DETERMINANTS OF CAPITAL STRUCTURE IN AGRICULTURAL COOPERATIVES IN NORTH DAKOTA

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Determinants of Capital Structure in Agricultural Cooperatives in North Dakota

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ABSTRACT

This thesis analyzes how the optimal capital structure is affected by capital management and major sources of risk under the rule of maximizing the value of discounted cash flows to members. The analysis is done by using the present value of cash flow method. This research employs the panel procedure in Statistical Analysis System (SAS) to solve the firm value optimization problem. The data set includes financial reports from farm supply and grain marketing cooperatives in North Dakota. Empirical Results indicate that the optimal debt ratio is related to the lagged debt ratio, the proportion of assets held as liquid assets, the marginal profit of capital, the marginal adjustment cost of investments, the expected marginal adjustment cost of investments, macroeconomic risks, and the annual fraction of equity retired by the cooperative. All these factors impact members' investments to the cooperative and the cooperative's debt financing.

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CHAPTER 1. INTRODUCTION

Problem Statement

The United States Department of Agriculture (USDA) defines a cooperative as a user-owned and user-controlled business from which benefits are derived and distributed equitably on the basis of use. Cooperatives distinguish themselves from other corporations by constraining their operations based on a particular set of principles. A typical set of cooperative principles states:

1. Cooperatives are owned and democratically controlled by those who use their services;
2. Net margins are distributed to users in proportion to their use of the cooperative;
3. Returns on investment are limited;
4. Cooperatives are financed substantially by those who use their services (Baarda 1989).

Cooperatives provide value to their members by purchasing and operating assets. An agricultural cooperative may require assets such as land, buildings, equipment and a means for acquiring working capital in order to conduct its operations. The capital necessary for investments in these assets is acquired through equity and debt. Taking on debt means to borrow money for the business, whereas equity is the investment members make in the assets of their cooperatives.

Members finance the cooperative by direct investments, per-unit capital retains and patronage refunds. Direct investments include cash purchases of common stock, membership certificates, or other forms of directly contributed equity. Per-unit capital retains refer to retention of a portion of the revenue obtained through a member's patronage with the cooperative as an equity investment. Patronage refunds are allocated distributions of net income returned to patrons in proportion to the value or quantity of their patronage. Each of these investment methods encourages members to contribute equity to the cooperative in proportion to their use of its services.

The patronage refund affects a member's cash flow in two ways. First, a portion of the patronage refund is retained by the cooperative and becomes a negative cash flow for the member. Moreover, it competes with other potential investment in the farming operation. The cost of the negative cash flow is the opportunity cost of the capital required to make up the difference between the cash patronage refund received and taxes paid on that refund over the revolving period. Conversely, a portion of the patronage refund is distributed to the member as cash, generating a positive cash flow for the member, which represents a positive return above the required passive investment generated by doing business with the cooperative (Junge and Ginder 1986).

Cooperative members favor cash patronage refunds and any policy that reduces the current cash patronage refunds may result in a negative response from members. Tubbs (1971) studied the impact of cooperative patronage refunds on farm operations. He argued that fewer cash patronage refunds and a long period of revolving fund terms may hurt the farmers in the sense of discounted present value because of the immediate tax obligation (Royer 2004). On the other hand, a greater proportion of cash patronage refunds can ensure that active patrons do not suffer negative cash flows due to taxes and can help a cooperative attract new business. For example, members with income in marginal tax brackets (federal plus state), higher than 20% of patronage refunds, are interested in a large percentage of cash patronage refunds because they tend to ease the burdens of cash outflows due to tax obligations. Such patrons would have a negative after-tax cash flow on patronage refunds if the minimum cash refund of 20% were given. These patrons insist on a high enough level of cash patronage refunds to offset the additional taxes from qualified refunds.

In addition to direct investments, per-unit capital retains and patronage refunds, two other methods are commonly used for accruing equity in a cooperative: unallocated equity and preferred stock. Unallocated equity is the amount of net income earned by the cooperative that is not allocated to any member, patron or other individual account, but retained in the cooperative. It is tax-paid retained earnings that remain permanently on a cooperative's balance sheet. Preferred stock is stock issued by a cooperative that carries a fixed or floating dividend rate that must be paid before returns are paid on common stock or other equity obligations. Prefer stock can be sold to nonmembers.

Since a member's equity in the cooperative is understood to be returned to the member at some future point, the value of equity to members is the net present value of cash flows that members will receive from the equity. The net present value concept entails consideration of all cash flows generated over the life of equity investment, and it considers the time value of money: the fact that money today is worth more than money tomorrow. This concept suggests that members can consider equity ownership in the cooperative as a benefit by observing the discounted book value of the equity at the time the cooperative decides to redeem equity. Another benefit of the value of equity is the expected incremental value of cash patronage and dividends. Thus, the net cash flow to members is defined as the sum of all equity redemption, patronage refunds and dividends.

Equity redemption is cooperatives' responsibility for redeeming equity to members at some future date in order to maintain the ownership in the hands of users. It ensures that members do not suffer negative cash flow and helps a cooperative attract new business because the cooperative has sufficient income generated by patronage to redeem old allocated equity. As a consequence, equity redemption creates member loyalty. Members will have more confidence in the cooperative investments and will place more value on the equity issued by the cooperative. Equity redemption also creates an additional incentive for members to patronize their cooperative in order to ensure its long-term viability, especially if they have built a substantial pool of allocated equity.

In addition to equity redemption, another cash flow to members is dividend. Members may decide to stay or exit the cooperative according to its cash flow management, especially the use of investment. Since cooperative members may have alternative options for investing, they need to select the investment with the highest return. The return is dividend, which is the cash payment made to equity investors. Dividend generated by the equity investment is a positive cash flow for members. Usually, dividend is paid only on membership stock, but sometimes dividend is paid on allocated retained patronage refunds or capital retains. The value of the dividend from equity investment is affected, in part, by how the cooperative uses the equity. If the management team invests in profitable projects and manages them successfully, those investments will generate additional earnings to the cooperative and its members. A portion of these earnings is retained in the cooperative, while the rest of the earnings are distributed to members in proportion to business volume. Since a member's retained earning becomes equity, it resembles an investment. The investment will affect the capital, and the capital will influence the dividend directly.

The cooperative considers the payment of cash patronage refunds and the payment of discounted retained equity as two separate cash flows. This complex cash flow is a unique feature of cooperative business finance. In addition, the timing of the payment of these two cash flows is a complex decision for the cooperative.

One of the key issues that need to be decided is the length of revolving period, which is the timing of equity redemption. The length is a compromise between the time necessary to accumulate equity and the time necessary to redeem it. A survey conducted in 2008 by USDA showed that the revolving fund length remains long, especially for grain, oilseed and supply cooperatives whose revolving fund length averages at least 18 years. The largest cooperatives redeemed patron equity more recently, but had a revolving fund length that, at 17 years, was four years longer than the smallest cooperatives.

Cooperatives should not only provide an equitable procedure for acquiring and redeeming current equity investments, but provide an adequate supply of equity capital for financing working capital and fixed assets. An adequate equity base is essential if a cooperative is to provide services desired by members, survive adversity and obtain credit. The equity is also a kind of cushion if the business suffers a loss. It provides security to the cooperative in times of financial stress. The negative effects of the recent U.S. economic crisis suggest that a stronger balance sheet can help preserve the financial health of a company. This requires additional equity financing. To strengthen their balance sheets with more equity financing in uncertain economic times, cooperatives may need to lengthen their equity redemption plans.

Taking the time value of money into consideration, the incremental cash flows of equity redemption, patronage refunds and dividends are influenced by many factors that make it more difficult for members to obtain the value of a cooperative in the present period. These factors include firm profitability, investment, membership horizon lengths, macroeconomic risks and idiosyncratic risks.

In addition, when equity is held at par value (i.e., does not appreciate or depreciate), it pays no dividends (Barton et al. 1996). Some cooperative managers incorrectly perceive the cost of acquiring equity to be zero in this situation. Thus, cooperative management may follow the practice of maximizing the use of equity capital and minimizing the use of debt. Snider and Koller (1971) reported that some cooperatives place a zero cost on revolving fund capital, which causes them to underestimate the overall cost of capital and overinvest in facilities.

Adding to the complexity of the capital management process for cooperatives, cooperatives also acquire capital through debt financing. Acquiring an optimal level of debt is attractive to cooperative directors: it allows members to achieve a higher return on patronage when the cost of debt is less than the cost of equity. The theory of optimal leverage suggests that the cost of debt is less than the cost of equity capital due to differences in risk and the tax deductibility of debt (Barton et al. 1996). However, acquiring too much debt may subject cooperatives to financial risk due to varying interest rates, and variability in net income may compound risk (Cobia 1989). According to the corporate literature, companies that are highly leveraged may be at risk of bankruptcy if they are unable to make payments on their debt; they may also be unable to find new lenders in the future.

As agricultural cooperatives are facing fierce competition, the management of cooperatives must weigh the trade-offs of debt and equity as sources of capital and how these tradeoffs are affected by major sources of risk. Managers need to be able to determine an optimal level of debt and equity to operate efficiently and guard against unexpected crises. In addition, determination of an optimal level of debt and equity is required to meet the expectations of both cooperative management and members.

Objectives

This thesis analyzes how the optimal level of debt and equity is affected by capital management and major sources of risk to the cooperative. We investigate the effects on capital structure of philosophy of allocation, cash flow management and exposure to risks under the rule of maximizing the value of discounted cash flows to the member. This research helps us understand the factors that influence the optimal debt-to-equity ratio, which determines the fraction of internal and external financing. This study reveals how a cooperative's profitability, investment, liquid assets and risks affect the cooperative's capital structure. In addition, our results show that these factors create complex outcomes for members and affect how cooperatives use debt financing to maintain corporate capital.

Method and Hypotheses

The theoretical model we proposed is based on the firm value optimization problem and represents a generalization of the standard Q models of investment by Baum et al. (2008). This paper built a dynamic, stochastic, partial equilibrium model of a representative investor-owned firm's value optimization. Since research has demonstrated that a firm's leverage has an effect on the market value of the firm, Baum et al. (2008) determined that the present value of the firm was equal to the discounted stream of expected dividends, D_t, paid to shareholders. In addition, Baum et al.'s (2008) model showed that the optimal level of debt relates to the marginal profit of capital, which is a function of idiosyncratic uncertainty, the marginal adjustment cost of investments, the expected marginal adjustment cost, the relative shadow cost of external financing, and the expected base interest rate, which is a function of macroeconomic uncertainty.

