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Rationing in agricultural credit markets: evidence from Iowa farm operators

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by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1. INTRODUCTION

Problem Setting

Since the early years of this century, credit has been an important component in farm policy development. However the specific policy issues have ranged widely from insufficient credit to too much, from weak credit institutions and insufficient competition to excessive competition leading to imprudent credit decisions by both farmers and lenders.

The use of credit in agriculture has also varied widely. Figure 1.1 summarizes asset and debt levels in U.S. agriculture from 1920-1970. Key financial ratios are presented as well. Farm debt remained at 1920 levels through 1950. However, this apparent stability is misleading.

The stock of debt doubled every ten years between 1950 and 1970. During the 1970s, expectations of higher future incomes, a soaring farm land market, liberal lending practices and high inflation encouraged many farmers to use financial leverage to take advantage of the boom. Debt financed much of the growth in capital formation during this period. Farm debt grew three fold between 1970 and 1980. The debt to asset ratios (Debt/Assets) escalated from 16.8 percent in 1970 to 22.2 percent by 1984.

Nominal interest rates increased along with the levels of debt significantly, in-

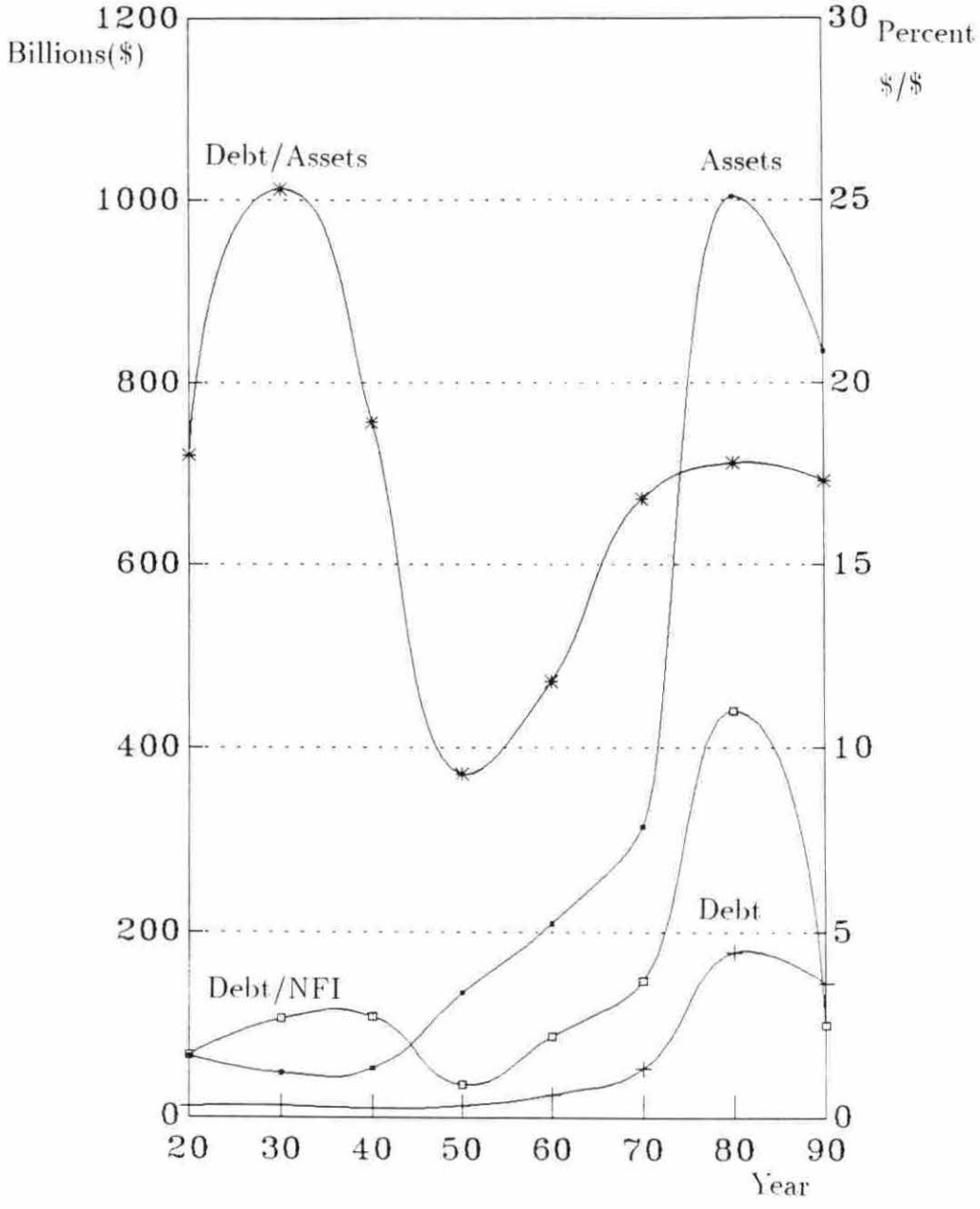

Figure 1.1: The trend of farm assets and credit use

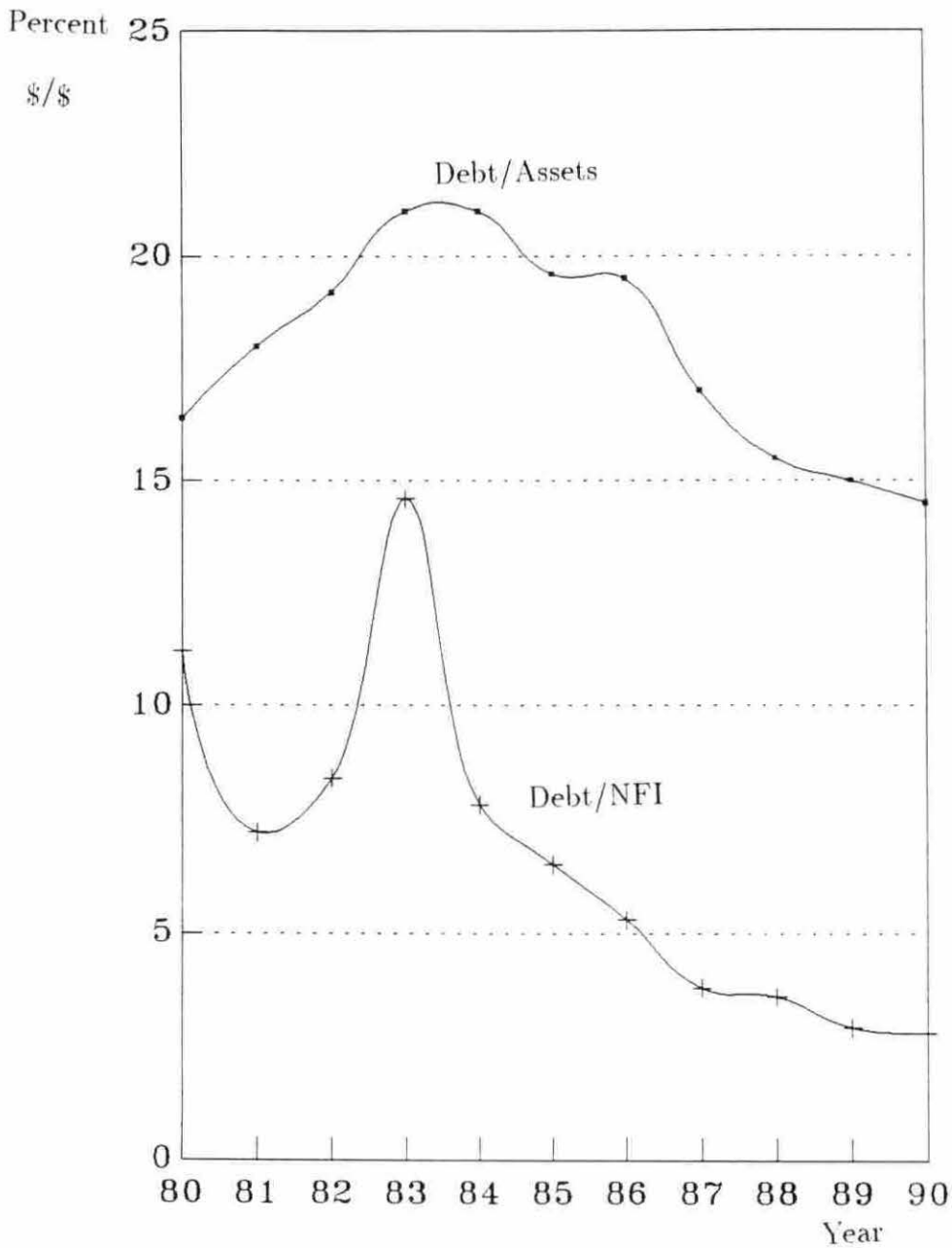

Figure 1.2: The changes of farm assets and credit in 1980s

creasing debt costs for farms. In 1950, each dollar of farm income supported less than a dollar's worth of debt (Debt/NFI). This ratio slowly increased to about 4 in 1980. Between 1970 and 1980, the debt to income ratio increased three times to a high of 11. As shown in Figure 1.2, during the 1980's, falling debt and improving incomes returned this ratio to levels observed in the fifties. However growing farm incomes and rapid inflation masked the danger of increased leverage. The risks faced by farmers also increased as well. Rapid growth of agricultural exports coupled with the switch to floating exchange rates in the 1970s increased the sensitivity of agricultural commodity prices to domestic and foreign macro-economic policies.

This inflation fed, and debt financed boom came to a crashing halt in 1979. The eighties ushered in a period of high real interest rates, reduced exports, low farm income compared to the 1970s and declining farm land values. These conditions led to the widespread adjustments in both the farm and financial sectors of the agricultural economy. By the end of the 1980s farm debt had decreased almost by 20 percent. This reduction came painfully as the result of asset liquidation by farmers, loan losses by lenders on pay downs.

At the beginning of the 1990s, the agricultural sector in the U.S. had stabilized. Income levels were at historical highs. The DAR and Debt/NFI ratios had returned to pre 1970 levels. Despite the apparent equilibrium, however a new set of concerns about farm credit began to emerge.

The trauma and adjustments of the 1980s forced farmers to delay capital purchases. Sales of new equipment plummeted significantly. It has been found, for example that over 88 percent of the tractors used by farm operators in Iowa, were built prior to 1980 (1989 Survey of Iowa Farm Operators). New investments in build-

ings and in livestock facilities were sharply curtailed as well. A report by the Iowa Business Council estimated that nearly most of Iowa's livestock facilities needed major renovation or replacement. Credit would be needed to modernized machinery, equipment and livestock facilities. There were also concerns expressed about the eventual transfer of farm assets to the next generation. The average age of farm operator continued to creep upwards approaching retirement level. Credit would be needed to facilitate this transfer of agricultural assets.

