly significant increase (p=0.100).

A combination of declining liquidity, increasing leverage, and some indications of changing trade credit conditions suggests one or a combination of these factors may be related to retail input pricing pattern changes. Correlation analysis of these items, with absolute changes in price, appears in table 2. The variable significantly related to absolute, year-over-year, changes in price, is EBITDA to total assets. The volume of trade credit and the ratio of trade credit and input sales are not significant. These correlations suggest it may be the firm's financial condition, specifically liquidity, not the cooperative's trade credit conditions, that explain firm pricing behavior in these product groups.

Pooled OLS regression estimates of the empirical model for retail price inflation are in table 3. A test for collinearity among regressors was conducted by calculating the variance inflation factor (VIF) for the coefficients in equation 7; model fit statistics indicate overall model significance.

The model estimates in table 3 provide evidence about the role of both internal funding needs and repayment risk as determinants of retail input price inflation. The first column, labeled Model 1, includes the full set of covariates that may have explanatory power or be useful controls. The second column – Model 2 – eliminates regressors with the least explanatory power to arrive at a more concise model. When models 1 and 2 are compared, the elimination of statistically insignificant variables increases the precision of the coefficient estimates of some variables, e.g., log of sales and trade credit.

This study's first research question is about the relationship between a cooperative's use of trade credit and retail credit price inflation. Results from Models 1 and 2 indicate incentives exist for patrons to use the cooperative. An increase in overall quantity of inputs sold, with all else equal, reduces the rate of price inflation. Evaluating the estimated coefficient for a 10 percent increase in quantity sold reduces the average rate of inflation by 4.6 percent.

The results also suggest a rationale for price inflation. The estimated marginal effects of the trade credit term, $m_{i,t}$, are positive and significant, and the quadratic trade credit term is relatively larger, has a negative sign, and is significant. These results suggest a concave relationship between a cooperative's provision of trade credit and retail price inflation during periods of relative liquidity. The extension of more trade credit, on net, creates incentives to increase retail prices. By decomposing the total consequence of adding trade credit, the linear positive term is present which implies increasing trade credit increases price inflation. However, the negative quadratic term appears to temper that effect, which is the through-put function effect that helps to moderate price inflation. For instance, the average trade credit in the sample is $8.5 million; average sales are $338 million. Evaluating the model for an increase in trade credit to $8.6 million (a one percent increase in trade credit as a share of sales), while holding sales constant, generates a net change (sum of the term credit and term credit squared variables) on the log of the change in sales by 0.30, or about a 25% increase in the ratio of price in period *t* to *t-1*, with all else equal. Likewise, a tightening of trade credit or restriction of its use is expected to result in negative price inflation. Prices during the study's research period for many product categories were falling from 2014 – 2017 (see table 1a). These results reinforce the importance of sound credit policies to mitigate retail price inflation associated with trade credit applications.

The second research question examines retail price inflation experiences during periods of illiquidity, when $Illiquid_{i,t} = 1$. Recall that we defined relative illiquidity as a current ratio less than 1.4. Neither the illiquidity variable nor interactions with measures of capital needs, i.e., DTA or plant investments, are associated with changes in retail price inflation.[a] Experiencing a period of illiquidity does not appear to influence the relationship between trade credit and retail price inflation, suggesting managers do not look to price changes to finance investments in working capital. This result reveals a potential benefit of cooperatives' pricing strategies. The cooperatives do not appear to pass along their internal liquidity needs to patrons in the form of higher prices on retail goods, exemplifying the risk-management and pooling functions of producer cooperatives. This benefit is particularly valuable if firm-level liquidity and financing constraints are contemporaneous with patron illiquidity.