We modified this model to analyze the cooperative's value optimization and to determine factors for the optimal capital structure. In cooperatives, the optimal level of debt and equity can be obtained by maximizing the cash flow of dividends to members rather than shareholders. The optimal debt ratio is determined by the lagged debt ratio, liquid assets, profitability and investment. In addition, membership horizon lengths, macroeconomic risks and idiosyncratic risks are important determining factors. In this study, we calculated the cash flow of dividends of investment and patronage funds under the constraints of capital, dividend and debt.

We used the free cash flow to equity model (Damodaran 2012) to calculate the cash flow of dividends. This is a basic model that defines the dividend, which is the cash flow available to be paid out, as a function of net income, capital spending, working capital and debt. This calculation can be presented as:

Free Cash Flow to Equity = Net Income – Capital Spending – Change in Working Capital + Change in Debt (1)

First, any capital expenditures are subtracted from the net income, since they represent cash outflows. Second, increase in working capital drains a firm's cash flows, while decrease in working capital increases the cash flows available to equity investors. Finally, repaying the principal on existing debt represents a cash outflow; but the debt repayment may be financed by the new debt issued, which is a cash inflow.

Organization

This thesis is divided into six chapters. Related studies about the firm valuation and the horizon problem are discussed in Chapter 2. Chapter 3 introduces theoretical framework, hypotheses and an empirical modeling approach. Chapter 4 is an independent chapter to discuss data and methods. Chapter 5 provides the empirical results. Finally, Chapter 6 discusses the overall summary, conclusions and questions for further study.

CHAPTER 2. LITERATURE REVIEW

Determinants of Firm Value

This study was designed to determine the optimal level of debt and equity by maximizing the value of a cooperative. A firm's value depends on operating efficiency, because efficiency measures the firm's ability to generate cash flows from assets, thereby indicating the desirability of investing or disinvesting. The value of a cooperative is the net present value of future cash flows to the equity owners, which includes all the cash patronage, equity redemptions and dividends received by members. In addition, since these cash flows occur at selected times, such as cash versus retained patronage refunds, the timing of cash flows impacts how members view their cooperative returns. Paying a high percentage of refunds in cash benefits current patrons and may encourage patronage and membership, because it maximizes the cash return to members, but is paid at the expense of using these funds to purchase capital goods.

In addition to the direct sources of obtaining equity, equity management affects cooperative valuation. Royer (1989) outlines two important objectives of a good equity management strategy. First, the strategy must provide an adequate supply of equity capital for financing working capital and fixed assets. Second, the strategy must provide an equitable procedure for acquiring and redeeming current equity investments. Equity management maintains the owner's equity investment in one or more accounts by increasing or decreasing the balance of each. Each account may represent a different class of equity and may have different sources or uses.

The length of time the equity is held is another factor affecting cooperative valuation. Money or cash flow has different values depending upon when it is received. As a result, the best investment decision is based on methods that treat cash flow differently across time. In the investment analysis, the cash flow of a period of time equals the difference between the cash balance at the beginning and ending of the time period. Clearly, the value of $1 today is not the same as the value of $1 next year. But the simple concepts of present value and future value allow us to fairly compare cash flows that occur at different times. The future value of cash flow can be discounted or reduced to make it comparable to cash flow in the present day.

The design of equity redemption programs affect members' expectations of the time their money will be retained in the cooperative. A survey conducted by the USDA in 2008, demonstrated that the equity redemption length remains long, averaging at least 18 years, for grain, oilseed and supply cooperatives. The increased total equity redemptions reduce members' expectations of the cash value of equity, because there is less equity as asset put to productive use. The decreased value of equity over time results in slower growth of equity as asset in the cooperative, which cuts returns of the cooperative.

A variety of risks also affect member valuation of cooperatives. Financial theory states that a business's optimal capital structure position will change as its business risk changes. Equity is one source for cooperatives to acquire capital; debt is the other. If business risks increase, a cooperative should change its capital structure by lowering its leverage (debt-to-equity) ratio (Robison and Barry 1987). Conversely, if business risks of the cooperative are to decrease, raising its leverage ratio would be appropriate.

Equity is capital at risk regardless of the magnitude of that risk. On the one hand, equity holders have rights to all residual returns of the cooperative. All increases in cooperative value belong to them. On the other hand, a strong equity base provides security for lenders and makes it possible for borrowers to receive more favorable interest rates. Equity also exists to serve as a buffer during periods of economic misfortune. Any losses experienced by the cooperative are subtracted from the cooperative's equity pool until it is exhausted. In case of liquidation, all liabilities must be satisfied before any cash can be returned to equity holders. Therefore, equity generates both special benefits of cooperative returns and the possibility of loss.

Damodaran's research (2012) indicated that investors in different ages have different risk preferences relative to other groups. In order to incorporate financial frictions, we use risk premium to express investors' risk preference. As investors become more risk averse, risk premiums will climb, and as risk aversion declines, risk premiums will fall. While risk aversion will vary across investors, it is the collective risk aversion of investors that determines risk premium, and changes in that collective risk aversion will manifest as changes in the risk premium. Markets with older investors in the aggregate, should have higher risk premiums than markets with younger investors for any given level of risk. In addition, the risk premium and the base rate of return are two factors that determine the gross interest rate. In our model, we used the gross interest rate as one source of macroeconomic risks.

Liquidity is another factor influencing risk premiums. Liquidity is theoretically defined as the ability of an asset to be converted into cash quickly and without any price discount. Liquidity refers to how easily investors can convert their securities into cash or get into and out of investments. Gilchrist and Himmelberg (1998) illustrated that the availability of liquid assets alleviates the external finance constraint and makes it easy to acquire debt. However, if investors have to accept large discounts on estimated value or pay high transaction costs to liquidate equity positions, they will pay less for equities today and thus demand a large risk premium. Gibson and Mougeot (2004) looked at U.S. stock returns from 1973 to 1997 and concluded that liquidity accounts for a significant component of the overall risk premium, and that its effect varies over time. Risk premiums will rise in periods when inflation is higher than expected and drop in periods when inflation is lower than expected.

The final determinant we investigated in this study is the horizon problem, which arises when an owner's claim on the net cash flow generated by an asset is shorter than the productive life of the asset (Porter and Scully 1987). Vitaliano (1983) stated that horizon problems "…can be expected to give rise to additional differences in subgroup preferences among members, based on differences in such horizons, with a general tendency for them to favor investment decisions with short payoff horizons." In Condon's (1990) PhD thesis, the author discussed, in part, the same issues. Condon (1990) presented a broad discussion under the terms of "the investment portfolio problem," "the common-property problem" and "the residual-horizon problem." Based on traditional assumptions on economic behavior, Condon's (1990) model illustrated some of the theoretical horizon problems. For example, members of cooperatives must see themselves as long-term members in order to find economic motives to accept certain investments in cooperatives. All these studies discussed the concept of the horizon problem.

While Staatz (1987) concluded that there are five characteristics that may intensify the horizon problem:

1. The per-member capital invested in the cooperative is large;
2. The cooperative has a closed membership;
3. Few member firms are legally incorporated;
4. The intergenerational transfer of membership within families is prohibited; and
5. The cooperative has a large, diverse membership.

All these characteristics make it difficult, even impossible, to transfer the cooperative membership. Members have to leave the cooperative earlier than the productive life of their asset if some unexpected things happen. As a result, the horizon problem is aggravated.

Compared to members of cooperatives, owners of investor-owned firms (IOFs) will not have the same problem as a result of the existence of the secondary market. Staatz (1987) discussed the link between the lack of secondary markets for cooperative membership and the horizon problem. Both Condon (1990) and Staatz (1987) identified conditions that might reduce the horizon problem. Most of the mechanisms for reducing horizon problems are linked to the potential of secondary markets for membership. The main argument is that the future value of cooperative investment may be capitalized in the value of farmland or other fixed resources among members.

Condon (1990) and Staatz (1987) also discussed how transferring membership to heirs within farm families may lessen the horizon problem. Staatz (1987) pointed out that "in smaller cooperatives, especially those in which members have strong ties to one another (e.g., because of a common religion or set of social beliefs) and in which there is a strong tradition of family farming, the horizon problem may pose fewer difficulties."

In recent years, researchers have focused on the importance of the horizon problem in relation to investments. For example, Cook (1995) demonstrated that "the severity of this problem intensifies when considering investment in research and development, advertisement, and other intangible assets." Likewise, Iliopoulos (1998) discussed the horizon problem in detail. One of Iliopoulos' (1998) conclusions is that modern cooperatives have more difficulties with an increased need to raise funds for investments in order to develop the business in relation to changed market conditions.

Methods of Calculating Firm Value

Numerous valuation approaches, such as the net present value method, exist to estimate the value of a target company. A well-known method employed by practitioners to value a target company is market multiple analysis. This method involves applying a market-determined multiple to net income, earnings before interest, taxes, depreciation, and amortization (EBITDA), earnings per share, sales, book value, or other measures. This approach helps to identify a value range for the target and is useful when there are no acceptable comparable transactions or public companies (Tarun et al. 2004). Liu, Nissim and Thomas (2002) examined the valuation properties of a comprehensive list of value drivers and found that multiples derived from forward earnings explain stock prices remarkably well compared to historical earnings measures, cash flow measures, book value of equity, and sales. Therefore, market multiple analysis is allowed to apply various multiples for valuing a target company.

Since market multiple analysis is referred to as direct comparison analysis or comparable companies analysis based on companies' size, industry classification, financial ratio and technology, it is not an appropriate method for our study. Instead, the discounted cash flow (DCF) method is the preferred approach for valuing a cooperative in our research. In addition, the consideration of different value of cash flows across time makes the DCF method a valid technique for the cooperative value. Baker, Miller and Ramsperger (1981a) reported that firms primarily use the DCF method to determine the value of takeover targets. In addition, Mohan et al. (1991) found that managers place high importance on the DCF and market value approaches compared to alternative techniques, especially liquidation and book value. Managers rely on the DCF valuation in general corporate finance settings. For example, survey results by Bruner et al. (1998) showed that the DCF method is the dominant investment evaluation technique used by the most financially sophisticated companies and financial advisers. Graham and Harvey (2001) reported similar findings. The use of the DCF method to value targets would also be consistent with evidence from past practitioner surveys on mergers and acquisitions by Baker et al. (1981a) and Mohan et al. (1991).