As concerns for adequate credit began to mount, farm and rural leaders began to criticize, lenders for their apparent unwillingness to extend credit to farmers (Yepsen, 1989). Many political advocants urged lenders to loosen up credit to farm operators to accomplish their acute needs of credit and thereby to revitalize the farm economy. With improved conditions in agricultural credit markets, lenders are in a position to satisfy a significant portion of farm credit demand in 1990s. But, instead loan/deposit ratio in agricultural banks remained low reflecting the evidence for their, apparent unwillingness to lend locally as well as their application of stringent standards on making new loans. Some analysts described the current credit problem not one of credit availability but of credit worthiness. Since lenders are carefully scrutinizing the credit worthiness before making new loans. The loan to deposit ratio of the commercial banks are rising at a very slow pace. The average loan to deposit ratio of rural banks in Iowa was 56.8 percent in 1989, ten percent below the lending observed in 1970's. Many of Iowa's smaller banks were far below the state average as were banks in economically depressed rural Iowa communities. In 1989, Iowa banks had loan/deposit ratios ranging from a low of two percent at small banks in Southern Iowa to 94 percent at large metropolitan banks in Des Moines (Yepsen, 1989).

In addition to the tight commercial credit, credit analysts have also expressed concern about recent policy changes that may restrict credit for borrowers who are heavily dependent on the federal government as their primary source of credit. For several years, federal funding levels for Farmers Home Administration direct loans have been declined. The mission of institution has been redirected towards providing guarantees through commercial lenders. The 1990 farm bill accelerates this transition. Guarantees may ration credit to high risk borrowers more effectively than did direct lending of appropriated funds.

In response to criticisms about overly conservative lending practices, banking industries spokes-persons have indicated that low loan/deposit ratio, does not necessarily mean banks are neglecting community's needs. Many banks, which have recently recovered from the loan losses, incurred during the farm financial crisis, remained cautious about agricultural lending. They argue that prudent lending practices requires them to reduce their exposure to the fluctuations in farm profitability and asset values. The pro-debtor laws, introduced during the 1980's, also impose an additional risk on lenders (Financial Committee of the First State Bank, Webster City, Iowa). Resolution of problem loans becomes more difficult and costly during periods of financial adversity, with pro-debtor laws.

Low lending rates may also be the result of weak demand for farm loans. Despite low interest rates in early 1990's debt in the farm sector increased very slightly. Lenders claim this behavior as a reflection of farmers' reluctance to make new capital investments in the midst of the general recession. Uncertainties about the future may keep many farm operators away from seeking new loans.

Whether a supply side or a demand side phenomenon, credit availability to

farmers and rural areas is an emerging policy issue. This fact was demonstrated by including in the 1990 farm bill a mandated study of rural credit cost and availability (United States General Accounting Office, 1992). The major objective of this was to evaluate the availability and adequacy of credit in rural America for the purpose of financing agricultural production, infrastructure and rural development and to clarify the level of lending and investments activities of lending institutions in rural America.

Objectives

The primary objective of this research is to study the existence and sources of credit rationing in a sample farm population of Iowa farm operators. This thesis will focus on the following hypotheses.

1. Is credit viewed as a limiting resources by farm operators? Do farm operators believe profits from the farming operation are being restricted due to inadequate financing.

2. If credit appears to be limiting, is it being restricted by farmers themselves or by their lenders? Farm operators may deliberately forego investment opportunities because of their reluctance to use debt financing. They may be constrained due to restrictions imposed by lenders as well.

3. If credit rationing appears to exist, determine the characteristics of farmers who are or are not being rationed. Farm operators being rationed may have distinct personal and financial characteristics, the operators not being rationed.

Thesis Outline

This thesis is organized as follows. Chapter 2 provides a review of credit rationing concepts and theory. Chapter 3 develops an empirical procedure to identify credit constrained farm operators. Chapter 4 presents and interprets the results from the empirical analysis. Chapter 5 presents some conclusions and suggestions for further research.

CHAPTER 2. THEORETICAL MODEL

There is an extensive literature on credit and capital limits. The literature reviewed in this chapter, will facilitate the development of a conceptual model of external and internal credit limits in farm production. The first part of the chapter reviews the role of credit and credit allocation. The second part presents discussions of possible credit rationing methods, and reasons and implications of those on borrowers, lenders and on the whole society. The chapter concludes with a discussion of the characteristics of internal and external credit rationed farm borrowers.

Role of Credit

Credit extended to farmers may be classified in many ways. The more common characteristics include the duration over which funds are used, the pricing mechanism employed, the repayment pattern involved, the purpose for which loan funds are used, the lending source providing funds, and the type of collateral necessary to secure the loan. This discussion will focus on the role of credit using a classification based on loan duration.

Short term credit

Short term loans have maturities for one year or less. These are also referred to as production or non-real estate loans. They are mostly used to finance the purchase of operating inputs and to hold inventories of stored commodities. In farming, inputs must be purchased in one period and products are sold later in the year, because cash inflows and outflows do not occur simultaneously. The use of short term credit, makes it easier to absorb these fluctuations and to match cash inflows and outflows (Lee et al., 1988; Brake, 1983; Padmanabhan, 1989).

Intermediate term credit

Intermediate term loans have maturities ranging from 1 to 10 years. They are used to finance the purchase of many types of assets, such as breeding livestock, farm machinery and equipment; and farm structures such as livestock production or grain storage facilities.

The use of intermediate term credit may make it possible to substitute one resource for another. For example machinery might be substituted for labor as a means of reducing cost, improving timeliness, or increasing the efficiency of the farm business. New technological developments or changing market conditions may require major adjustments in intermediate assets. For instance, adopting confinement hog production technology or acquiring modern tillage, planting, harvesting or power equipment may be essential to maintain efficiency and farm income as prices decline and costs increase. Such adjustments require major capital investments and intermediate term credit can be used to assist in making these adjustments and changes (Lee et al., 1988).

Long term credit

Long term credit in agriculture is mostly used to finance land purchases. Long term loans carry maturities in excess of 10 years and less than 40 years, and usually range between 15 and 30 years (Barry et al., 1988). Long term loans are primarily used to finance expansion of the land been operated by existing farms. However long term credit is also needed to acquire start up capital and in transferring business from one generation to another. Getting established and obtaining control of a sufficient set of resources is a major problem for beginning farmers. Most new farm businesses are spun-off from existing operations. The transfer of an on going farm business from parent to child usually involves large quantities of capital. Without credit, many operations would have to liquidate during the transfer process, because some nonfarm heirs may want their inheritance in cash rather than an ownership interest in farm real assets and other assets. Credit is essential for successful inter-generational transfer, because the tax liability and claims by off-farm heirs erode the liquidity and equity capital base of the business, credit can be used to substitute for the equity lost in transfer process (Lee et al., 1988).

Optimum Use of Credit

The decision to use credit involves allocation of credit between use in loans and use in reserve (Barry and Baker, 1971). The choice presumably depends on the value of credit in each use. Hence the borrower has to evaluate the returns earned from the business by employing borrowed funds and the liquidity value of the credit reserve.

Credit reserve

A firm's credit reserve is represented by its unused borrowing capacity. The credit reserve is a valuable resource of liquidity for many farm businesses. Unused credit, like balance sheet assets that are liquid, constitute a reserve of liquidity that can be called upon to counter the effects of unanticipated events (Baker, 1968). The credit reserve reduces costs associated with liquidating productive assets to meet cash demands and then reacquiring assets later, when adverse conditions have passed.

Allocation of credit

By studying the producers credit allocation problem numerous economists have attempted to explain a wide range of issues such as the demand for a credit reserve, liquidity, and reservation prices on credit use. Baker and Hopkin (1969) explored the effects of leverage and liquidity on the growth characteristics of the farm business. Specifically they examined the credit equilibrium of a farm based on the costs and returns of credit in its two possible uses. The model assumed that a farm operator established a business relationship with one major lender and he engages in the production of a single farm commodity.

The curve labelled V_R in Figure 2.1, represents increments to loan costs from added units of debt. The curve's slope reflects the assumption that the farmer faces higher cost of loan sources as his debt increases. It has two components the interest rate (i) charged by the lender and the liquidity premium (r) ascribed by the borrower on the credit reserve as a source of liquidity.

$$V_R = i + r \tag{2.1}$$

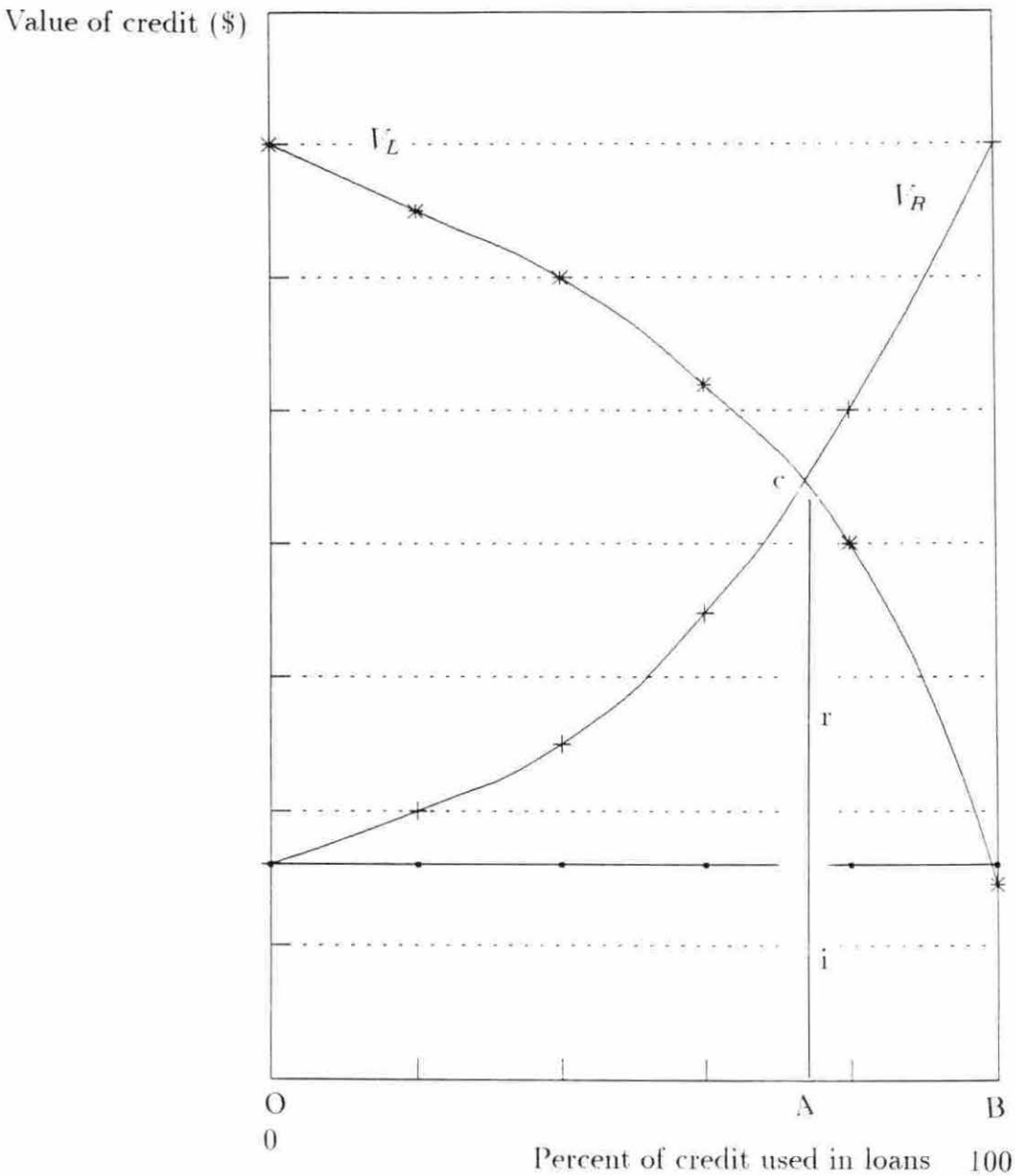

Figure 2.1: Optimal credit allocation

The interest rate is established as a part of loan contract, thus it is observed in the loan market. The authors assumed the interest rate to be constant, over the amount borrowed, however increasing interest rate schedule is plausible as well.