Estimates from model 2 provide insight about the financial and operational factors that may influence retail prices of input products to producers. An increase in a product's sales quantity over the last period relates to a reduction in prices for that product in the current period, evidence that cooperatives may reduce prices to drive sale quantities. In addition, the estimated coefficient on total sales (measured in dollars) is positive and significant, corroborating evidence

[a] The lack of significance regarding liquidity's effect on pricing could be driven by the fact that while the cooperatives in this study experienced mild illiquidity according to balance sheet measures, they did not experience severe liquidity conditions during the study period.

that sales (dollars) may be higher under this strategy. The PPE ratio coefficient estimate represents information about retail price responses to capital expenditures on permanent assets: an increase in the relative size of PPE puts upward pressure on retail prices of input products. This result is plausible in the context of financing expansions internally versus seeking debt sources to finance expansions. It is notable that prior-period earnings and working capital do not help explain variations in retail price changes, although this lack of explanation is consistent with the lack of significance in the illiquidity binary variable.

**Discussion**

The model estimates offer salient insights into the firm-specific mechanisms that may reduce the incentive, or need, to increase retail input prices. Marginal modifications to existing trade credit policies (e.g. lower credit limits or shorter credit repayment periods) may lead to increases in retail input prices. On the other hand, a growth in trade receivables suggests cooperative managers are comfortable increasing the availability of inputs for sale while balancing changes to nonpayment risk. One question that emerges is whether strategies to improve the collection of current accounts could be valuable tools for price stability: extensive collection intervention that would affect current assets could affect inflation pressures through their effect on the EBITDA to current assets ratio.

Asset growth can reduce incentives for price increases since this can lead to additional sales. Increased profits, through efficiency and not through price inflation, can reduce these incentives since profits become a substitute for internal cash needs. Conversely, strategies to increase total sales, without concurrent adjustments to profitability, assets, and working capital, tends to increase incentives that lead to raising retail prices on farm inputs. Finally, the regression estimates provide some compelling evidence to suggest that cooperatives may not rely on retail price inflation as a mitigation mechanism when faced with internal illiquidity constraints. Investments in fixed assets seem to contribute to retail input price inflation, though the additional debt load, measured by the DTA ratio, may not be driving this result regardless of the liquidity situation. The positive relationship between relatively more PPE and retail price inflation likely signals greater cash flow and liquidity needs being met through higher prices.

**Conclusion**

Agricultural input supply cooperatives face incentives to change their retail input prices. A sample of cooperatives, retailing inputs during a period of relative financial distress for their patrons, was evaluated to examine whether internal needs for funds or repayment risks were determinants of retail price inflation. Our findings suggest a positive relationship between retail prices for common agricultural input goods and the use of trade credit to finance them. We also find that increases in physical assets (investments) are associated with increases in retail prices. However, neither earnings (EBITDA) nor solvency (DTA), common measures of a firm's financial condition, were observed to affect retail price inflation. An important take-away is that cooperative managers should recognize that while trade credit usage can have a positive effect on through-put of products, an equilibrium should be determined to balance producers' input needs while safeguarding against repayment risk.

This study has limitations. The most obvious is the data sample. Cooperatives in two states, marketing inputs to patrons raising the predominant crops in these states were observed. Cooperatives serving retailing inputs to patrons producing fundamentally different crops with distinct fixed input needs may have different results. Certainly, cooperatives only conducting marketing activities would have different results since only retailing to patrons is considered. On the other hand, the cooperatives observed in this sample reflect significant sales volume, which is representative of input supply by firms in other states serving patrons with similar input needs. This pattern may be indicative of the federated nature of cooperatives serving the same region.

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**Table 1. Summary statistics, selected year**
**Panel A – Average annual cooperative input price and average quantity**

| | 2014 | | 2015 | | 2016 | | 2017 | | 2018 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Input | Price | Qty | Price | Qty | Price | Qty | Price | Qty | Price | Qty |
| Dry fertilizer (tons) | $523.93 | 20,059 | $505.24 | 53,566 | $464.04 | 57,365 | $389.85 | 37,475 | $414.56 | 35,306 |
| Liquid fertilizer (tons) | $350.77 | 16,849 | $372.90 | 47,416 | $340.46 | 43,943 | $285.46 | 96,062 | $276.17 | 114,432 |
| Anhydrous ammonia (tons) | $713.14 | 7,511 | $631.56 | 54,043 | $568.15 | 34,332 | $477.07 | 12,834 | $463.17 | 13,010 |
| Gasoline (gal.) | | | $2.66 | 3,054,194 | $2.18 | 3,459,957 | $2.20 | 3,515,399 | $2.53 | 4,280,240 |
| Diesel (gal.) | | | $2.74 | 6,296,031 | $2.21 | 6,399,778 | $2.10 | 6,119,780 | $2.51 | 6,840,160 |
| Propane (gal.) | | | $1.47 | 3,538,037 | $1.23 | 3,099,798 | $1.21 | 2,934,254 | $1.42 | 3,091,832 |