Several studies, including Beierlein and Schrader (1978), Royer (1987) and Corman and Fulton (1990), have used the present value of cash flow received from a cooperative as the criterion for evaluating the effects of various equity financing and redemption practices on patrons as a group. But there is little literature using the present value of cash flow method to calculate a cooperative's value. Therefore, our research attempted to fill this void in the literature and expanded the current literature on cooperative valuation by using the present value of cash flow method.

In order to use this method, we need to understand how cash flow operates in a cooperative. The cooperative's financial performance is closely tied to the cash flow received by members. Members with ample cash on hand are able to invest the cash back into the business in order to generate more cash and profit.

Therefore, a cooperative's financial statements can help us determine its cash flow. The flow of funds to finance a business includes cash inflow and cash outflow. Cash inflows include equity investments, sales of fixed assets, sales of inventory, accounts receivable collection, and depreciation. Cash outflows consist of fixed assets purchases, inventory purchases, advances on purchased products, accounts payable, and customer credit. The net financial benefit or cost of "cash flow" investment in the cooperative over the interval depends on: (1) the amount of cash flow received from each year's cash patronage refund after taxes, (2) number of years in the interval to be evaluated, and (3) the rate at which cash flow benefits or costs are compounded to account for the time value of money (Junge and Ginder 1986).

According to the previous discussion about cash flow operation, we used the free cash flow to equity model (Damodaran 2012) as the basic model in our research. The cash flow to equity includes debt payments after covering capital spending and working capital needs. It is a function of net income, capital spending, net changes in working capital and debt.

In order to complete our model, we added risks described in Baum et al.'s (2008) paper as determinants to firm value. Baum et al. (2008) derived how firm valuation is affected by risk, cash flow and investment. The authors modeled the firm valuation problem as a dynamic, stochastic, partial equilibrium model of a representative firm. Under the constraints of capital, dividend and debt, the optimal level of debt was obtained by maximizing the present value of the firm, which was equated to the expected discounted stream of D_t, dividends paid to shareholders. The optimal level of debt was a function of: the marginal profit of capital, which was a function of idiosyncratic uncertainties; the marginal adjustment cost of investments; the expected marginal adjustment cost; the relative shadow cost of external financing; and the expected base interest rate, which was a function of macroeconomic uncertainties. In this research, we took risks into account and estimated the effects they have on discounted cash flow value.

The complex and dynamic nature of the interaction between cooperatives and their user-owners is not addressed by Baum et al. (2008), however. Cooperative members are likely to question the value of the cooperative if chronic cash flow deficits result in high opportunity costs of cooperative membership. When those opportunity costs exceed the value of the refund itself, producers may conclude that membership is not worthwhile (Junge and Ginder 1986).

Diaz-Hermelo et al. (2001) also showed that attitude is important. They analyzed alternative capitalization strategies that enhance the farmer-owned agricultural cooperative's control of capital structure, growth, and return on investment while maintaining the member balance in a way that provides an acceptable level of financial risk. This suggests that members favor cash patronage and any policy that reduces its current level results in negative response from members. Moreover, members appreciate the use of debt as an equity redemption method because it results in a higher amount of cash flows at lower variability.

In conclusion, we used the discounted cash flow method to calculate the optimal level of debt and equity by maximizing the value of a cooperative. Determinants such as cash flow, investment, membership horizon lengths, macroeconomic risks and idiosyncratic risks were also included in our model.

CHAPTER 3. MODEL

Model Concept

Cooperatives are created to provide value to members, who frequently use the cooperative's services and have made an equity investment in the company. Unique features of cooperative business finance require additional consideration when users assess the value of a cooperative. For example, equity in traditional corporations is subject to retirement but is rarely done so in practice. In contrast, cooperatives are required to return equity to members. As a result, members value each dollar of equity as a potential cash flow, albeit with uncertain repayment timing. The timing is affected by the cooperative's cash flow, which is a function of firm profitability, the rate of capital investment in the cooperative, and the firm's access to debt. Additionally, cash flow is affected by the macroeconomic and idiosyncratic risks that affect costs and revenues, as well as the level of patronage of their fellow members, making it more difficult for the members to evaluate their equity value in the present period.

The purpose of this research was to understand how a cooperative's value is affected by the capital structure choices made subject to its cash flow, capital and risks. We maximized, subject to capital structure choice, capital stock, cash flow and a variety of risks to find out the relationship between these factors and the cooperative's value. Using an analytical model of firm value maximization, we derived the conditions for maximum firm value and then tested hypotheses about how capital structure choice, capital stock, cash flow and a variety of risks affect the value of a cooperative.

Theoretical Model

The cash flow valuation method was used to calculate the current value of a company based on discounted future cash flows. Cash flows realized by the cooperative occur at different points in the future. Since the value of money diminishes over time, investment decision making is best done when it is based on methods that treat cash flow differently over time. The total value of the cash flow in the forecast period is a measure of how much cash of equity can be paid to members of the cooperative.

We used the Q model of investment to measure the value of cash flows. The Q model of investment relates investment to average q, which is the ratio of the maximized value of the firm to the cost of its capital, abstracted from debt, other assets and taxes (Bond and Cummins 2001). The analysis of investment demand must begin with an expression for the value of the firm, which in turn stems from the arbitrage condition governing the valuation of equity. The return to members of cooperative i at time t comprises current dividends and capital appreciation. In equilibrium, if members are to be content holding their equity, this return must equal their required return. In the absence of any bubbles, the value of the firm is simply the present discounted value of the expected after-tax dividend stream (Whited 1992). Thus the firm's objective is to maximize:

$$V_t = E_t[\sum_{s=1}^{\infty} \beta^{t+s} D_{t+s} |F_t], \text{ for t=0, 1, 2 …} \quad (2)$$

where:

D_{t+s} Dividend generated in period t+s

β^{t+s} Discount factor used in period t+s to discount expected dividends in period t+s, with $\beta^t = 1$

$E_t[.]$ An expectation conditioned on information available in period t

F_t A filtration represents information set until time t

This model, the standard Q model of investment, has been used widely, especially in corporations. Whited (1992) used it to deal with how the problems of asymmetric information in debt markets affect financially unhealthy firms' ability to obtain outside finance and to allocate real investment expenditure over time. Hubbard and Kashyap (1992) used an estimation strategy based on the q theory with adjustment costs to find that internal funds are likely to be an important determinant of investment for many firms in the presence of information imperfections in capital markets.

Except for the basic model, the Q model of investment, determinants which influence the cooperative valuation were added into this model. Capital investment is one source of cash flows. The value of the cooperative, from members' perspective, equals their prior investments plus future investments—usually made through net margins that are generated by their patronage. Members will support an investment if, and only if, it is profitable. As the value of the cooperative increases, through cash flow management and member patronage, members may continue to be willing to invest in the cooperative. Therefore, our model took these investments as given and considered how a cooperative makes and finances investment choices today that will generate income in the future.

The distribution of cooperative valuation among members is designed to favors those currently using the cooperative, although the entire financial benefit may not be received until some point in the future. Any equity capital earns a limited rate of return. Limiting the rate of return on equity capital helps ensure that the benefits of cooperation, such as cash dividends, are distributed to users of the cooperative rather than its investors. In the short term, cash dividends to users promote demand for service and have a tendency to increase the value of the cooperative assigned by members, because the cooperative's value is derived mainly from current and future dividend payment expectations. The current dividend is dividend paid on membership stock, while the future dividend is equity redemption which happens far in the future. The equity is usually redeemed when the member is seventy-year-old and retires from the cooperative.

In addition to equity investment, risk is another factor affecting cooperative valuation. Risks affecting cooperative valuation include macroeconomic factors and idiosyncratic uncertainties. Macroeconomic factors include economic conditions of the United States and other cooperatives. For example, the financial risk comes, in part, from variation in interest rates on short-term debt. In addition, idiosyncratic uncertainties include investor age, liquidity and debt.

The cooperative could undertake any investment with an adequate positive net present value to members. For example, a cooperative may choose an investment with positive expected net present value and large variance, including significant chances of not returning to members the opportunity cost rate of interest. The variance as well as the expected (average) return on investment now matter. The more risks an investment has, the more net present value members will lose, if the investment is failed. Lower net present value results in less investment to the cooperative, which in turn diminishes the value of the cooperative. Cooperatives are unable to allow share trading, so members cannot manage their own risk by transferring ownership. As a result, any member’s valuation of the cooperative is affected by the entire cooperative’s next exposure to risk outcomes. The cost of providing equity to a cooperative by the member is the opportunity cost of investing money in a member's own operation or other alternatives. As a result, members value knowing when their retained earnings will be revolved because each additional unit of time represents foregone returns from funds allocated to them that would have been invested elsewhere. So long as the cooperative experiences adequate income, members will prefer to add more value to the cooperative through patronage and associated equity through retained earnings.

The third determinant of cooperative valuation introduced here is the level of debt. Having significant amounts of equity relieves the cooperative of the fixed costs associated with debt payments. Relatively lower interest payments free up earnings to be paid out in cash allocations. It also results in a lower financial risk, because acquiring too much debt may subject cooperatives to financial risk due to varying interest rates. An increase in the amount of income retained increases the solvency of the cooperative, which will also reduce the cooperative's exposure to risks. Reduced risks stimulate members to place more value on the cooperative.

Another factor that affects cooperative valuation is the membership horizon lengths. The horizon problem occurs when a member's residual claim on the net income generated by an asset is shorter than the productive life of that asset (Porter and Scully 1987). For instance, some members will exit the cooperative before the full benefits from their investments are extracted. Investments are decided by the majority of current members and not the majority of equity holders, including those who are about to exit the cooperative. As a result, members evaluate the investment according to a shorter horizon than the economic lifetime of the investment: they know that some of the benefits will occur even though the cooperative provides no financial value to them. Equity redemption payments are authorized by active members. These payments affect both exiting members and continuing members. We assumed active members cannot control the exit decision; we assumed it is exogenous in the sense that it is not influenced by the success of the cooperative. It is solely determined by external factors, such as new outside opportunities, age, declining health, or the business acumen of the member. Members make the decision about the exit payment before they make the investment decision. Hence, the exit payment cannot depend on the success of the investment.