The liquidity premium is a more subjective concept, determined by the borrower's level of risk aversion. It is similar to reservation price or required rate of return on the next unit of borrowing. The liquidity premium or credit reservation price is assumed to increase as additional borrowing depletes the credit reserve. Conversely the value of additional units of unused credit is assumed to decline as borrowing declines (Barry and Baker, 1971).

The curve labelled V_L in Figure 2.1, represents the returns from borrowing. Returns from additional units of resources and resource services acquired with borrowed funds are assumed to decrease at an increasing rate (Baker et al., 1988). Hence the curve V_L is considered to be a payoff schedule from using borrowed funds in the business or the opportunity cost of maintaining the credit reserve. Alternatively, this schedule could also be considered as the returns on potential investment opportunities, in descending order, versus the percent of credit in used in loans. The marginal returns on potential investment projects using a criterion such as net present value for example, decline as discount rate increases. Therefore taking on a project financed with debt, whose, rates of returns exceeds its cost of capital, increases the owners wealth. On the other hand, if the rate of return of a project is less than the cost of capital, then taking, on such a project imposes a cost on current owners (Brigham et al., 1991).

Referring again to Figure 2.1, V_L as the marginal value of liquidity from credit held in reserve, a rational individual may equate the marginal returns of borrowing

with marginal cost. In this case he would borrow OA with AB held as a credit reserve. This allocation of credit varies with risks associated with borrower as well as the lender.

The height and shape of V_L and V_R, are determined jointly by the manager's risk attitude, levels of risk, business characteristics, and practices employed in risk management (Barry et al., 1988). These curves also could shift and change shape over time, as a result of experience, age, preference changes or other changes that alter the importance of risk to him.

Returns

Debt financing facilitates the adoption of income increasing investments, as well as the maintenance and replacement of depreciable capital items. Similarly, financial leverage enhances the returns on these profitable investments and capital stock, reducing associated business risks, as long as leverage costs do not exceed the returns. However the fixed repayment obligations and reduced liquidity also increase the variability of returns to the equity investor and raise the potential loss of equity capital.

Credit risks

The amount of credit an individual is willing to use varies with the degree of risk aversion. The more risk averse the decision maker, the higher is the position of V_R and lower is the position of V_L (Figure 2.2). Increasing risk aversion tends to increase the liquidity premium on unused credit reserves and to discount the returns of borrowing (Venezian, 1959; Barry and Baker, 1971; Penson and Lins, 1980; Barry

et al., 1988). In the absence of lending restrictions the owners arbitrarily establish a cut off rate for investment that is higher than the firm's cost of capital. The use of this higher rate as the discount factor in evaluating capital investments, at each and every discrete level of debt, would shrink the marginal returns schedule. Thus greater risk aversion yields, smaller debt holdings. This situation is referred to as the demand side or internal credit rationing and is illustrated by Figure 2.2.

Risk aversion also influences lenders' willingness to extend credit. Lenders may express their risk response to a farmer's credit worthiness in non price terms by imposing limits on credit availability. In that case, the curve V_L, the marginal value product curve may encounter the right margin of Figure 2.3, before it crosses V_R leaving an excess return above the total cost of borrowing. Lender respond to risk by including a premium on interest rates. In this situation, the interest line (i) may curve upwards or become completely inelastic (Figure 2.4).

Internal Credit Rationing

As mentioned above, internal or rationing by borrowers can result in reduced credit use (Figure 2.2). Demand side or internal credit rationing by borrowers arises from their demand for credit reserves as a source of liquidity to counter unanticipated variation in their cash demands. Farm operators may choose to ration their remaining credit capacity because they wish to save the remaining for liquidity reasons (Penson and Lins, 1980). These self-imposed limitations on credit use provide liquidity in the form of a credit reserve and limit exposure of the borrower's equity. Hence debt aversion is a form of risk aversion and thereby constitutes an important alternative response to uncertainty (Barry and Baker, 1971).

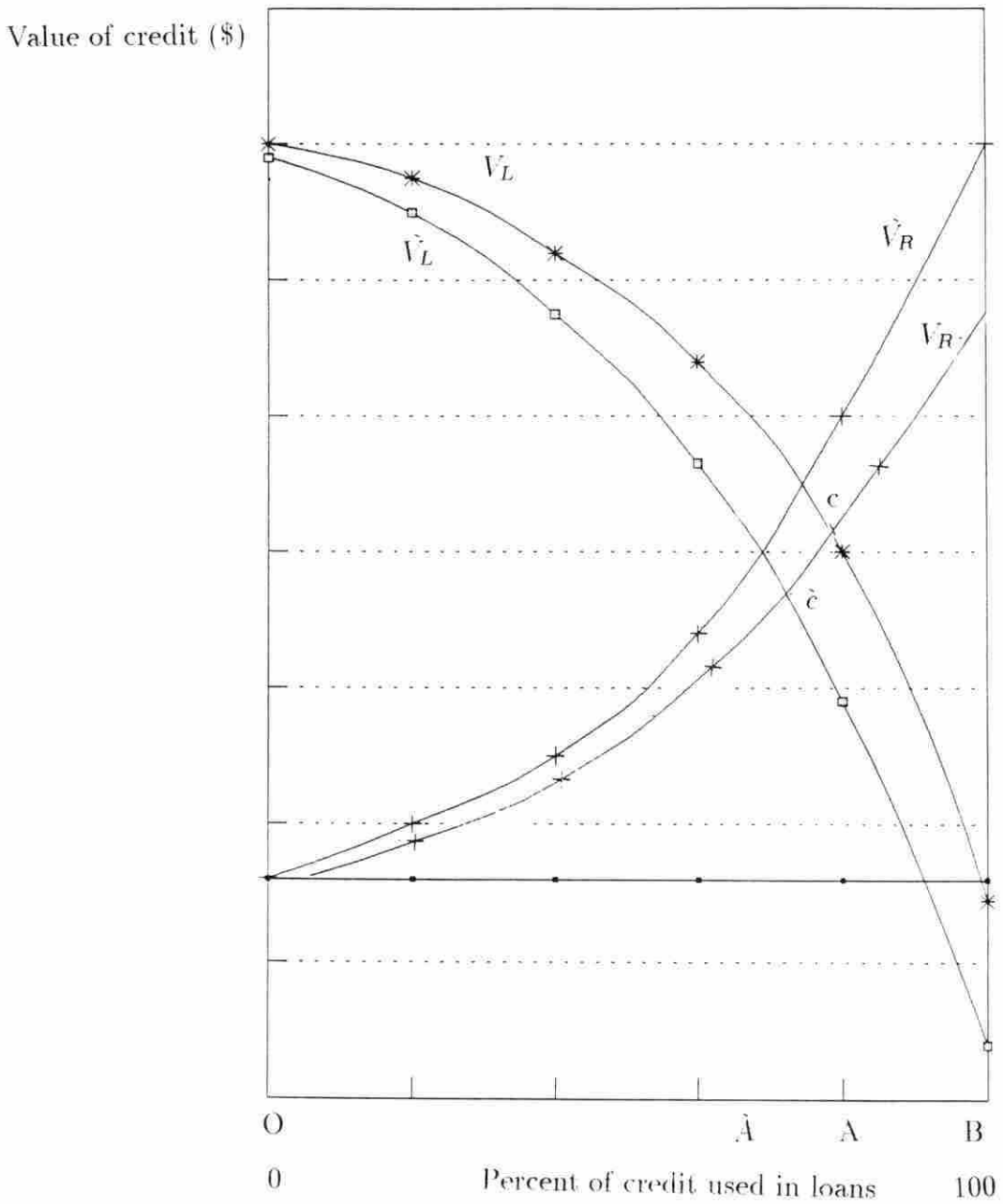

Figure 2.2: Internal credit rationing

Reasons for internal credit rationing

A number of studies over the past forty years have attempted to identify factors that result in internal credit rationing.

Fear of possible rejection One strongly suspects that for many farmers the fear of possible rejection keeps them from asking for loans, thus truncating the demand for loans (Baker, 1968). Jappelli (1990) indicated that individuals may not apply for credit, thinking they will be refused mainly due to their lower income level, not sufficient collateral or due to unestablished credit history.

Attitude Heady and Swanson (1952) provided evidence that 9.2% of southern Iowa farmers looked upon debt as being "bad". Coutu and Lindsy (1961) investigated the attitudes of the farm operators, in all income categories, toward accepting credit. They found that some low income farmers, were reluctant to accept credit. They viewed the terms for available credit specified by the credit institutions as unacceptably stringent. Further, the large volume of credit which would be required to transform their farms into a viable commercial unit, coupled with the fear of losing all they currently possessed made low income farmers unwilling to use additional credit.

Coutu and Lindsy also observed that mid-income farmers failed to use credit in farm adjustments because unfavorable price behavior or improper management would, in their view, destroy their source of livelihood more rapidly than a gradual decline through failure to re-organize. High income farmers may also limit the use of credit because of fears that in destroying the status quo.

Experience Bohlen and Beal (1961) showed that an experience dealing with credit that is perceived as a crisis with much emotional involvement may lead to an embedding of an attitude toward credit that will be difficult to change, and thus some farmers who have had similar experiences may restrict use of credit. For example farmers who lived through the great depression may be conservative in their use of credit.

Risk and uncertainties One of the key element in the theory of internal credit rationing is risk aversion. Heady and Swanson (1952) estimated, that 61.5% of southern Iowa farm operators identified greater uncertainity as the reason for their reduction in borrowing. Moreover they observed that some farm operators had faced, the difficulty in making and carrying-out decisions, when they were confronted with risk and uncertainty. Barry et al. (1981) also showed the inverse relationship between the credit risk and the debt use. The greater the risk aversion the lower the amount of credit uses. Farm operators confronted with uncertainties about lending institutions and about future economic policies tend to reduce demand for credit and their indebtedness (Trechter et al., 1986).

External Credit Rationing

External credit rationing is said to exist when a lender's supply of funds is less than the borrower's demand at quoted contract terms. Two different definitions were given for external credit rationing based on relative role of loan rates versus non price factors of the loan contract. Lenders' risk responses to differences in farmers' credit worthiness primarily may take the form of non price rationing using differing

loan limits among borrowers security requirements, loan maturities, loan supervision, documentation, and other means of credit administration. In that case, lender may extend credit only amounts to $O\tilde{A}$ instead of OA in Figure 2.3. A price response by a lender is characterized by an increase in the interest rate charged on the loan.