**Panel B – Average annual cooperative sales and assets**

| | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|
| Sales | $310,586,406 | $337,497,160 | $311,889,629 | $302,216,527 | $363,184,015 |
| Assets | $70,996,220 | $148,843,648 | $151,955,426 | $154,133,791 | $195,310,337 |
| Current ratio | 1.54 | 1.50 | 1.48 | 1.48 | 1.35 |
| Debt-to-asset ratio | 0.11 | 0.11 | 0.13 | 0.13 | 0.13 |

**Table 2. Correlation of year-over-year absolute retail input price change and other items, 2015-2018**

| | Changes in Quantity | Current Ratio | DTA | Total sales, per day, as trade credit | Trade Credit ($) | Trade Credit to Input Sales | EBITDA to Total Assets |
|---|---|---|---|---|---|---|---|
| Corr. Coeff | 0.0207 | -0.0074 | -0.0493 | 0.0212 | -0.0100 | -0.0793 | 0.2329 |
| p-value | 0.7338 | 0.9032 | 0.4170 | 0.7272 | 0.8696 | 0.1913 | 0.0001 |
| N | 273 | 273 | 273 | 273 | 273 | 273 | 273 |

**Table 3. Pooled OLS Regression Product Price Inflation Models**

| | Model 1 | Model 2 |
|---|---|---|
| Constant -- $Int_i$ | -1.066*** | -1.054*** |
| | *(0.008)* | *(0.001)* |
| Time Trend – $T$ | 0.093*** | 0.095*** |
| | *(<.0001)* | *(<.0001)* |
| Fertilizer Indicator -- $Fert_i$ | -0.062** | -0.062** |
| | *(0.023)* | *(0.022)* |
| Log Ratio of Quantity Change -- $ln(q_{i,t}/q_{i,t-1})$ | -0.497*** | -0.496*** |
| | *(<.0001)* | *(<.0001)* |
| Log PPE Ratio -- $ln(PPE_{i,t}/Assets_{i,t})$ | 0.215** | 0.221*** |
| | *(0.013)* | *(0.007)* |
| Log Total Sales -- $ln(Sales_{i,t})$ | 0.031 | 0.031* |
| | *(0.179)* | *(0.054)* |
| Earnings Ratio -- $EBITDA_{i,t-1}$ / $Curr\ Assets_{i,t-1}$ | -0.006 | |
| | *(0.981)* | |
| WC Ratio -- $WC_{i,t-1}$ / $Assets_{i,t-1}$ | -0.049 | |
| | *(0.926)* | |
| Trade Credit Term -- $m_{i,t}$ | 19.6* | 18.4** |
| | *(0.052)* | *(0.049)* |
| Trade Credit Term Sqrd -- $(m_{i,t})^2$ | -311.94** | -290.47* |
| | *(0.058)* | *(0.057)* |
| DTA Ratio -- $Debt_{i,t}$ / $Assets_{i,t}$ | 0.028 | |
| | *(0.864)* | |
| Illiquidity Indicator ($Illiquid_{i,t}$) | -0.259 | -0.156 |
| | *(0.147)* | *(0.19)* |
| Illiquidity x DTA Ratio | 0.607 | |
| | *(0.419)* | |
| Illiquidity x Log PPE Ratio | -0.152 | -0.132 |
| | *(0.159)* | *(0.184)* |
| Illiquidity x Trade Credit Term | 3.734 | 3.282 |
| | *(0.33)* | *(0.378)* |
| $R^2$ | 0.462 | 0.459 |

*Note:* Significance levels indicated as: * p<0.1; ** p<0.05; *** p<0.01. P-values are in parentheses.