Since cooperative membership is heterogeneous, the horizon problem causes differences in members' cooperative valuation. The individual ownership in traditional cooperatives is untradeable. Hence, members are not able to achieve the future income stream of investments in cooperatives. Compared to shareholding companies, cooperative owners have restrictions in relation to the possibility to transfer as well as to exchange their ownership. The problem with investments can be expected to be more severe in cooperatives with a large share of elder members as compared to cooperatives with a more uniformly distributed age structure. Conflicting interests between elder and younger members have been recognized in empirical work (see e.g. Hakelius, 1999, who identified a number of differences in attitudes towards cooperatives in a comparison of young and old farmers in Sweden). Richards et al. (1998) investigated potential principal-agent related problems in cooperatives in Alberta, Canada. In these investigations, age is one parameter that is significant in explaining differences in opinions among members. For example, full redemption will benefit members who are going to retire shortly, while the members who are not retiring have an interest in a low redemption. Hansmann (1999) explained that the benefits to the continuing members from a low redemption (the saved redemption) come immediately, while their disadvantage in receiving a low redemption upon their own retirement will not occur for many years.

In our research, we formulated a dynamic, stochastic, partial equilibrium model of the cooperative's value optimization problem. Here we proposed a theoretical model that builds on the firm value optimization problem developed by Baum et al. (2008), but our model was written from the cooperative point of view. We maximized the value of the cooperative, which means the joint value of members' on-farm income and returns from investment were maximized. In addition, uncertainties and discrete time were added to this model to provide a dynamic feedback mechanism between the cooperative and its members. The member behavior portion of the model reflects how changes in income affect patronage. Changes in patronage inform a member's willingness to do business with the cooperative, which in turn influences future volume and future income.

The model was based on an empirically testable hypothesis regarding the association between the optimal level of debt and uncertainties arising from macroeconomic sources, idiosyncratic sources and the annual fraction of equity retired in a cooperative. The dynamic model accounted for the interactions between the cooperative's profitability, investment and user-owner cash flow burden. By explicitly capturing the dynamic cash flows of dividends and patronage refunds, the model estimated the optimal level of debt. We also posited that each patron will prefer any action that will increase the present value of future cash flows the patron receives from the cooperative.

The objective of members when choosing investment at time t is to maximize the present value of the stream of current and expected future net distributions. Assuming, for simplicity, no taxes, the dividend to members coincides with the net revenue generated by the cooperative in each period. Thus the objective is to maximize the present value of the cooperative, which is equated to the expected discounted stream of dividends paid to members:

$$\arg\max V_t(K_t) = D_t + E_t\left[\sum_{s=1}^{\infty} \beta^{t+s} D_{t+s} | F_t\right], \text{ for } t = 0, 1, 2\ldots \tag{3}$$

The objective function is maximized subject to five constraints, equation 4 to equation 8, faced by cooperatives as following:

$$K_{t+1} = (1-\delta) K_t + I_t \tag{4}$$

where:

K_t Capital stock of cooperatives at the beginning-of-period

I_t Investment expenditure

δ Constant rate of economic depreciation

$$D_t = \Pi\,(K_t, \Phi_t) - C\,(I_t, K_t) - I_t + B_t - B_{t-1}R(\tau_t)\,\eta\,(B_{t-1}, K_t, \xi_t) \quad (5)$$

where:

Π Maximized value of current profits

Φ_t Idiosyncratic uncertainty, which affects capital stock

C Real cost of adjusting I_t units of capital

B_t Financial liabilities of the cooperative

R Base rate of return

τ_t Macroeconomic uncertainty

η External premium

ξ_t Stochastic shock

$$D_t \geq 0 \quad (6)$$

$$\lim_{T\to\infty}[\Pi_{j=t}^{T-1}\beta^s]B_T = 0, \forall t. \quad (7)$$

$$\alpha \cdot s \cdot X_t + (1\text{-}\alpha)\,(1\text{-}s)\,X_t = V_t = I_t \quad (8)$$

where:

α Fraction of members facing risk of exogenous exit

s Exit rate

X_t Exit payment

The first constraint, equation 4, is the capital stock accounting identity.

The second constraint, equation 5, defines a cooperative's dividends. Discrete time causes variables to have different values. At time t, all present values are certain, while all future variables are stochastic. According to "pecking order" theory, we assumed that equity financing is so expensive that cooperatives exhibit a strict preference for debt financing. In this way, the role of debt financing is isolated from equity financing. Another assumption is that managers have rational expectations. In order to incorporate financial frictions, we used external premium, $\eta\ (B_{t-1}, K_t, \xi_t)$, to express members' risk preference. The external premium depends on cooperative-specific characteristics such as debt and capital stock as well as a stochastic shock ξ_t. In addition, $R(\tau_t)\ \eta\ (B_{t-1}, K_t, \xi_t)$ is a risk adjustor to incorporate risk premium to the base interest rate. $R(\tau_t)$ is the base rate of return, which depends on the macroeconomics environment but not on cooperative-specific characteristics. The interest rate is diverse in different years, and a lower interest rate reduces the borrowing cost of members.

The third constraint, equation 6, restricts dividends to be non-negative.

The fourth constraint, equation 7, is a transversality condition, which prevents the cooperative from borrowing an infinite amount to pay out as dividends.

The fifth constraint, equation 8, determines the investment level. The investment decision is made knowing that some members will exit the cooperative before the payoff falls. Full redemption occurs when the expected payoff V_t equals the investment costs I_t. The decision about exiting the cooperative can be caused by internal or external factors. We used an exit rate, s, to model the exit before the payoff falls. Hence, with probability, 1-s, a member will stay in the cooperative. When members exit the cooperative before the payoff falls, they may receive a compensation, which we referred to as exit payment X. In our model, the amount on the personal equity account was determined by X. α is a fraction of members exiting the cooperative before the payoff falls and have a survival rate below one, i.e. $1\text{-s} < 1$. We referred to this group as uncertain members. The rest of the members, $1\text{-}\alpha$, face no risk of exogenous exit and have a survival rate of 1. We referred to this group as certain members. If we think of certain members as young members and uncertain members as old members, the model can be interpreted as a model of generational conflict. To give certain members incentives to support an investment, the value of the cooperative must, at least, be equal to the investment costs.

We constructed $V_t(K_t) = D_t + \lambda_t D_t + \beta(D_{t+1} + \lambda_{t+1} D_{t+1})$ to solve the optimization problem. From the first-order condition for investment, we derived:

$$C_{It}+1 = E_t\left[\beta\Theta_t(\Pi_{Kt+1} + (1-\delta) \times (C_{It+1} + 1) - R_{t+1}\eta_{Kt+1}B_t)\right] \quad (9)$$

Lagrange multiplier λ_t can be interpreted as the shadow cost of internally generated funds. Note that $\Theta_t = (1 + \lambda_{t+1}) / (1+\lambda_t)$. Expression $\beta\Theta_t$ may serve as a stochastic time-varying discount factor, which is equal to β in the absence of financial constraints ($\lambda_{t+1} = \lambda_t$). This derivative explains how much value will change when the investment changes one unit.

From the first-order condition for debt, we derived:

$$E_t\left[\beta\Theta_t R_{t+1}(\eta_{t+1} + \eta_{B_{t+1}} B_t)\right] = 1 \quad (10)$$

The derivative of value for debt means how much value will change when the debt changes one unit. Combining the first-order condition we derived the optimal level for borrowing as:

$$B_t = \frac{E_t\{\Pi_{Kt}\Theta_t\} + (1-\delta)E_t\{\Theta_t C_{It+1}\} - E_t\{\Theta_t\eta_t R(\tau_t)\} - 1/\beta C_{It}}{\eta_B E_t\{\Theta_t R(\tau_t)\} + \eta_K E\{R(\tau_t)\}} \quad (11)$$

We found that leverage is affected by a combination of member-controlled and manager-controlled variables. It is a function of revenue affected by capacity, adjustment cost changed by investment and risk from debt and capital. Since members will require a return on their equity capital that includes a large risk premium as well as the risk-free interest rate if a cooperative's investments are risky, the leverage level will fluctuate as the premium changes. Therefore, risks do have a significant effect on the equity value. The theoretical model derived above provides the calculation of an optimal level of debt for a cooperative. Additionally, the effects of changes in business risk can be evaluated.

As in Cooper and Haltiwanger (2006), the traditional investment model assumed that costs of adjustment were convex. Here, we adopted a quadratic cost specification and considered the following specification of the adjustment function:

$$C\,(I_t, K_t) = \frac{\gamma}{2}\left(\frac{I_t}{K_t}\right)^2 K_t \tag{12}$$

where γ is a parameter. The adjustment cost function is decreasing and convex in K_t, and non-decreasing and convex in I_t (Groth and Khan 2007). We derived equation 12 for investment as:

$$C_I = \gamma\left(\frac{I_t}{TA_t}\right) = \gamma\left(\frac{\alpha s X_t + (1-\alpha)(1-s)\,X_t}{TA_t}\right) \tag{13}$$

This is the marginal adjustment cost of investments of a cooperative at time t. TA is total assets of a cooperative at time t, which is a proxy for capital K_t. The first-order condition for costs of adjustment relates the marginal adjustment cost to the investment and capital at time t.

In equation 11, we derived $\frac{\partial B_t}{\partial E_t\{R(\tau_t)\}} < 0$, $\frac{\partial B_t}{\partial E_t\{\Pi(\Phi_t)\}} > 0$ and $\frac{\partial B_t}{\partial C_{It}} < 0$. A higher rate of return in period t induces less leverage. Similarly, more marginal adjustment cost of investments causes a lower level of debt. The maximized value of current profits in the present period, however, has a positive relationship with debt. The more profit obtained, the more borrowing occurs. Based on previous research, we assumed $\frac{\partial E_t\{R(\tau_t)\}}{\partial \tau_t} > 0$, $\frac{\partial E_t\{\Pi(\Phi_t)\}}{\partial \Phi_t} < 0$ and $\frac{\partial C_{It}}{\partial \alpha} > 0$. Higher macroeconomic risks are accompanied by a higher rate of return. Intuitively, high idiosyncratic risks decrease the maximized value of current profits. The last source of risk, the annual fraction of equity retired in a cooperative, reflects how retired equity in the cooperative increases the marginal adjustment cost of investments.