Non-price rationing The concept of non price credit rationing as a bank reaction to changing economic conditions was developed in the early 1950s as an integral part of the credit availability doctrine. Since that time, the topic has received considerable attention. Non price rationing is defined as a situation in which the interest rate persistently stays at a level where demand exceeds supply. Consequently insufficient supplies be allocated by some means other than prices.

Luckett (1970) examined non price rationing. He showed that banks use non price loan terms such as shortened maturities, larger compensating balances or collateral, in the decision making process to extend loans. In this case, markets clear via non price terms. Harris (1974) defined credit rationing as a change in non price contract terms by viewing the loan agreement between a bank and its customer as a vector of contract terms that includes the interest rate and all non price variables. He confirmed the existence of non price rationing in the banks, by reviewing the time series data for long term balances from 1944 to 1970. Azzi and Cox (1976) examined quantity rationing of credit with non price terms. They proved that a borrower can increase the size of a loan from a risk averse or risk neutral lender by offering more collateral. In other words, the supply of credit to a borrower is an increasing function of the amount of collateral and equity offered by the borrower. They extended this proof to show that credit rationing cannot be optimal for any lender, as long as there

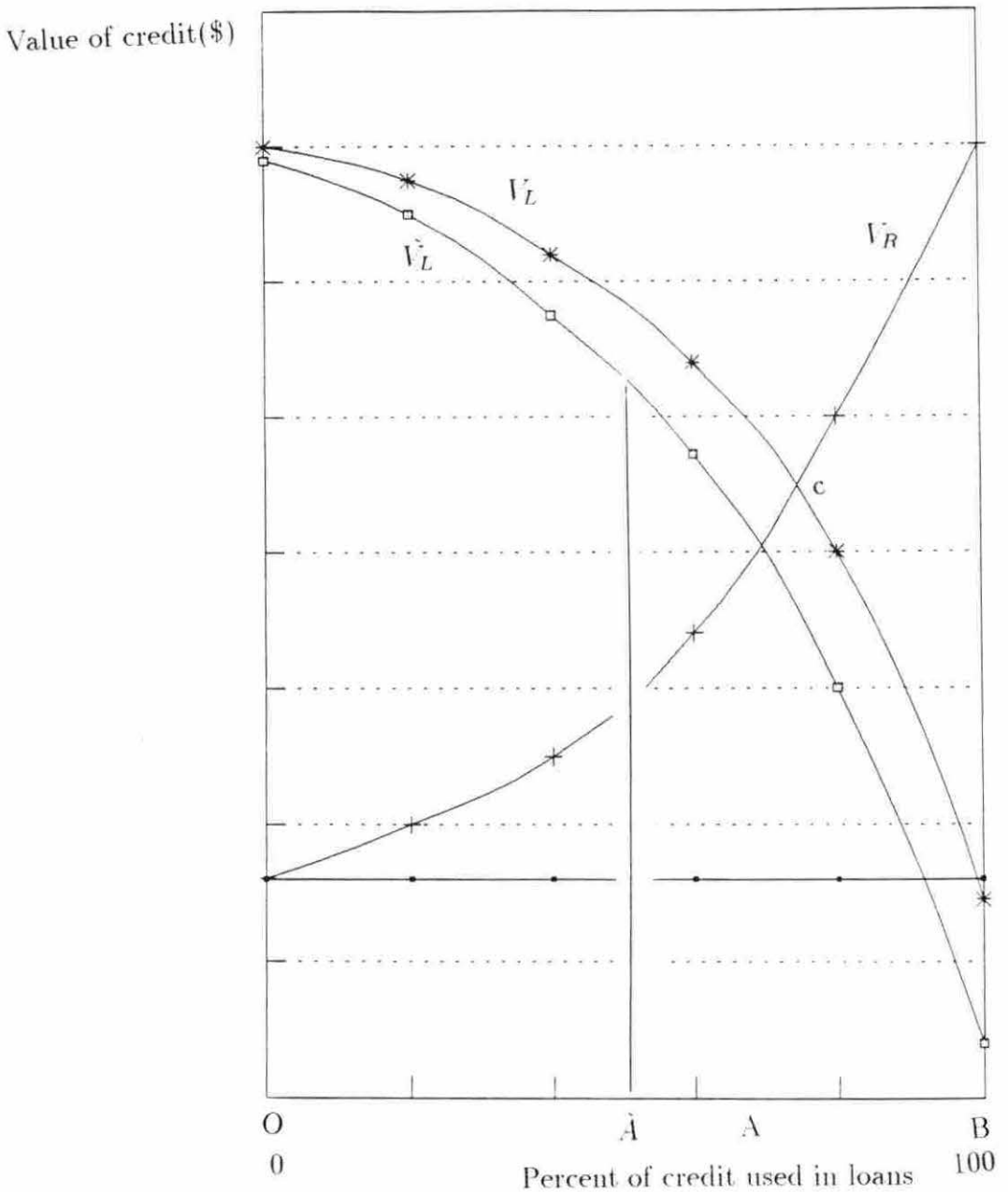

Figure 2.3: Non price rationing

are no constraints on collateral or on other equity components.

Price rationing Lenders may also use the interest rate as a tool to ration loans to borrowers. Credit rationing through increase of interest rates, is regarded as price rationing (Figure 2.4).

Guttentag (1960) argued that the use of high interest rates would increase lenders own gross return per dollar, which makes it possible to attract additional loanable funds. In addition, the increase of interest rates will reduce the demand for loans. He also argued that, normally, there is a tendency for interest rates and credit availability to move in opposite directions in response to changes in demand or supply of loanable funds and these movements could either persist temporarily or indefinitely.

Freimer and Gorden (1965) developed, a rationale for bankers to practice strict price rationing, that is to set an interest rate and ration credit at that rate. They indicated that an expected profit maximizing banker would be willing to increase the size of his loan with the interest rate over a wide range of variation in the interest rate. However real bankers are not so liberal and may not lend more than a finite amount regardless of the interest rate. The authors stressed that on high risk investments, the rates of interest bankers would charge would make it less attractive for individuals to borrow more than they could obtain at the customary rate and the individuals would be constrained at this instance.

Stiglitz and Weiss (1981) indicated that higher loan rates may increase the lenders expected revenues on any given project, but it may also create moral hazard and adverse selection effects that could retard the lender's expected revenues for all borrowers.

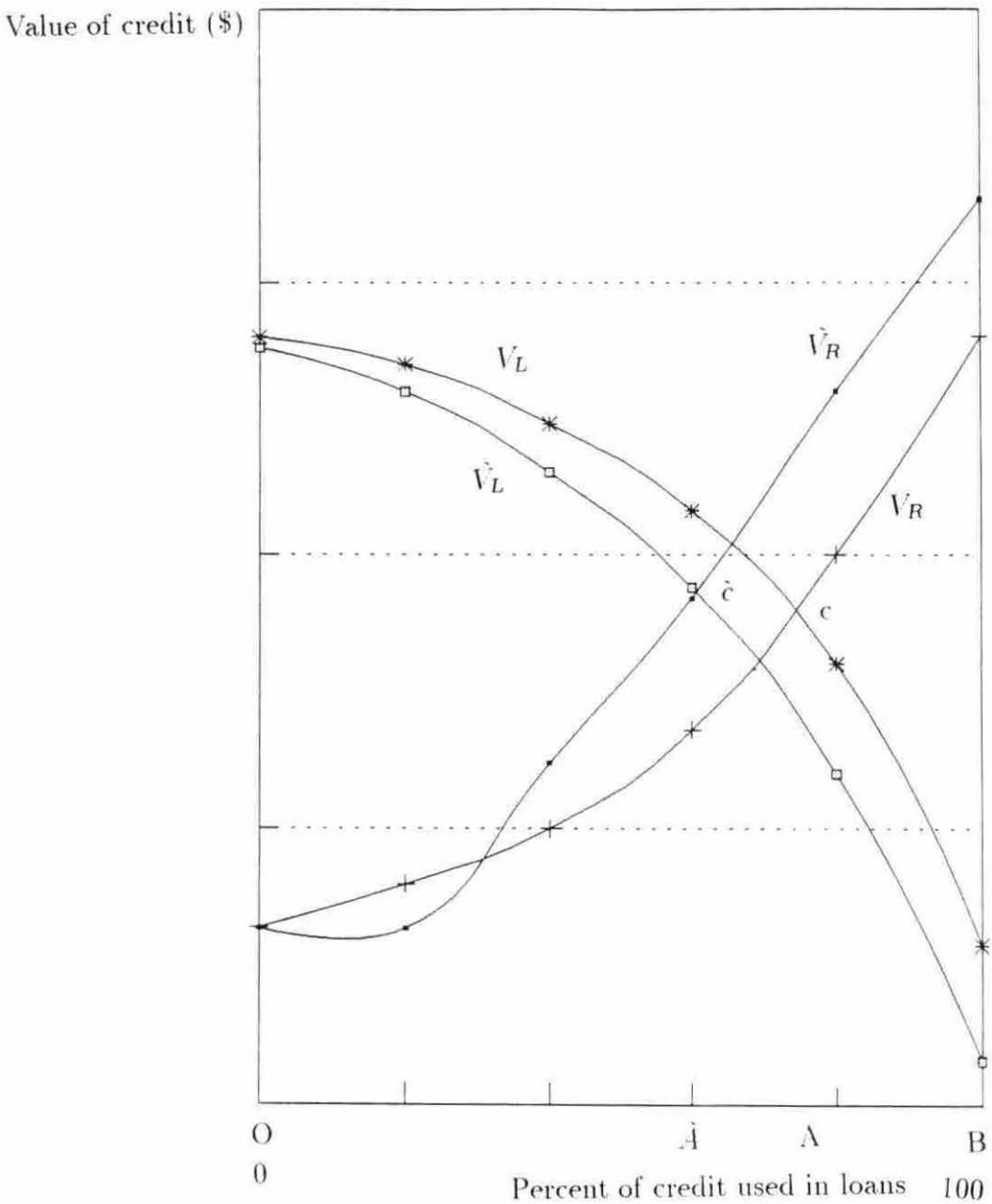

Figure 2.4: Price rationing

Historically, the heavier reliance has been placed on non price responses. In the late 1980s the balance appeared to shift more toward price responses in which interest rates are tailored more closely to the risk position and other financial characteristics of individual farm borrower. The wide spread use of loan pricing and customer profitability analysis among commercial bankers is a case inpoint.

Reasons for external credit rationing

Short term disequilibrium In the short term, excess credit demand is viewed as a temporary disequilibrium phenomenon. Sometimes referred to as dynamic rationing. This may occur the economy experiences an unexpected exogenous shock. It has been suggested, in view of the oligopolistic structure of the banking industry, that the actual rate charged customers is likely to adjust slowly to changes in the long run equilibrium rate. Consequently, there is a transitional period in which rationing of credit occurs. By this definition, dynamic rationing can be positive or negative, and it has be shown that its magnitude is positively associated with the spread between loan rates (Jaffee, 1971).

There are two main market forces that can change the actual loan rate. A change in market interest rates may lead to a change in the opportunity cost. Or a shift in the customer demand schedules influences the rate. Any of these methods would drive up the actual loan rate. Therefore, it is quite apparent that as the actual loan rate rises relative to the long run loan rate, rationing occurs (Jaffee, 1971).