According to these derivatives and assumptions, we derived the hypotheses about macroeconomic uncertainty τ, idiosyncratic uncertainty Φ and the annual fraction of equity retired in a cooperative α as:

$$\frac{\partial B_t}{\partial \tau_{t+1}} = \frac{\partial B_t}{\partial E_t\{R(\tau_{t+1})\}} \frac{\partial E_t\{R(\tau_{t+1})\}}{\partial \tau_{t+1}} < 0 \quad (14)$$

$$\frac{\partial B_t}{\partial \Phi_{t+1}} = \frac{\partial B_t}{\partial E_t\{\Pi(\Phi_{t+1})\}} \frac{\partial E_t\{\Pi(\Phi_{t+1})\}}{\partial \Phi_{t+1}} < 0 \quad (15)$$

$$\frac{\partial B_t}{\partial \alpha} = \frac{\partial B_t}{\partial C_{It}} \frac{\partial C_{It}}{\partial \alpha} < 0 \quad (16)$$

Risks, including member preferences for retained investment, affect the optimal capital structure. More equity is needed when sources of risk external or internal to the cooperative increase in size or when member preferences for retained investment decrease. During increasingly uncertain circumstances, no matter the macroeconomical or idiosyncratical risks, cooperatives will decrease their level of debt ratio to cover the higher costs of external financing caused by these uncertainties. Also, the longer members stay in cooperatives, the more borrowing that is needed.

Statistical Model

According to equation 11, we concluded that the optimal level of debt, B_t, is related to: (1) the marginal profit of capital, Π_{Kt}, which is a function of idiosyncratic uncertainty, Φ_t; (2) the marginal adjustment cost of investments, C_{It}; (3) the expected marginal adjustment cost, $E_t\{C_{It+1}\}$; (4) the relative shadow cost of external financing, Θ_t; and (5) the expected base interest rate, which is a function of macroeconomic uncertainty, $R(\tau_t)$.

Since we calculated the marginal adjustment cost of investments at time t from equation 12, the expected marginal adjustment cost at time t+1 can be obtained in the same way:

$$E_t\{C_{It+1}\} = \gamma(E_t\{\frac{I_{t+1}}{TA_{t+1}}\}) \quad (17)$$

Gilchrist and Himmelberg (1998) described the marginal profit of capital by using a sales-based measure rather than income measure:

$$\Pi_{Kt+1} = \theta_1(S_t/TA_t) + \theta_2\Phi_t \tag{18}$$

The expected profitability of capital is parameterized as a linear function of the marginal profitability of fixed capital, S_t/TA_t, and idiosyncratic uncertainty, Φ_t. S is the cooperative's sale, TA is total assets, $\theta_1 = \rho_t/\mu$. ρ_t is the capital share of output from the Cobb-Douglas specification, and μ is the markup (defined as $1/(1+\kappa^{-1})$, where κ is the firm-level price elasticity of demand).

Another aspect provided by Gilchrist and Himmelberg (1998) is that debt aggravates the probability of financial distress, while the availability of liquid assets alleviates the external finance constraint:

$$\Theta_t = a_0 + a_1 Cash_t + a_2 B_{t-1} \tag{19}$$

where:

$Cash_t$ Cash and cash equivalent

a_0 A firm-specific measure of financial constraints

As to the base interest rate, $R(\tau_t)$, we assumed that it is a linear function of macroeconomic uncertainty as:

$$R(\tau_t) = \omega_1\tau_t \tag{20}$$

Finally, we derived the empirical specification as:

$$\frac{B_t}{TA_t} = \epsilon_1\frac{B_{t-1}}{TA_{t-1}} + \epsilon_2\frac{Cash_t}{TA_t} + \epsilon_3\frac{S_t}{TA_t} + \epsilon_4\frac{I_{t+1}}{TA_{t+1}} + \epsilon_5\frac{I_t}{TA_t} + \epsilon_6\tau_t + \epsilon_7\Phi_t + \epsilon_8\alpha_t + e_t \tag{21}$$

Lagged proxy for debt to total assets ratio in the regression was used in order to reflect that recently experienced volatility will affect cooperatives' behavior.

The expected sign from each variable can be determined through the theoretical framework. The main hypothesis of this model is that ϵ_6, ϵ_7 and ϵ_8 are all less than zero. That is, macroeconomic risks, idiosyncratic risks and exit uncertainties have negative effects on the optimal level of leverage ratio. The higher uncertainties the cooperative experiences, the less borrowing ratio it will have. Since a business's optimal capital structure position will change as its business risk changes, high borrowings decrease the level of equity. Inversely, cooperatives with low borrowings have more equity. In addition, increasing income will compel members to add more value on the cooperative when they evaluate it. The results obtained here will help managers identify what factors affect the optimal capital structure, which sequentially impacts members' investment to the cooperative and the cooperative's borrowings. Both members' investment and the cooperative's borrowings are significant aspects for the growth of the cooperative.

CHAPTER 4. DATA AND METHOD

Chapter 4 is an individual part which examines the used data and methods to test our hypotheses in the research. The characteristics and source of data are discussed. We applied the panel procedure in SAS to a panel of information about local cooperatives drawn from their income statements and the balance sheets covering the period 2002—2011. The model we used is the one-way fixed-effects model. A modified model is provided, which includes a cooperative size dummy.

Model Estimation

The model estimated with panel regression was specified as:

$$\frac{B_t}{TA_t} = \epsilon_1 \frac{B_{t-1}}{TA_{t-1}} + \epsilon_2 \frac{Cash_t}{TA_t} + \epsilon_3 \frac{S_t}{TA_t} + \epsilon_4 \frac{I_{t+1}}{TA_{t+1}} + \epsilon_5 \frac{I_t}{TA_t} + \epsilon_6 \tau_t + \epsilon_7 \Phi_t + \epsilon_8 \alpha_t + e_t \qquad (21)$$

$\frac{B_t}{TA_t}$ is the independent variable, the total debt to total assets ratio. $\frac{B_{t-1}}{TA_{t-1}}$ is the lagged debt ratio, which is represented by debt in the last period over total assets in the last period. The liquidity $\frac{Cash_t}{TA_t}$ is measured as cash divided by total assets. $\frac{S_t}{TA_t}$ illustrates the marginal profitability of a cooperative, which is presented by sales over total assets. The current, $\frac{I_t}{TA_t}$, and future, $\frac{I_{t+1}}{TA_{t+1}}$, adjustment costs of investment are reported by depreciation divided by total assets. τ_t is the macro economical sources of risks, which include short-term interest rates, the annual inflation rate on all consumer goods, the dollar exchange rate, North Dakota gross state product (GSP), an index of world commodity prices, and an index of input prices. We defined the standard deviation of sales, revenues and expenses as idiosyncratic risks Φ_t. α_t stands for the fraction of equity retired in a cooperative, which is the ratio of retired equity to total assets.

Data Description

Data were collected and regressed on the dependent variable from equation 21 to show any effect that risks, debt and investment may have on the debt ratio. The cooperatives studied in our research include farm supply and grain marketing cooperatives operating within the state of North Dakota. The data used in this paper are obtained from annual financial reports, including the balance sheets and income statements from 126 North Dakota farm supply and grain marketing cooperatives between 2002 and 2011.

These data are typical of panel data in that the dataset is wide, consisting of 126 cross-sectional units, and short, observed over 10 years. Panel data (also known as longitudinal or cross sectional time-series data) contain observations of micro units over time. Analysis using panel data is powerful in that it can be used to study heterogeneity in the cross-sectional units over time. Heterogeneity means that micro units are all different from one another in fundamental unmeasured ways. In any cross-section, there are many unmeasured explanatory variables that influence the behavior of the micro units being analyzed. Omitting these variables causes bias in estimation. The same holds true for omitted time series variables that affect the behavior of the micro units differently in each time period. Panel data allow us to control for variables we cannot observe or measure like difference in business practices across companies (Torres 2012). In addition, panel data create more variability and alleviate multicollinearity problems by combining variation across micro units with variation over time. The more informative the data collected the more efficient estimations of independent variables.

But heteroscedasticity and autocorrelation often arise in the analysis of panel data. In statistics, a collection of random variables is heteroscedastic if there are sub-populations that have different variability from others. That is, the standard deviations of a variable, monitored over a specific amount of time, are non-constant. Additionally, autocorrelation most often occurs in time series data where the observation at a given point in time is dependent on the observations from the previous time periods. The likelihood ratio test is a widely used method of testing for heteroscedasticity. Since our data set includes ten time series, this short panel data does not cause severe autocorrelation.

A complete panel observation for any cooperative should include 10 observations from 2002 to 2011. Fifty-two cooperatives have complete observations in our data. The other cooperatives have incomplete observations, meaning one or more annual observations are missing. Hence, results from regressions using balanced and unbalanced data were provided. In the unbalanced data case, the number of observations per time period varies.

The financial variables we used in our model were computed using financial reports. According to equation 21, we defined the financial liabilities of the cooperative B_t as the sum of current liabilities, long term debt and other long-term liabilities. To make our calculation simple, we thought of current asset and depreciation as cash and investment expenditure, respectively. All depreciation is assumed to be spent as reinvestment so that investment expenditure is equal to depreciation. Total assets, TA, and sales, S, were obtained directly from financial reports.

Since our time period is from 2002 to 2011 for all cooperatives, we generated forecasts about: (1) B_t and TA in 2001; (2) investment expenditure, I, and TA in 2012. The data of B_t and TA in 2001 were generated by assuming the 2001—2002 change was equal to the average rate of change over the length of the data series. Likewise, the data of I and TA in 2012 were calculated by assuming the 2011—2012 change was equal to the average rate of change over the length of the data series. For example, the growth rate of B_t can be calculated by the debt change from

2002 to 2011 divided by 10, the number of years. According to the growth rate and debt in 2002, we obtained the debt in 2001, which used for the lagged debt ratio.

The dependent variable is the ratio of B_t to TA. This ratio shows the total share of assets as debt and suggests the tradeoff between debt and equity, whereas debt alone only reports an amount of borrowing. Hence, if the total debt increases, but the total equity increases at a faster rate, then the ratio would actually be affected more by the equity than the debt, even though the quantity of debt increases.

The independent variables are defined according to equation 21. These variables consist of the lagged debt ratio, $\frac{B_{t-1}}{TA_{t-1}}$, current liquidity, $\frac{Cash_t}{TA_t}$, current marginal profitability of fixed capital, $\frac{S_t}{TA_t}$, current investment ratio, $\frac{I_t}{TA_t}$, and investment ratio in the next period, $\frac{I_{t+1}}{TA_{t+1}}$. We considered $\frac{I_t}{TA_t}$ and $\frac{S_t}{TA_t}$ as measures of variables in the theoretical model, current marginal adjustment cost of investments and marginal profit of capital (described in Chapter 3).

Other independent variables include the fraction of equity retired in a given year, macroeconomic risks and idiosyncratic risks. Since the annual fraction of equity retired in a cooperative in a given year, α, is not publicly available, data were gathered using financial statements and rational assumptions. We assumed that no more than 10% of total equity was retired annually in all cooperatives. We chose 2%, 4%, 6%, 8% and 10% as the fraction of equity retired in a given year to conduct a simulation. The results were discussed later.

Secondary data were collected as measures of macroeconomic risks and idiosyncratic risks. Cooperatives act differently when they face macroeconomic risks from economic conditions of the United States and the world. We considered the following factors as risks in macro-economy that affect the capital structure of farm supply and grain marketing cooperatives in North Dakota: short-term interest rates, the annual inflation rate on all consumer goods, the dollar exchange rate, North Dakota gross state product, an index of world commodity prices, and an index of input prices. Regressing these macroeconomic risks on the dependent variable indicates how changes in macroeconomic conditions affect the capital structure choices of North Dakota farm supply and grain marketing cooperatives. Table 1 summarizes all statistics for these macroeconomic risks.

We used the interest rate of back prime loan as one macroeconomic risk. Prime is one of base rates used by banks to price short-term business loans. According to the Fisher effect, the base interest rates contain anticipated inflation. Data were obtained from Board of Governors of the Federal Reserve System. We subtracted annual inflation rates to obtain the real short-term interest rates. Table 1 shows that short-term interest rates in the first three years (2002—2004) are stable. The rates grow rapidly in the next three years and decrease in the last four years because of the economic depression.

The annual inflation rate on all consumer goods was easily collected from www.InflationData.com. This rate affects not only cooperatives' leverage, but also their costs of obtaining external finance, and in turn, their investment dynamics. The annual inflation rates in Table 1 present there is no dramatic change over 10 years except for a negative rate appeared in 2009.

Information about the dollar exchange rate was obtained from www.fxtop.com. The dollar exchange rate is an index of exchange rates of main countries the cooperatives in North Dakota export to. According to the United States Census Bureau, the top five export countries are Canada, Mexico, Belgium, Australia and Germany. We used the direct quote, which is the domestic currency per unit of the foreign currency, to obtain the dollar exchange rate. In order to keep the factors within a comparable magnitude, ratios were multiplied by 100 to indicate a percentage change. Since 2002 was the first year, we set the exchange rate for 2002 as 100%.

Gross state product is the state counterpart to a country's gross domestic product (GDP), which is the most comprehensive measure of national economic activity. Data of GSP in North Dakota from 2002 to 2011 came from www.usgovernmentrevenue.com. The trend of GSP in North Dakota is that it keeps a sustainable growth over 10 years, which is displayed in Table 1.

The last two macroeconomic risks are an index of world commodity prices and an index of input prices. The commodity processed by farm supply and grain marketing cooperatives in North Dakota are mainly grain wheat, corn and soybean. Also, the inputs of cooperatives consist of fertilizer, fuels, chemicals, land and labor. Both commodity prices and input prices were available from www.usda.gov. We set 2002 as the benchmark when we calculated these two indexes. Every index was computed as a fraction, which shows any change in commodity prices or input prices over time compared to the index base year 2002.

Based on Baum et al.'s (2008) paper, we proxied the idiosyncratic risks by computing the standard deviation of sales, gross revenues and expenses. In our research, sales were not equal to gross revenues, which were sales subtracted by costs. The standard deviation shows how much variation exists from the average, while sales, gross revenues and expenses represent a cooperative's operating condition. These variables helped us decide which risks were significant in determining the optimal level of debt.

The last variable, the annual fraction of equity retired in a cooperative, measured using the assumption that retired members hold less than 10% of total equity. A simulation was conducted to show how a variety of retirement rates are related to the optimal capital structure. We chose 2%, 4%, 6%, 8% and 10% as the fraction of exit equity. Then we calculated the ratio of equity retired in a cooperative to total assets. This ratio illustrates the total share of assets coming from outgoing members' equity. The parameter estimate of retired equity increases with the fraction increasing. The highest estimation is -2.640 when the exit equity fraction is 10%. This simulation provided the range of membership horizon lengths' effect on the optimal debt ratio.

Table 2 provides summary statistics on annual financial reports for the cooperatives evaluated in our research. The table helps us identify the operating trends of cooperatives over 10 years. The rows are time series from 2002 to 2011. The columns include the number of cooperatives evaluated and the average of significant financial items, such as sales, gross revenue, expenses, depreciation, total savings, total assets, total liabilities and equity. According to Table 2, the initial data set includes 911 observations with 126 cooperatives over 2002—2011. In addition, sales, gross revenue, expenses, total savings, total assets and total liabilities keep increasing until 2009. This trend may have been due to the financial crisis in 2008. Agricultural cooperatives suffered a great regression and recovered slowly in the next few years, because means of these variables increased steadily after 2009. Column six and column ten of Table 2 indicate that depreciation and equity increased over time, which demonstrates that agricultural cooperatives relied more on equity and decreased leverage during the financial crisis.

Table 1. Secondary Data for Macroeconomic Risks

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Interest Rate	4.67%	4.12%	4.34%	6.19%	7.96%	8.05%	5.09%	3.25%	3.25%	3.25%
Inflation Rate	1.59%	2.27%	2.68%	3.39%	3.24%	2.85%	3.85%	-0.34%	1.64%	3.16%
Exchange Rate	100.00%	88.54%	82.95%	81.95%	81.31%	76.20%	73.19%	80.16%	80.73%	77.47%
GSP (Billion)	1.00	1.09	1.14	1.21	1.28	1.40	1.56	1.57	1.75	1.98
Commodity Price	100.00%	112.70%	129.89%	107.74%	114.33%	161.41%	230.28%	182.33%	180.71%	248.04%
Input Price	100.00%	108.71%	111.74%	125.61%	123.11%	151.17%	171.99%	153.01%	151.80%	173.41%

Table 2. Summary Statistics on Annual Financial Reports

Year	Number of Observations	Sales	Gross Revenue	Expenses	Depreciation	Total Savings	Total Assets	Total Liabilities	Equity
2002	110	$ 12,065,203	$ 1,557,143	$ 1,370,834	$ 166,280	$ 269,502	$ 6,005,284	$ 2,756,370	$ 3,251,338
2003	112	$ 15,092,124	$ 1,728,367	$ 1,501,688	$ 199,668	$ 291,671	$ 6,773,899	$ 3,180,694	$ 3,593,016
2004	94	$ 19,274,210	$ 2,131,206	$ 1,806,154	$ 226,515	$ 415,203	$ 7,196,676	$ 3,211,595	$ 3,978,999
2005	91	$ 20,871,487	$ 2,449,322	$ 1,992,910	$ 240,809	$ 598,495	$ 8,350,290	$ 3,935,708	$ 4,419,444
2006	99	$ 22,935,527	$ 2,379,796	$ 2,006,987	$ 251,770	$ 595,254	$ 8,685,418	$ 3,999,853	$ 4,684,096
2007	99	$ 28,507,746	$ 2,797,204	$ 2,185,550	$ 259,789	$ 1,022,176	$ 13,101,965	$ 8,117,037	$ 4,984,928
2008	65	$ 38,152,850	$ 4,090,379	$ 2,547,360	$ 288,722	$ 1,462,475	$ 15,241,557	$ 9,325,823	$ 5,936,362
2009	86	$ 29,640,650	$ 3,140,267	$ 2,449,302	$ 292,890	$ 1,407,793	$ 13,995,705	$ 7,443,882	$ 6,113,385
2010	85	$ 30,792,926	$ 3,745,661	$ 2,551,250	$ 334,719	$ 1,384,646	$ 14,831,350	$ 8,034,778	$ 6,962,330
2011	70	$ 46,280,510	$ 4,583,159	$ 3,374,844	$ 435,217	$ 1,722,392	$ 19,942,656	$ 11,081,893	$ 8,260,550

Estimation Procedure

Our hypotheses were tested by applying the panel procedure in SAS to a panel of information about local cooperatives drawn from their income statements and the balance sheets covering the period 2002—2011. The panel procedure analyzes a class of linear econometric models that commonly arise when time series and cross-sectional data are combined. This procedure can process data with different numbers of time series observations across different cross sections.

The panel data models can be grouped into several categories depending on the structure of the error term, such as the fixed-effects model and the random-effects model. A random-effects model assumes that the variation across cross-sectional units is random and uncorrelated with the independent variables included in the model. A fixed-effects model is used whenever we are only interested in analyzing the impact of variables that vary over time. A fixed-effects model is estimated by generating an intercept variable for each cross sectional unit, omitting the general intercept, and regressing the dependent variable, together with the independent variables, onto the intercept variables. Ordinary least squares (OLS) generate unbiased estimates in this case.

To decide between fixed or random effects, the Hausman test was used. The null hypothesis of this test is that the preferred model is the random-effects model. The Hausman test determines whether the unique errors are correlated with the regressors, and the null hypothesis is that they are not. If the null hypothesis is rejected, then the fixed-effects model is considered more appropriate.

In order to prove the existence of group effects, we conducted three separate regressions for three size groups of cooperatives based on revenue. We ran the original data using SAS. The first quartile and third quartiles of these 126 cooperatives are \$751,891 and \$3,239,775, respectively. The small group was defined as cooperatives whose revenue was between \$0 and \$751,891. Likewise, cooperatives with revenue between \$751,891 and \$3,239,775 were assigned as the medium group. The remaining cooperatives which had revenue over \$3,239,775 were considered the large group. The intercept of the small group was 1.336, the medium group was 3.810 and the large group was 0.232. The three different intercepts for three groups implied that there were individual effects, which means a fixed-effects model was more appropriate. In addition, the Hausman test statistics is 74.54 (p-value < 0.0001), which confirmed that we could reject with the 95% confidence, which also supported the appropriateness of a fixed-effects model.

But there is a problem existing in out model. That is, if a lagged value of the dependent variable (Y_{t-1}) appears as a regressor, both fixed and random effects estimators are biased. One way of dealing with this problem is by finding a suitable instrument to apply the instrumental variable (IV) estimation. A common choice of instrument is Y_{t-2} used as an instrumental variable (Kennedy 2008). We used Y_{t-2} as an instrumental variable in our model to get unbiased estimated coefficients.

When we used the panel procedure for analysis, some guidelines needed to be followed. For example, for each cross section, the panel procedure requires at least two time series observations with no missing values for all model variables. There should be at least two cross sections for each time point in the data. Therefore, five cooperatives, which only have values in one year, were omitted from the data set, because the panel procedure could not generate the result.

To reduce the potential impact of outliers upon the parameter estimates, we also deleted any observation in the input data set with a missing value for one or more of the regressors. After these screening procedures, the final sample included 704 observations.

The descriptive statistics of the explanatory variables are summarized in Table 3.