Equilibrium credit rationing Jaffee (1971) has stressed the rationality of equilibrium rationing. He has shown that a bank classifies customers into equivalent

rate categories, based on the risk characteristics of the customer. Specific parameter values could lead to the profitability of credit rationing. In the two customer-one class case, Jaffee demonstrated that one customer would not be rationed while the other customer might be rationed. Similarly, when a bank servicing many diverse customers in terms of demand and risk, is forced to classify these customers into a relatively small number of rate categories, It would generally find it profitable to ration at least some of these customers. In the real world, banks use a limited number of rate categories, thus it is inevitable to see some borrowers being credit rationed.

In the past, long term credit rationing was explained by governmental constraints, such as usury laws and deposit rate ceilings. Usury law ceilings become restrictive if the ceilings are not adjusted in line with rising market rates of interest. As a consequence, credit is rationed for some customers. Most usury laws in the U.S. were removed during the early 1980s, therefore it is anticipated that credit rationing in these markets due to these imposed ceilings will decline in future.

Asymmetric information Banks making loans are concerned not only about the interest rate they receive on the loan, but also the riskiness of the loan. However the interest rate a bank charges may itself affect the riskiness of the pool of loans by either sorting potential borrowers or affecting the actions of borrowers. Both effects derive directly from the residual asymmetric information present in loan markets. Therefore banks become more concerned about increasing loan rates in the presence of asymmetric information.

In an asymmetrically informed bank credit market, is one in which lenders know that borrowers with heterogeneous default characteristics exist, but are unable to

identify the "good borrower" or control a specific borrower characteristics. Thus asymmetry in information and particularly the inability of lenders to distinguish good borrowers may lead banks to ration credit to borrowers (Jaffee and Russel, 1976). Thakor et al., (1983) observed that lenders can remove asymmetry in information, but at a cost. When banks take into account these information costs, their cost of lending would increase. Therefore it is likely that banks will refuse to supply credit simply because the cost of funds, exceeds the maximum possible price the credit applicant can pay.

In actual banking situations, some potential borrowers are denied loans even if they indicated a willingness to pay more than the market interest rate or to put up more collateral than is demanded of recipients of loans (Stiglitz, 1981). Increasing interest rates or increasing collateral requirements could increase the riskiness of the bank's loan portfolio, either by discouraging safer investors, or by inducing borrowers to invest in riskier projects and therefore decrease the bank's profits. Hence neither instrument will necessarily be used to equate the supply of loanable funds. Under these circumstances, credit rationing takes the form of limiting the number of loans the banks will make. Clementz (1987) gave a good interpretation for external credit rationing based on asymmetric information. He showed that, for a bank it is crucial importance to whom it grants a loan and what actions the borrower takes. For a baker, in contrast, it is immaterial to whom he sells bread and what the buyers do with it. The objective of a bank is not just to find borrowers, but to find good borrowers. A good borrower from the bank's point of view is one who defaults with very small probability, who causes small administrative costs, and who uses other services offered by the bank.

Impacts of Credit Rationing

Barry (1988) suggested that Credit be viewed as a power concept. In the process of borrowing money, a farmer obtains the economic power to carry-out a particular course of action, however limited it may be (Barry, 1988). Thus the extension of credit is a joint decision. The borrower and lender decide together, implicitly of explicitly, upon the nature and the scope of the action which credit makes possible. Therefore rationing of credit affects borrowers as well as lenders, perhaps the whole society. A substantial amount of recent work focuses on the importance of credit constraints and their effects on several sectors of the economy.

Effects on borrower

Investment Jaffee (1971) indicated that if firms are rationed in the commercial loan market, they are also rationed in the capital markets. Therefore commercial loan rationing will have a direct and important effect on investment expenditures of the rationed firms. However financial constraints could account for a large proportion of the aggregate variability of investment. Fazzari et al., (1988) found empirical evidence about the effects of credit rationing on investment. They clearly emphasized the link between financing constraints and investment varies by type of firm. Thus the investment of firms that exhaust nearly all of their low-cost funds are more affected by fluctuations in their cash flows than the other firms.

Consumption Effects of credit rationing have also been identified in other sectors of the economy. Liquidity constraints play an important role in determining the path of consumption over time . When income is uncertain and individuals are

unable to borrow, they will take precautions against being caught short of income in the future. Hubbard and Judd (1986) give a good deal of attention to intergenerational issues. They stressed that the households systematically consume less early in life and more late in life than they wish, since liquidity constraints preclude their borrowing to smooth consumption in the way that they would like.

Performance Credit constraints on farmers can significantly affect their financial capacity and performance. Usually local lenders retrench and tighten up on credit extension during periods of agricultural income stringency . Perry (1985) showed a tighten credit policy may increase the chance of prematurely terminating a farm operation that could probably recover if given additional credit. This issue was demonstrated during the farm crisis in 1980s.

Profit Patrick and Eisengruber (1969) found that credit rationing either internally due to individual preferences or externally due to lack sufficient resources, affected the rate of farm expansion. Moreover, the credit constraints also affected the farmers profit margins. In the 1980's without accompanying increases in returns to farm assets, credit constraints and higher loan rates reduced the borrower's near term profitability from narrowing profit margins (Barry and Bernard, 1985).

Effects on lenders

Credit rationing also affects the lenders' position in several ways. It is known that the financial conditions of the lenders are closely tied to the financial conditions of the borrowers.

Loan losses The financial problems of the borrowers could be easily transmitted to the lenders unless precautionary steps were taken. Thus it is quite reasonable to ration borrowers to reduce lending risks, loan delinquencies and greater loan losses. Evidences indicated that the banks have made credit less available to finance corporate mergers and to restructure, i.e. to the highly leveraged borrowers as a precautionary step to avoid possible loan delinquencies (LaWare, 1990).

Earning power and capital In 1980s financial institutions serving agricultural areas experienced the impact of severe financial stress among farmers for the second time in this century (Barry and Bernard). Melicher and Irwin (1985) pointed out that, at some financial institutions serving borrowers and agricultural businesses, a large proportion of farm debt was owed by customers who required partial or total liquidation. This occurred at a time when asset prices were sharply reduced. The resulting loan delinquencies and losses far exceeded risk premiums incorporated in interest rates, thereby eroding loss reserves, threatening capital positions and destroying earning power.

Effects on society

Credit rationing reflects imperfections in capital markets and institutions . Excessive rationing limits credit and capital formation may reduce economic efficiency. In contrast, Greenspan(1990) indicated that, it is the responsibility of the banks to foster prudent lending policies and adequate capital bases to protect the tax payer, whose credit ultimately banks insured deposits. He stated that only in this context of the continued vitality of the banking industry be assumed.

Credit rationing cannot be viewed as a totally negative action taken by lenders or borrowers. On the contrary, credit rationing is necessary in some instances to protect other individuals and to foster the advancement of the economy.

Characteristics of Credit Rationed Borrowers

Credit constrained borrower

As an operational definition, credit constrained borrowers are defined as those who had their request for credit rejected by financial institutions. At first glance, one may suspect the validity of this definition as a proxy to identify constrained individuals. If there is a cost to apply, consumers with high probability of loan denials may not apply because they perceive that, if they do, they will be rationed (Jappelli, 1990). This group is referred to as discouraged borrowers. Jappelli (1990) defined that credit constrained consumers must include both those are directly rejected and those, who are discouraged. Several researches have attempted to identify the characteristics of credit constrained borrowers.

Age The capital needs of young farm families are substantial both for household and farm operation purposes. Therefore these farm operators indicate a greater willingness to assume debt. This is attributed in part to the needs for accumulation in the early part of the family cycle (Whittaker and Ahearn, 1991). Even though younger farmers appear to posses a greater willingness to assume debt, it is more likely that younger farmers to be rejected by the financial institution.

Jappelli (1990) finds that the single most important reason for a borrower to be rationed is the fact that a credit history that had not been established. This

is often a function of the age of applicant. Certainly age is an important factor closely associated with both vocational and social experience. Jappelli (1990) also determined that directly rationed and discouraged borrowers are young .

Education The degree of formal education may influence the extent to which credit is used. Therefore it is expected that the credit use increases with education. Formal education is expected, to improve an individual's knowledge and self confidence (Coutu, 1961). A previous study has indicated the positive correlation between the attitude toward agriculture and education . Thus a farmer who has a better education might be expected to believe that the use of scientific information and methods in farming is necessary. This type of farmer would be rational in his decision making process and one might infer, more likely to consider the optimum use of credit as a means to success (Bohlen, 1961; Repp, 1962). Therefore a farmer with better education has a greater inclination to assume credit. Bagi (1982) observed that the probability of a farmer would choose to use credit is positively related to the level of formal education. Jappelli (1990) observed that the rejected applicants as well as unconstrained consumers are more educated than the discouraged consumers.

Assets Assets measure the productive capacity of a farm borrower. There exists a positive relationship between the high value on land, and the willingness to take risks (Coutu, 1961). It has also been observed that, the probability that a consumer is liquidity constrained decreases with increasing asses. (Jappelli, 1990). Jappelli also finds that assets of rejected applicants are 63 percent lower than those of the unconstrained consumers, further, the discouraged borrowers hold even lower levels of assets.

Income It was observed that low income and medium income farmers show aversion to change. This can translate in to reluctance to assume credit. Consequently they tend to postpone or avoid decisions essential to change and cling to their present system (Coutu, 1961).

Lenders also consider the level of income of borrowers as one of the major determinants in the credit evaluation process. Tullio Jappelli (1990) found that the probability that a consumer is credit constrained decreases with increasing income. The author also indicated the income of the rejected applicants is 36 percent lower than that of the unconstrained consumers and discouraged consumers have even lower levels of income. However credit constrained individuals possess different characteristics than unconstrained individuals. According to the research findings directly rationed applicants and discouraged borrowers have similar characteristics.

Conclusions

This chapter gives a critical account of several questions related to the existence, type and causes of credit rationing. Several inferences can be drawn from this theory for the development of a model for credit rationing in the Iowa farm sector.

First, the theory suggests that credit rationing, or the limited use of credit, could occur either by external or internal constraints.

Second, the theory establishes the underlying causes for credit rationing. External credit rationing may occur as a result of short run or long run disequilibrium or asymmetric information in credit markets. Internal credit rationing may arise from the borrowers attitudes toward risk or from factors that influence returns to capital investment.

A tentative empirical model proposed here, attempts and identify the forms of credit rationing in the farm sector, to investigate the characteristics of the farm operators belonging to separate categories and determine the relevance of those characteristics to credit rationing.

The credit rationing model suggested is

$$Y = f(D, F, C). \tag{2.2}$$

where, Y= a credit rationing indicator.

D= Demographic characteristics of the farm operator.

F= Financial characteristics.

C= Reasons for limited borrowing.

CHAPTER 3. EMPIRICAL MODEL

This chapter will discuss the empirical procedures used in testing the hypotheses identified in chapter 1. The chapter begins with a discussion of the sample data from the 1991 Iowa Farm Finance Survey and a description of the survey instrument. The next section presents a discussion of the procedures used in identifying and defining credit constrained and unconstrained farmers from the data. Next a description of the variables used in the study is presented. Finally a presentation of the empirical model to be estimated and a brief description of the estimation procedures used in the study is given.