Table 3. Summary Statistics of Independent Variables

Label	Mean	Std Dev	Minimum	Maximum
Last Debt/Last TA	0.396	0.509	-5.975	10.623
Cash/Total Assets	0.569	0.373	0.018	9.514
Sales/Total Assets	2.475	3.733	0.000	104.536
Next Depreciation/Next TA	0.027	0.018	0.000	0.324
Depreciation/TA	0.029	0.020	0.000	0.324
Interest Rate	0.078	0.186	0.000	4.456
Inflation Rate	0.410	1.009	0.041	25.895
Commodity Price	0.768	1.003	0.019	25.115
GSP	0.673	0.981	0.000	25.138
Exchange Rate	0.337	0.989	0.001	25.285
Input Price	0.657	0.976	0.001	25.143
Std Sales	0.521	0.912	0.000	8.933
Std Revenue	0.494	1.069	0.002	14.281
Std Expense	0.318	0.440	0.001	3.196
Redeemed Equity/TA	0.059	0.045	-0.962	0.677

Modified Model Estimation

We also considered three sample splits, because the size of a cooperative may impact its optimal structure. All cooperatives were divided into three groups—small, medium and large—according to their average revenues across ten years. We added a dummy variable as the cooperative size and modified the equation 21 as:

$$\frac{B_t}{TA_t} = \epsilon_1 \frac{B_{t-1}}{TA_{t-1}} + \epsilon_2 \frac{Cash_t}{TA_t} + \epsilon_3 \frac{S_t}{TA_t} + \epsilon_4 \frac{I_{t+1}}{TA_{t+1}} + \epsilon_5 \frac{I_t}{TA_t} + \epsilon_6 \tau_t + \epsilon_7 \Phi_t + \epsilon_8 \alpha_t + f_i + e_t \quad (22)$$

where f_i is the cooperative size dummy. We thought of the cooperative size dummy as a truth value represented as a numerical value 1, 2 or 3 for small, medium and large cooperatives, respectively. The dummy variable trap may happen when there is a dummy variable in the regression. The dummy variable trap is when there are dummies in all observations, the constant term has to be excluded. If a constant term is included in the regression, it is important to exclude one of the dummy variables from the regression, making this the base category against which the others are assessed. If all the dummy variables are included, their sum is equal to 1, resulting in perfect multicollinearity. This is referred to as the dummy variable trap. In order to get rid of the dummy variable trap, we excluded the small cooperatives. Hence, there were intercept dummies for medium and large cooperatives in addition to estimated coefficients of independent variables in the results.

CHAPTER 5. RESULTS AND DISCUSSION

Empirical results showed the effects of debt, liquidity, profitability, investment and risks on the capital structure in an agricultural cooperative. The regression statistics did not contradict our hypotheses. We found that the optimal debt to equity ratio was affected by a combination of member-controlled and manager-controlled variables. The ratio was related to the lagged debt ratio, the proportion of assets held as liquid assets, the marginal profit of capital, the marginal adjustment cost of investments, macroeconomic uncertainties, and the annual fraction of equity retired by the cooperative.

We conducted three regressions in our research: (1) the regression with unbalanced panel; (2) the regression with balanced panel; and (3) the regression with the dummy variable of cooperative size.

The Regression with All Observations

Summary statistics, such as model description, fit statistics and parameter estimates, were obtained after running the panel regression. The table of model description presents the used estimation method, the number of cross sections and the time series length. Our model is a one-way, fixed-effects model. We used this model because the Hausman test (described in Chapter 4) proved the existence of a group effect. In order to generate estimated coefficients from the data, each cooperative should have observations in at least two periods and no missing values for all model variables. 26 cooperatives were deleted from the original data set, because they did not meet this criterion. Observations from 100 cooperatives remained and ten distinct years were observed.

The table of fit statistics gives some basic statistics for the fitness of panel data, including the coefficient of determination and the root mean square error. The coefficient of determination,

R^2, is one commonly used goodness-of-fit statistic. The value of the R^2 coefficient gives an estimate of how well the regression fits the data. An R^2 near 1 means that the regressors predict much of the variation in the dependent variable; an R^2 near 0 means they do not. Therefore, R^2 statistics are useful summaries of the predictive ability of the regression. The coefficient of determination in our study was R^2=0.9710. The large value of R^2 implied that much of the variation in the optimal debt to total assets ratio is accounted for by the independent variables.

For fixed-effects model analysis, an F-test for the absence of fixed-effects is produced. The F-test is used to test the hypothesis that all the estimated coefficients of the independent variables are jointly equal to zero. But the null hypothesis of the F-test in a fixed-effects model analysis is that there are no fixed effects. That is, if all fixed-effects variables are not statistically significant, the hypothesis is rejected and there are no fixed effects. We obtained an F value of 11.78 (p-value < 0.0001), which means that the null hypothesis was rejected, and we asserted that a fixed-effects model was appropriate.

Table 4 is the table of regression parameter estimates. Each row of the table includes the name of the regressor, parameter estimate, and the significance probability of the t statistic. A more complicated pattern of parameter estimates was presented after applying the panel procedure. The parameter estimates included intercept estimates of 100 cross sectional effects for our fixed-effects model. We did not include these intercept estimates for the purpose of concision. Most of the cross-sectional effects were highly significant. There were 54 cooperatives whose intercept estimates were significant at the 1% confidence level. In addition, 11 and 8 intercept estimates were significant at the 5% and 10% confidence level, respectively. These 73 units were the intercepts for our fixed-effects model. This means that these cross sections were significantly different from others.

According to the parameter estimates, the objective equation 21 can be transformed to:

$$\frac{B_t}{TA_t} = 0.016\frac{B_{t-1}}{TA_{t-1}} + 0.734\frac{Cash_t}{TA_t} + 0.008\frac{S_t}{TA_t} - 0.500\frac{I_{t+1}}{TA_{t+1}} + 1.720\frac{I_t}{TA_t} - 0.157\tau_1 + 0.054\tau_2 - 0.090\tau_3 - 2.640\alpha_t + e_t \quad (23)$$

The lagged debt ratio positively affects the present debt ratio. The estimated coefficient on the lagged debt ratio was 0.016, which means that an increase in the lagged debt ratio by 10% was estimated to increase the present debt ratio by 0.016%. If total assets were constant between two consecutive periods, increasing the lagged debt 62.5 times (1%÷0.016%=62.5) would induce one unit increase in present debt. The positive relationship illustrates that as the lagged debt ratio increases, the amount of debt financing should increase and less equity financing should be used. This finding reveals that past volatility in debt directly affects the firm's capital structure. In addition, it supports our discussion in the statistical model (described in Equation 19) that debt in the last period aggravates the present external finance constraint.

However, a relative small estimated coefficient, 0.016, did not mean that lagged debt ratio had less influence on the present debt ratio in the practical world. The standard deviation of the lagged debt ratio in Table 3 demonstrates that one unit change of the lagged debt ratio happens relatively fast.

The estimated coefficient for the marginal effect of the proportion of assets held as liquid assets was 0.734 and was highly significant (p-value < 0.0001). The coefficient of 0.734 means that one unit increase in the liquid asset ratio, on average, associated with an increase in the optimal debt to total assets ratio of 0.734 points. Since the liquid asset ratio and the optimal debt to total assets ratio have the same denominator, current total assets, we can compare two numerators directly. As the liquid asset increases one unit, 0.734 units of debt financing should be used, and that is 0.734 units of the equity financing should be decreased if total assets are unchanged. In the practical world, one unit change in liquid assets happens fast according to Table 3. The practical consequence of this change is that if liquid assets increase \$1,000, then the current debt should increase \$734.

High marginal profit of capital, which proxied by sales per unit of total assets (Gilchrist and Himmelberg, 1998), is associated with higher debt ratio. The coefficient of marginal profit of capital was 0.008, so 1% increase in the marginal profit of capital associated with an increase in the debt ratio of 0.008%. The effect of the marginal profit of capital, however, is a half of the effect of lag debt ratio. That is, 125 (1÷0.004=125) units increase in the marginal profit of capital resulted in one unit increase of debt, if other explanatory variables were constant. Even though 125 is a big number, the change of marginal profit of capital happens very fast according to Table 3. Hence, managers should pay more attention to the impact of marginal profit of capital on the optimal capital structure.

The present marginal adjustment cost of investments has a positive effect on the optimal debt to total assets ratio. It was statistically significant at the 1% confidence level and had a parameter estimate of 1.720. The coefficient of 1.720 means that the debt ratio increases by 1.720 for each one unit change in present marginal adjustment cost of investments. One unit increase in the present marginal adjustment cost causes approximately a two times increase in debt in order to cover the higher costs.

The present marginal adjustment cost of investments has a larger slope coefficient in the model, but one unit change in this explanatory variable barely happens in the practical world. The standard deviation of current marginal adjustment cost of capital is less than 0.05. Hence, the great parameter estimation does not mean a great effect on the dependent variable.

The marginal adjustment cost of investments in the next period, however, has a negative relationship with the present debt ratio. The coefficient, -0.500, can be used to indicate how increasing the future marginal adjustment cost of investments decreases a cooperative's current leverage ratio. A unit increase in the marginal adjustment cost of investments in the next period was estimated to decrease the debt ratio by 0.500 points. The estimation shows that a cooperative should increase the proportion of internal financing, equity, rather than the proportion of external financing, debt, to cover a higher marginal adjustment cost of investments in the next period.

The results in Table 4 also prove our hypothesis that macroeconomic uncertainty has a negative and significant effect on the optimal capital structure. That is, an increase in business risk leads a cooperative to increase financing through equity. As the level of risk increases, the leverage ratio decreases. This indicates that a cooperative that has more macroeconomic risks prefers to decrease its fraction of debt to cover the higher costs of external financing caused by these uncertainties.

The first source of macroeconomic risks, short-term interest rates, negatively affects the debt ratio at the 5% significant level. The coefficient of this independent variable was -0.157. An increase in the short-term interest rate by 1% reduced the debt ratio by 0.157%. A higher short-term interest rate means a higher opportunity cost to borrow money. Therefore, the cooperative prefers to apply more equity.

The change in the leverage ratio from a change in the variance of the annual inflation rate on all consumer goods, the second source of macroeconomic risks, has a positive relationship. The estimated parameter of the annual inflation rate was 0.054, which demonstrated that the effect of this risk was approximately one third as large as the effect of the short-term interest rate in the absolute value. A one unit increase in the annual inflation rate would cause a 0.054 unit increase in the debt ratio. Hence, increasing the debt ratio is a preferred choice for cooperatives, regardless of whether the annual inflation rate is anticipated inflation or unanticipated inflation. Inflation benefits borrowers rather than lenders, because the real value of money declines during inflation. Thus a cooperative, as a borrower, gains from increased inflation.