The Data Set

The data used in this study were derived from the 1991 Iowa Farm Finance Survey (FFS). Demographic and financial information on 881 valid responses from a panel of 2142 farm operators was extracted from the survey. A copy of the survey instrument is included in Appendix A.

When demographic characteristics of the 1991 survey respondents are compared with the same characteristics from the 1987 Census of Agriculture, it is evident that the data over-represents older more established farmers with large operations (Table 3.1). Small farms (under 180 acres) are under-represented in the 1991 data, while

Table 3.1: Comparison of farm size and age distributions between the 1987 census and 1991 Farm Finance Survey responses[a]

	Farm Finance Survey 1991 (percent)	Ag census 1987 (percent)
Farm size (acres)		
1-49	4.2	18.0
50-179	16.0	26.2
180-499	44.0	37.1
500-999	28.4	15.1
1000 up	5.6	3.5
Average acres	438 acres	301 acres
Age group		
Less than 35	2.0	19.3
35-44	13.4	20.2
45-54	19.4	20.7
55-64	35.8	24.0
65 up	28.7	15.8
Average age	58 years	49 years

[a]Jolly and Biedenbach, 1991.

medium to large size farms (180 to 1000 acres) are over-represented.

Farm operators under the age of forty-five are under-represented while farm operators over fifty five years are over-represented (Jolly and Biedenbach, 1991). Therefore the 1991 farm finance survey is more representative of the commercial farm sector in Iowa.

Identifying Credit Rationed Farmers

This study uses cross-sectional data to assess the proportion of credit rationed farmers and their characteristics. Using established definitions, externally rationed farmers are those, who had their request for credit rejected by financial institutions. In the survey, only requests for intermediate and long term credit were considered. Requests for credit to expand or modernize the farm business are believed to be more vulnerable to rationing than are requests for short term operating credit. Operating credit will generally be extended until the farm business is on the verge of failure.

As Table 3.2 depicts, 161 out of 874 farmers, in the sample requested financing for expansion purposes over the three year period beginning in 1989, only nine farmers were rationed out externally. Consequently, using of those, denied as an indicator of external rationing, data indicates that it is not a limiting factor in the Iowa farm sector.

This observation is consistent with the recent literature available on rural lending (Drabenstott and USDA). The question of adequacy of credit, remains unanswered, however. It might be that farmers limit their use of credit voluntarily. This pattern of behavior may be consistent with Bohlen and Beal's evidence about farmers' attitudes toward the use of credit. Their work suggests that borrowers tend to discount the payoffs of investments using credit, because of uncertainty, which in turn, may result in limited borrowing. The condition, which limits or completely prevents farmers from using credit is known as internal rationing. Internal credit rationing may be the major factor that accounts for the limited use of credit in the farm sector.

Although the theoretical model is helpful in conceptualizing the factors involved in credit rationing, it is difficult to apply empirically. Consequently, an operational

Table 3.2: Percentage of credit requests and approvals[a]

		Credit Requested		Total
		yes	no	percentage
Credit requests approved	yes	17.4	0	17.4
		(152)	0	(152)
	no	1.0	81.6	82.6
		(9)	(713)	(722)
Total		18.4	81.6	100
		(161)	(713)	(874)

[a]The number of observations are reported within the parenthesis.

definition is used to identify credit rationed farmers.

Internally rationed farmers are defined as those, who did not request, but were still aware of the need for credit to operate their farms more efficiently. Accordingly two classifications were developed to approximate forms of credit rationing occur among farm operators. Table 3.3 illustrates different credit constrained/unconstrained categories based on classification one. A total of 63 farmers out of 713 who did not request financing for expansionary purposes answered "Yes" to the question "Has inadequate financing limited the profitability or growth of your farm business ?". These operators may have recognized, limited use of credit as the plausible reason for limited profits or the growth of the farm operation, but still may not use because of their aversion to risk. These farm operators are assumed as the internally credit rationed. The category which includes individuals who requested for financing but still finds limited profits due to inadequate financing are defined as externally rationed borrowers. i.e. 2.96 percent of the sample are externally rationed (Group 1). As Figure 2.3 depicted external credit rationed farm operators may also have truncated

Table 3.3: Classification 1-requested for financing versus limited profitability due to inadequate financing [a]

		Credit requested		Total
		yes	no	percentage
		[1]	[2]	
Limited	yes[b]	2.96	7.18	10.15
growth		(26)	(63)	(89)
		[3]	[4]	
	no	15.74	74.12	89.85
		(138)	(650)	(788)
Total		18.7	81.3	100
		(164)	(713)	(877)

[a]The group number is given in square brackets.

[b]The number of observations are reported within the parenthesis.

their demand schedule for credit due to uncertainties, but at this instant they are assumed to be constrained by external lender restrictions.

According to classification 1, of the 877 farm operators, total of 89 farmers are credit constrained and rest of the farmers (i.e. 90% of the sample) are unconstrained. Among these unconstrained farmers only 138 (Group 3), did request for financing while other 650 farmers (Group 4) did not. Group 4 is characterized by older more established farm operators (Table 3.4), as Ladue et al., (1991) indicated, these farm operators have reached a reasonable income and farm size, and thus they tend to reduce investment and use of debt.

Classification two summarizes the information of the farmers, those who requested financing versus willingness to accept additional debt if lender offers to make credit available (Table 3.4). The willingness to assume debt may reflect disposition toward taking on debt. Therefore it might be expected that, if other things being

Table 3.4: Classification 2-requested for financing versus willing to accept additional debt[a]

		Credit requested		Total
		yes	no	percentage
		[1]	[2]	
Willing to	yes[b]	5.6	10.5	16.1
accept		(49)	(92)	(141)
		[3]	[4]	
additional	no	13.1	70.8	83.9
debt		(115)	(621)	(736)
Total		18.7	81.3	100
		(164)	(713)	(877)

[a]The group number is given in square brackets.

[b]The number of observations are reported within the parenthesis.

equal, farm operators with a higher willingness to assume debt would use credit more often and in greater amount than farm operators with a lower willingness to assume debt.

As shown in Table 3.4, a total of 92 out of 713 farmers who did not request for financing indicated their willingness to accept credit if lender offers. It may be that their willingness to assume debt is overwhelmed by the uncertainties attached to use of debt. These operators may have recognized credit as a valuable source that can help them to obtain greater income, but still may not use it because of their aversion to risk. Thus those farm operators who did not request, but still indicated their willingness to assume debt, are defined as internally credit rationed farm operators. The category which includes individuals, those who already sought for financing but still willing to accept additional credit, are defined as externally rationed farm operators. Accordingly 5.6% of the sample are externally rationed, based on the

information of classification 2. According to classification 2, total of 13.1 percent of the sample consists of farm operators, requested financing but not willing to accept additional debt, and 70.8 percent of the sample, neither requested nor indicated their willingness to accept additional debt.

Although the operational definitions are useful in identifying farm operators to different credit constrained/ unconstrained groups, it is difficult to filter-out externally credit rationed farm operators from the internally credit rationed farmers more cleanly. The study will be proceeded, by presuming that the farm operators found in Group 1, are mostly represented by external credit rationed borrowers, and the those who are in Group 2, are mostly internally credit rationed.

Comparison of Farm Operators

It may be insightful to compare the demographic and financial characteristics of the various credit constrained groups. The following section presents income and balance sheet information for the sample population.

Demographic characteristics

Average farm operator characteristics using the two credit rationing classifications are displayed in Tables 3.5 and 3.9. Statistical significance of some interested variables are indicated. Tables 3.5 and 3.9 indicate that the two classifications produced similar results for the credit constrained and unconstrained farm operator groups. The major differences in farm operator characteristics based on the classifications one and two include:

1. According to both classifications, Groups one and three consist of younger farmers with less farming experience and larger families compared to Groups two and four. Thus externally rationed farm operators (Group one) are younger than farmers of groups two and four. Jappelli (1990) found that young borrowers are more likely to be rationed by financial institutions.

2. The internally rationed farm operators (Group two) of the sample do not represent by young farmers as found by Jappelli. This might be due to sampling problems that, data under-represents farmers under 45 years and over-represents farmers older than 55. Average age of Group two farm operators is significantly different than that of Groups three and four farm operators, at the 5 percent confidence level, implying internally credit rationed farm operators are significantly older than Group three farm operators and younger than Group four farm operators.

3. It is interesting to note that Group four farm operators are the oldest on average, with more years experience in farming, smaller families and less education than other three group averages. Mean age of Group four farm operators is higher than the rest of the groups at five percent confidence level.

4. Group two farm operators are more educated than farm operators of Group four. This contradicts earlier findings about the low level of the internally credit rationed borrowers.

5. In all cases sales of crops comprise over 52 percent of gross income. Next to crop sales Groups one and three farm operators have the greatest percentage

of sales from pork, while Groups two and four farm operators have the greatest percentage of sales from beef.

Balance sheet

The balance sheet lists all that the business owns, its assets, and all that it owes, its liabilities, at a specified moment in time. Balance sheet as of January 1, 1991 are summarized by credit rationing classification, in Tables 3.6 and 3.10.

Major asset and liability structural differences apparent from the tables include:

1. Group two farm operators, hold the smallest amount of total assets and net worth. The total assets owned by Group two farm operators are significantly lower than those of Group three farm operators at five percent confidence level. Mean net worth of Group two farm operators is lower than that of Groups three and four farm operators. This indicates that the internally credit rationed farm operators own relatively smaller amount of assets and claims on those assets.

2. Group three farm operators own the largest dollar worth of total assets and net worth than those of Groups two and four farm operators.

3. Group four farm operators are the least indebted, owe significantly smaller amount of liabilities for lenders than all other groups.

Comparative income statements

The comparative 1990 income statements provide a summary of revenues and expenditures of sample farm operators by credit rationing classification are given Tables 3.7 and 3.11. Several differences among credit rationing groups are evident:

Table 3.5: Farm operator characteristics by credit rationed groups[a]

	Group 1	Group 2	Group 3	Group 4	Sample mean
Operator %	3.0	7.2	15.6	74.2	100
Family characteristics					
Average age	51.0 (4)[b]	56.0 (3,4)	49.0 (2,4)	60.0 (1,2,3)	57.8
Years in farming	28.2	32.7	25.3	36.0	34.0
Total dependents	2.8	2.7	3.2	2.4	2.5
Dependents under 18 years	0.7	0.6	1.0	0.3	.5
Husband education[c]	1.7	1.7	1.8	1.6	1.6
Wife education	1.3	1.6	1.9	1.5	1.5
Sources of gross farm income					
Crops	53.8	57.7	53.6	59.4	58.2
Pork	24.0	15.3	22.2	14.6	16.1
Beef	16.0	16.8	16.5	17.4	17.2
Dairy	0	1.4	3.5	1.5	2.5
Other	6.2	8.8	4.2	6.2	6.0
Total	100.0	100.0	100.0	100.0	100.0
Land tenure characteristics					
Total acres operated	510.0	414.7	685.1	396.7	438.6
Acres owned	218.0	235.0	311.5	250.8	258.0
Acres of renting land	297.5	185.0	345.0	173.5	204.8
Acres rented	5.7	5.3	28.6	27.6	25.5

[a]1991 Iowa Farm Finance Survey.

[b]Selected group means significantly different from each other at 5 percent confidence level, are included within parenthesis

[c]Highest education institution attended: 1= high school, 2= community college, 3= college, 4= post graduate.

Table 3.6: 1991 Comparative balance sheets by credit rationing classification 1[a]

	Group 1	Group 2	Group 3	Group 4	Mean
Assets					
Current assets					
Cash	$4,744	$6,545	$12,058	$16,041	$14,214
Financial investments	10,138	14,048	18,832	58,412	46,224
Crops and livestock held for sale	118,228	57,902	145,681	69,577	83,860
Intermediate assets					
Machinery, equipment and breeding stock	89,132	81,137	144,206	90,108	98,986
Long term assets					
Land and buildings	277,812	259,513	435,947	294,406	316,400
Other assets	0	12,421	17,396	0	4,811
Total assets	$500,054	$431,566	$774,120	$528,844	$564,495
		(3)[b]	(2,4)	(3)	
Liabilities					
Non real estate					
Bank	$59,134	$28,839	$59,097	$13,833	$23,683
Farm Credit System	3,000	2,018	5,324	1,472	2,193
FmHA	9,095	8,786	5,702	992	2,589
Insurance company	659	3,242	778	369	661
Individual	13,159	6,386	5,878	2,676	3,781
Merchant/dealer	982	2,457	3,827	1,102	1,651
Other loans	1,796	3,820	8,023	2,113	3,208
Non real estate total	$87,825	$55,548	$88,629	$22,557	$37,766

[a]Source: 1991 Farm Finance Survey.

[b]Selected group means significantly different from each other at 5 percent confidence level, are included within the parenthesis

Table 3.6 (Continued)

Real estate					
Bank	$34,179	$6,451	$36,439	$13,465	$17,301
Farm Credit System	9,417	39,083	36,669	14,594	19,910
FmHA	22,016	11,465	8,605	3,521	5,471
Insurance company	37,990	10,600	4,171	4,041	5,515
Individual	5,278	22,948	34,537	9,622	14,573
Merchant/dealer	0	243	118	177	167
Other loans	1,062	155	2,958	262	718
Real estate total	$109,942	$90,945	$123,497	$45,682	$63,655
Total debt	$197,767 (4)	$146,493 (4)	$212,126 (4)	$68,239 (1,2,3)	$101,421
Net worth	$302,287	$285,073	$561,994	$460,305	$463,074

1. Group three farm operators have the highest gross income, gross farm income and net income. Mean gross income of Group three is significantly larger than that of all other groups.

2. Group two farm operators have the lowest net farm income, while Group three farm operators have the highest.

3. Group two farm operators have the greatest accrual off-farm income and this off-sets the low net income of this farm operator group.

4. Based on classification one, the externally credit rationed borrowers (Group one) have the smallest value of net income using classification two Group four farm operators had the lowest net income.

Table 3.7: 1991 Comparative income statements by credit rationing classification 1[a]

	Group 1	Group 2	Group 3	Group 4	Mean
Operator %	3.0	7.2	15.6	74.2	100
Gross income	$116,065	$125,202	$204,806	$110,292	$128,261
	(3)[b]	(3)	(1,2,4)	(3)	
+ Net rental income	1,160	1,530	1,699	2,340	2,137
+ Sale breeding stock	4,190	2,455	3,416	2,027	2,348
Gross farm income	121,415	129,187	209921	114,659	132,753
- Operating expenses	91,610	89,353	144,902	74,6709	88,875
- Interest expense	17,489	15,391	17,536	7,873	10,355
Net cash farm income	12,316	24,443	47,458	32,177	33,523
+ Inventory change	7,979	3,263	16,287	7,328	8,689
Adjusted net cash income	20,295	27,706	63,770	39,505	42,212
- Depreciation	14,073	10,597	21,157	11,976	8,689
Net farm income	$6,222	$17,109	$42,613	$27,529	$33,523
Wages and salaries	10,296	13,856	10,292	7,866	8,821
+ Interest and dividends	1,513	1,423	3,222	6,207	5,190
+ Other income	9,000	26,571	5,877	4,133	6,268
Off farm income	20,809	41,850	19,391	18,206	20,279
+ Capital gains	3,036	5,360	7001	17,941	4,346
Accrual off farm income	$23,845	$47,210	$26,392	$36,147	$24,625
Net income	$30,067	$64,319	$69,005	$63,676	$58,148
Net cash income	$33,125	$66,293	$66,8745	$50,383	$53,802

[a]Source: 1991 Farm Finance Survey.

[b]Selected group means which are significantly different from each other at 5 percent confidence level, are reported within the parenthesis

Comparative financial ratios

Several common financial ratios are summarized in the Tables 3.8 and 3.14 respectively for credit rationing group. Several differences among groups are evident:

1. Group three operators performed the best with the highest return on assets (ROA), return on equity, interest coverage, net capital ratio and with smallest debt to asset and leverage ratios indicating the most profitable and solvent group of the sample.

2. Group one farm operators have the highest debt to asset (D/A) and leverage ratios. Group four farm operators have significantly lower D/A ratio than that of the farm operators found in groups one, two and three. The interest coverage ratio is negative, implying the possibility of occurring solvency problems. This group might face a substantial burden of interest expenditure on income.

3. The current ratio for Group two farm operators is smaller than other three groups, but still exceeds one, signifying of a strong liquidity position. All farm operators may be able generate cash to meet their cash demands.

4. Group two farm operators have smaller returns on assets, returns on equity than an average farm operator of the sample, reflecting of a comparative lower profitability.

5. The results of Tables 3.8 and 3.14 indicate, that the businesses of the internally rationed borrowers are not as solvent as the businesses of Groups three and four farm operators (unconstrained farm operators), but is still reflective of a fairly

good solvency position than Group one farm operators (externally rationed farm operators).

The comparisons among credit constrained groups presented in this chapter shows many differences and as well as some similarities. Group three farm operators have the most favorable income statement and balance sheet. Internally rationed farm operators (Group two) have the highest off-farm income. Group three operators appears to be the most profitable and solvent group, they have the highest return on assets, equity and smallest debt to asset and leverage ratios. Group one farm operators may be undergoing solvency difficulties to some extent.

Although comparison of group means is a simple technique, it does not permit a formal test of the hypotheses listed in Chapter 1. The next chapter focuses on the results of multinomial logit models estimated, to test hypotheses indicated in Chapter 1.

Empirical Procedure

Empirical models will be designed to test hypotheses, included in Chapter 1. Models will attempt to test, whether credit being limited by farmers themselves or by their lenders, by incorporating the established classifications as endogenous dependent variables. Demographic and financial characteristics together with plausible reasons for them to limit use of credit, will be included as independent (right hand

Table 3.8: 1991 Comparative financial ratios[a] and by credit rationing classification 1[b]

	Group 1	Group 2	Group 3	Group 4	Mean
Operator %	3.0	7.2	15.6	74.2	100
Profitability Ratios					
Return on assets	-0.3	1.6	4.4	2.2	3.2
Return on equity	-6.3	-2.9	6.1	2.6	1.7
Cost of debt	8.8	10.5	8.2	11.5	10.2
Solvency Ratios					
Debt to asset	39.5 (4)[c]	33.9 (4)	27.4 (4)	12.9 (1,2,3)	17.9
Net Capital ratio	252.8	294.5	364.9	774.5	556.5
Leverage ratio	65.4	51.3	37.7	14.8	21.9
Interest Coverage ratio	-9.8	45.9	197.9	151.6	178.1
Efficiency ratios					
Gross ratio	101.4	86.9	85.6	81.0	83.4
Turn over ratio	24.2	29.9	27.11	21.69	23.5
Liquidity ratios					
Current ratio	151.5	141.0	199.0	638.5	382
Fixed ratio	252.6	285.3	353.0	644.0	359.0

[a]Financial ratios are defined in Appendix B

[b]Source: 1991 Farm Finance Survey.

[c]Selected group means which are significantly different from each other at 5 percent confidence level, are reported within the parenthesis

Table 3.9: 1991 Comparative demographic characteristics by credit rationing classification 2[a]

	Group 1	Group 2	Group 3	Group 4	Sample mean
Operator %	5.5	10.5	13.0	71.0	100
Family characteristics					
Average age	49.0 (4)[b]	52.0 (3,4)	49.0 (2,4)	61.0 (3,2,1)	57.8
Years in farming	26.0	29.0	25.8	36.8	34.0
Total dependents	3.1	3.0	3.2	2.3	2.6
Dependents under 18 years	1.0	0.8	1.0	0.3	0.5
Husband education[c]	1.9	2.0	1.7	1.5	1.6
Wife education	1.8	1.8	1.8	1.5	1.6
Sources of Gross Farm Income					
Crops	56.2	58.7	52.6	59.3	58.2
Pork	19.0	15.8	23.7	14.5	16.1
Beef	17.0	17.5	16.2	17.4	17.2
Other	5.7	4.6	3.9	6.6	6.0
Total					
Land tenure characteristics					
Total acres operated	558.0	523.3	631.0	380.0	438.6
Acres owned	276.5	247.3	305.4	250.0	258.0
Acres of renting land	298.5	288.8	354.0	157.7	204.8
Acres rented	17.0	13.0	28.4	27.6	25.5

[a]Source: 1991 Farm Finance Survey.

[b]Selected group means which are significantly different from each other at 5 percent confidence level, are reported within the parenthesis

[c]Highest education institution attended: 1= high school, 2= community college, 3= college, 4= post graduate.

Table 3.10: 1991 Comparative balance sheets by credit rationing classification 2[a]

	Group 1	Group 2	Group 3	Group 4	Mean
Assets					
Current Assets					
Cash	$11,287	$5,230	$10,774	$16,632	$14,214
Financial Investments	7,280	17,128	21,467	59,679	46,224
Crops and Livestock held for sale	155,548	82,715	135,176	66,012	83,860
Intermediate Assets					
Machinery, equipment and breeding stock	133,878	101,599	136,569	87,182	98,986
Long term Assets					
Land and Building	389,828	262,621	419,742	295,625	316,400
Other assets	0	32,777	27,534	0	4811
Total Assets	$697,821	$502,070 (3)[b]	$751,262 (2,4)	$525,130 (3)	$564,495
Liabilities					
Non Real Estate					
Bank	$75,565	$27,153	$52,580	$13,468	$23,683
Farm Credit System	1,988	2,438	6,195	1,387	2,193
FmHA	10,539	3,991	4,444	1,384	2,589
Insurance Company	1,128	2,027	612	432	661
Individual	2,146	6,998	8,902	2,435	3,781
Merchant/Dealer	2,854	1,914	3,631	1,128	1,651
Other loans	14,4472	4,960	4,114	1,875	3,208
Non Real Estate total	$108,692	$49,481	$80,748	$22,109	$37,766

[a]Source: 1991 Farm Finance Survey.