An increase in North Dakota gross state product, the third macroeconomic risk, has a negative impact on the leverage ratio. That is, as the gross state product increases, the ratio of debt financing to total assets should decrease. The gross state product was statistically significant at the 10% confidence level and had a parameter estimate of -0.090. An increase in the gross state product by 1% was estimated to decrease the debt ratio by 0.090%. That is, if the economy in North Dakota grows, members in agricultural cooperatives would contribute more. Members have more willingness to invest in the cooperative during a flourishing period in order to obtain more dividends. Hence, the growth rate of equity is bigger than the growth rate of debt.

In addition to macroeconomic risks, the annual fraction of equity retired in the cooperative has a negative impact on the leverage ratio. The coefficient for the retired equity variable was -2.640 and was highly significant at the 1% confidence level. The coefficient can be used to indicate how increasing the variability of retired equity decreases a cooperative's leverage ratio. When members exit the cooperative with more equity, the cooperative prefers to rely on equity financing rather than debt financing. It helps the cooperative supplement equity taken away by retired members.

Our third hypothesis about the relationship between the idiosyncratic risks and the debt ratio was not verified by the regression. The coefficients on the standard deviation of sales, revenues and expenses were insignificant at the 10% significance level. Therefore, the idiosyncratic risks do not have significant influence on the optimal level of debt ratio.

Table 4. Estimation Results of Unbalanced Panel and Balanced Panel

Independent Variable	Estimates of Unbalanced Panel	P-Value of Unbalanced Panel	Estimates of Balanced Panel	P-Value of Balanced Panel
Lagged Debt Ratio	0.016*	0.085	0.071*	0.091
Liquid Assets	0.734***	<0.0001	0.633***	<0.0001
Marginal Profit of Capital	0.008**	0.015	0.017*	0.061
Next Adjustment Cost of Investments	-0.500**	0.044	-0.126	0.607
Present Adjustment Cost of Investments	1.720***	<0.0001	0.916**	0.009
Interest Rate	-0.157**	0.003	-0.063	0.253
Inflation Rate	0.054**	0.047	0.132***	0.001
World Commodity Price	0.034	0.200	0.069**	0.013
Gross State Product	-0.090*	0.050	-0.093**	0.037
Exchange Rate	0.004	0.914	0.095**	0.041
Input Price	0.036	0.492	-0.040	0.456
Stdev of Sales	-0.014	0.446	-0.007	0.697
Stdev of Revenues	-0.000	0.979	0.002	0.890
Stdev of Expenses	0.017	0.766	-0.022	0.691
Retired Equity/ Total Assets	-2.640***	<0.0001	-0.559**	0.029

Note: ***represents significant level at 1%; ** at 5%; * at 10%.

One disadvantage of the numbers of coefficients is that they do not include the units of parameters. For example, a one unit change in gross state product can happen quickly, but a one unit change in the marginal adjustment cost of investments is rare in the data. The summary statistics of independent variables in Table 3 prove this inference. The standard deviations of future adjustment cost of investments, current adjustment cost of investments and retired equity ratio are all less than 0.05, indicating that much of the variation is close to the mean ratio value. Hence, large variations in the value of these variables are rare, even though they have great parameter estimations. However, a one unit change in liquid assets can happen relatively quickly and the parameter estimation of liquid assets is 0.734, which means liquid assets matter when an agricultural cooperative considers its optimal capital structure.

In this study, the optimal capital structure is determined by manager-controlled and member-controlled factors. For example, retired equity is affected by both managers and members' decisions. On one hand, managers in a cooperative should decide which equity redemption plan is used in order to make sure the cooperative is owned and controlled by users. On the other hand, members may exit the cooperative for unexpected reasons, such as new outside opportunities or declining health. Therefore, decisions from both managers and members should be considered when managers decide the optimal debt ratio. In addition, external uncertainties should be observed. These factors are exogenous variables and not influenced by one cooperative. Understanding the category and effects of different macroeconomic risks can help determine the optimal capital structure. Therefore, cooperatives' managers and members can refer to our results to decide the optimal capital structure by determining the vital determinants.

After the estimation analysis, we needed to test whether the estimated coefficients were efficient. If the assumptions of OLS are violated, then the data need to be modified to overcome the violations. Since Breusch–Pagan (BP) test for testing heteroskedasticity is not valid in the case of unbalanced panels, we used a likelihood ratio test to test the null hypothesis of no heteroscedasticity in our data. The null hypothesis of the likelihood ratio test is homoscedasticity.

Hence, rejecting the null hypothesis indicates the presence of heteroscedasticity. The statistic of likelihood ratio test obtained in our research was 2185.2, with $p < 0.0001$, which means that the observed outcome is not more than or equally likely or nearly as likely to occur under the null hypothesis as compared to the alternative, and the null hypothesis can be rejected.

In the presence of heteroscedasticity, the covariance matrix has a complicated structure which can result in inefficiencies in the OLS estimates and biased estimates of the variance covariance matrix. We added Heteroscedasticity-Corrected Covariance Matrices (HCCME) option in SAS to solve this problem. The signs of estimated coefficients were same as the previous regression, but the significance of estimated coefficients were increased.

The Regression with Balanced Panel

The previous regression used an unbalanced panel to generate the estimated coefficients. In order to confirm our results obtained from the previous regression, we compared these coefficients with those generated by a regression using a balanced panel. The balanced panel included only cooperatives with ten annual observations. Fifty-two cooperatives were used. Compared with the first regression with all valid observations in 126 cooperatives, the estimated coefficients from the two datasets all have the same signs and no change in the statistical significance of parameters. Table 4 shows the independent variable labels, estimated coefficients and p-values.

The Regression with the Dummy Variable of Cooperative Size

Table 5 provides summary statistics of the regression with a size dummy variable. Included in this table is the name of intercepts and independent variables, regression parameter estimates and p-values. The estimated coefficients for the regression with a cooperative size dummy have the same signs and the same significance as the previous two regressions.

The important feature of the regression with a cooperative dummy is intercept dummies for medium and large cooperatives. The estimated coefficient of intercept dummy for large cooperatives was 0.059. This dummy is statistically significant at the 10% confidence level. That is, the intercept dummy for large cooperatives was important in our model.

Table 5. Estimation Results of the Dummy Variable in Cooperative Size

Independent Variable	Estimates	P-Value	Independent Variable	Estimates	P-Value
Medium Intercept Dummy	0.022	0.239	World Commodity Price	0.030	0.246
Large Intercept Dummy	0.059*	0.011	Gross State Product	-0.103**	0.027
Lagged Debt Ratio	0.015*	0.104	Exchange Rate	0.029	0.407
Liquid Assets	0.736***	<0.0001	Input Price	0.046	0.385
Marginal Profit of Capital	0.008**	0.023	Stdev of Sales	-0.015	0.425
Next Adjustment Cost of Investments	-0.451*	0.070	Stdev of Revenues	0.004	0.794
Present Adjustment Cost of Investments	1.736***	<0.0001	Stdev of Expenses	0.019	0.748
Interest Rate	-0.135***	0.009	Retired Equity/ Total Assets	-2.633***	<0.0001
Inflation Rate	0.024	0.382			

Note: *** represents significant level at 1%; ** at 5%; * at 10%.

CHAPTER 6. SUMMARY AND CONCLUSION

The objective of this research was to identify determinants of the optimal capital structure in farm supply and grain marketing cooperatives within the state of North Dakota. This research utilized the standard Q model of investment and the present value of cash flow method to solve a firm value maximization problem.

The present value of cash flow method indicates that the firm value in a cooperative is the net present value of all cash flows generated over the life of equity investment, which include equity redemption, patronage refunds and dividends received by members. Taking the time value of money into consideration, the optimal capital structure is affected by many factors under the rule of maximizing the value of a cooperative. The estimation of our theoretical model provided insights into the determinants of the optimal capital structure, which include firm profitability, investment, membership horizon lengths and macroeconomic risks.

Our results presented that the lagged debt ratio, the proportion of assets held as liquid assets, the marginal profit of capital and the present marginal adjustment cost of investments had positive and significant effects on the optimal debt ratio. The estimated coefficients showed that present marginal adjustment cost of investments had the greatest influence on the capital structure. It is necessary, however, to consider the variation in the value of this variable by looking at the trend of a cooperative's development. For example, the effect of present marginal adjustment cost of investments is not as large as its estimated coefficient (1.669) presented if large variation in the value of this variable is rare, even though it has large parameter estimation.

In addition, our results displayed that the effects of marginal adjustment cost of investments in the next period and the annual fraction of equity retired in the cooperative were negatively significant for determining the optimal debt ratio. A unique feature of cooperative business finance is to return equity to members. As a result, members value each dollar of equity as a potential cash flow, albeit with uncertain repayment time. Therefore, the membership horizon length was a vital explanatory variable with the estimated coefficient of -2.675.

The empirical results also showed that macroeconomic uncertainty had a negative and significant effect on the optimal leverage ratio. That is, an increase in business risk leads a cooperative to increase financing through equity. As the level of risk increases, the leverage ratio decreases. This indicates that a cooperative that has more macroeconomic risks prefers to decrease its fraction of debt to cover the higher costs of external financing caused by these uncertainties.

As agricultural cooperatives are facing fierce competition and various risks, the management of cooperatives must weigh the trade-offs of debt and equity as sources of capital and how these tradeoffs are affected by intrinsic and extrinsic factors, which sequentially impact members' investment to the cooperative and the cooperative's debt financing. Both members' investment and the cooperative's debt financing are significant aspects for the growth of the cooperative.

In summary, this study discussed the factors impacting the optimal capital structure of farm supply and grain marketing cooperatives in North Dakota by using the present value of cash flow method. There are few studies using this method to calculate a cooperative's value and to obtain the optimal debt ratio. Some additional areas of research may be expanded for future studies. For example, some studies may focus on the capital structure of other cooperative categories, such as energy cooperatives, housing cooperatives and utility cooperatives. Also, because this study is limited to an incomplete data set, more accurate and comprehensive financial reports from these agricultural cooperatives would be helpful. Finally, the geographic area of this study is the state of North Dakota, which is an important agricultural state in the United States. However, due to the economic difference in regions, how the optimal level of debt in other states affected by factors, such as capital management and exposure to risks, may be worthwhile to investigate in the future research.

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