[b]Selected group means which are significantly different from each other at 5 percent confidence level, are reported within the parenthesis

Table 3.10 (Continued)

Real Estate					
Bank	37,427	21,222	35,551	11,543	17,301
Farm Credit System	48,272	26,625	26,097	15,352	19,910
FmHA	17,940	7,018	7,503	3,829	5,471
Insurance Company	7,859	7,319	9,711	4,234	5,515
Individual	27.454	22,103	31,375	9,115	14,573
Merchant/Dealer	0	163	143	186	167
Other loans	3,631	797	2,278	168	718
Real Estate Total	$142,583	$85,247	$112,658	$44,427	$63,655
Total Debt	$251,275	$134,728	$193,406	$66,536	$101,421
	(4)	(4)	(4)	(1,2,3)	
Net Worth	$446,546	$367,342	$557,856	$458,594	$463,074

side) variables, to determine the characteristics of credit constrained and unconstrained farm operators, consistent with classifications. Thus, a discrete regression model may be appropriate to handle the qualitative nature of the dependent variable.

Explanation of the technique

The credit constrained and unconstrained groups displayed in Tables 3.3 and 3.4 provide important information about the farming operation, limited use of credit, limited profitability etc. A multinomial logit model is used to predict the relative probability that an individual will fall into any of the four categories given in the Tables 3.3 and 3.4.

A variable which defines these categories in any order desired is known as an unordered variable. Multinomial logit model, is one procedure which does allow both an arbitrary number of categories or responses and continuous right hand side variables (Theil , 1974). Thus unordered multinomial logit model will be employed in

Table 3.11: 1991 Comparative income statements by credit rationing classification 2[a]

	Group 1	Group 2	Group 3	Group 4	Mean
Operator %	5.5	10.5	13.0	71.0	100
Gross Income	$173,230	$142,266	$199,906	$106,829	$128,261
+ Net Rental Income	1,989	1,781	1,471	2,339	2,137
+ Sale Breeding Stock	2,875	2,532	3,782	1,997	2,348
Gross Farm Income	$178,094	$146,579	$205,159	$111,165	$132,753
- Operating Income	124,569	98,871	142,695	72,179	88,875
- Interest Expenses	21,673	13,598	15,943	7,762	10,355
Net Cash Farm Income	$31,852	$34,110	$46,521	$31,224	$33,523
+ Inventory Change	21,427	2,580	12,382	7,648	8,689
Adjusted Net Cash Income	$53,279	$36,690	$58,903	$38,872	$42,212
- Depreciation	18,689	12,227	20,700	11,790	8,689
Net Farm Income	$34,590	$24,463	$38,203	$27,082	$33,523
Wages and Salaries	13,249	16,903	9,165	7,090	8,821
+ Interest and Dividends	1,764	1,920	3,446	6,367	5,190
+ Other Income	11,284	10,964	4,231	5,482	6,268
Off Farm Income	26,297	29,787	16,842	18,939	20,279
+ Capital Gains	3,905	3,637	7,466	3,834	4,346
Accrual Off Farm Income	$30,202	$33,424	$24,308	$22,773	$24,625
Net Income	$64,792	$57,887	$62,511	$49,855	$58,148
Net Cash Income	$58,149	$63,897	$63,363	$50,163	$53,802

[a]Source: 1991 Farm Finance Survey.

Table 3.12: 1991 Comparative Financial ratios by credit rationing classification 2[a]

	Group 1	Group 2	Group 3	Group 4	Mean
Operator %	5.5	10.5	13	71	100
Profitability Ratios					
Return on assets	4.4	2.5	3.8	1.8	3.2
Return on equity	2.20	-.2	2.3	0.4	1.7
Cost of debt	8.6	10.0	8.2	11.6	10.2
Solvency ratios					
Debt to assets	36.0 (4)[b]	26.0 (4)	25.7 (4)	12.6 (1,2,3)	17.9
Net Capital ratio	277.7	372.6	388.4	789.2	556.5
Leverage ratio	56.3	36.6	34.6	14.5	21.9
Interest Coverage ratio	142.2	92.87	180.1	121.2	178.1
Efficiency ratios					
Gross ratio	90.9	85.6	85.9	80.5	83.4
Turn over ratio	25.5	29.2	27.3	21.1	23.5
Liquidity ratios					
Current ratio	160.2	212.3	207.3	643.7	382
Cash Flows	6.2	9.3	5.9	5.2	5.1
Fixed ratio	273.4	492.3	372.5	665.4	497.0

[a]Source: 1991 Farm Finance Survey.

[b]Selected group means which are significant at 5 percent confidence level, are reported within the parenthesis

this study to reflect the basic qualitative characteristics of these categorical groups.

Multinomial logit technique

The logit model is based on the logistic cumulative distribution function (Judge et al., 1988). Logistic distribution is the cumulative distribution of the hyperbolic secant-square ($sech^2$) distribution and is specified as :

$$P_i = F(Z_i) = F(\alpha + \beta X_i) = \frac{e^{Z_i}}{(1+e^{Z_i})} = \int_{-\infty}^{Z_i} \frac{e^u}{(1+e^u)^2} du \qquad (3.1)$$

where :

P_i is the probability that an event occurs, in this case the probability of an individual will be categorized in to one group;

X_i denotes the vector of cross sectional values of the explanatory variables.

The logit model is used to predict the probability that an observed dependent variable that is linearly related to a set of independent variables will fall into a specific category (Turvey and Brown ,1991). For applications the equation (3.1) may be easily linearized into:

$$ln(\frac{P_i}{(1-P_i)}) = \alpha + \beta X_i \qquad (3.2)$$

This function is called the logit of P_i, so that the name of the logit analysis was derived (Greene, 1990).

The dependent variable in this regression is the logarithm of the odds that a particular choice will be made. This model transforms the problem of predicting

probability within a (0,1) interval to the problem of predicting the odds of an event occurring within the range of the real number line.

When the dependent variable is polychotomous and unordered instead of dichotomous, the multinomial logit can be derived directly from the equation 3.2.

If there exists "m" categories and $P_1, P_2, ..., P_m$ are the probabilities associated with these categories then;

$$P_j = \frac{e^{\beta_j X}}{1 + \sum_{j=1}^{m-1} e^{\beta_j X}} \quad (j = 1, 2, ..., m-1) \tag{3.3}$$

$$P_m = \frac{1}{1 + \sum_{j=1}^{m-1} e^{\beta_j X}} \tag{3.4}$$

This model is commonly referred to as the multinomial logit model (Maddala, 1983).

This model implies that we can compute $m - 1$ log odds ratios (Greene, 1990). Accordingly, the multinomial logit model can also be expressed as by the probability of an observation falling in to one class relative to a base reference class, say the last m, by simplifying equations 3.3 and 3.4 we obtain

$$\frac{P_j}{P_m} = e^{\beta_j X} \tag{3.5}$$

$$ln\frac{P_j}{P_m} = \beta_j X \qquad j = 1, 2, ..., m-1 \tag{3.6}$$

Therefore in a model with four categories the logit model can be written as:

$$ln\frac{P_1}{P_4} = \alpha_1 + \beta_1 X \tag{3.7}$$

$$ln\frac{P_2}{P_4} = \alpha_2 + \beta_2 X \tag{3.8}$$

$$lm\frac{P_3}{P_4} = \alpha_3 + \beta_3 X \tag{3.9}$$

The coefficients in this model are difficult to interpret (Greene, 1990). The estimated coefficients do not indicate the increase in the probability of the event occurring, given a one unit increase in the corresponding independent variable, rather the coefficients reflect the effect of a change in an independent variable on logit $\frac{P_j}{P_m}$ (Judge et al., 1988).

The logit coefficients can be transformed in to linear mutually exclusive probabilities, through equation 3.3. The probability of an observation falling into the reference group "m" can be determined by equation 3.4. Further the partial derivatives of equations 3.3 and 3.4 , allow us to find the marginal effects of the regressors on the probabilities.

$$\frac{\partial P_{ij}}{\partial X_i} = P_{ij}\beta_j - P_{ij}\sum_{k=1}^{m-1} P_{ik}\beta_k \quad j = 1, 2, .., m \; k = 1, 2, .., m-1 \tag{3.10}$$

$$\frac{\partial P_{im}}{\partial X_i} = -P_{im}\sum_{k=1}^{m-1} P_{ik}\beta_k \tag{3.11}$$

The logit partial derivatives are analogous to linear regression coefficients. The magnitude and the signs of the partial derivatives indicate how changes in the value of the regressor change the probability that an individual will fall into a specific category. A positive sign indicates an increase in "X" leads to an increase in the predicted probability while a negative sign indicates an increase in "X" leads to a decrease in the predicted probability.

The significance of a logit model is tested using likelihood ratio statistic. This statistic is asymptotically distributed as Chi squared statistic with degrees of freedom equal to the number of groups times the parameters estimated.

Variables to Predict Credit Rationing

The literature suggests that both demographic and financial characteristics are likely to characterize credit-rationed borrowers. In this section variables included in the logit model are briefly described.

Demographic characteristics

Age Age of farm operators may be closely linked to expectations farmers have about their future and their farm business. Therefore the farm operators in different age groups may hold different perceptions about borrowing. In accordance with life cycle theory, younger farmers invest more as they are trying to increase their level of income. In contrast, older farmers who have reached a reasonable income and farm size may reduce investment and then disinvest as they near or reach retirement age (Ladue et al., 1991). Whittaker (1991) found that the proportion of farmers without debt increases with increasing age. Thus the younger farmers tend to borrow more funds in order to achieve their goals, such as staying in business, increasing net worth and farm profits while the farm operators in sixty or over age reduce borrowing since they had already achieved this goal (Wise, 1983).

Jappelli (1990) indicated that externally and internally credit constrained consumers are younger than the unconstrained consumers. Thus it may be unlikely the older farm operators, who had established a good credit history would be externally credit rationed. Also the fear of possible rejection may also keep younger farmers from requesting loans. Therefore, there may be greater probability that younger farmers also to be internally credit rationed.

Education Education is hypothesized to contribute positively to the extent of credit use. As the theory indicated, the level of formal education may improve one's knowledge, self-confidence and attitude toward agriculture. Thus a farm operator with better education might be expected to adopt new technology on risk management strategies in farming and would be more likely to consider the use of credit as a necessary means to success. This would suggest that a better educated farm operator is less likely to be internal credit rationed. Moreover a better educated farm operator would tend to use credit more efficiently and would be less likely to be externally rationed.

Experience In general, the age of the farm operator is positively related to the number of years being farmed. Hence as the literature stated young, less experienced farm operators are expected to use more debt and also to be externally credit rationed. Lenders would tend to view lack of experience as an indicator of inefficient farm business, and are more hesitant to extend credit to such farm business (Lee et al., 1988). It is also possible that less experienced farm operators would be internal credit rationed. due to unestablished credit history and inexperience in farming.

Number of dependents The family living expenses tend to increase with number of dependents. The difference between the net farm income and the total used for family living represents the amount available to the farmer for payment for income taxes, savings in the farm business or debt retirement (Judd, 1991). The greater the number of dependents, the smaller this difference. As the family living expenses increase, financial performance may decrease. Farm operators with larger families may be more likely to be externally rationed (Lee et al., 1988).

Farm size Farm size, in this study is measured by the acres of land operated including land owned and rented. Size of farm is likely to influence the probability of a farmer using credit for a number of reasons. First, the larger the size, the larger the inputs needed to operate the farm. Also large farms tend to use relatively more purchased inputs, due to the commercial nature of their operations. Second, land is generally the main collateral the farmer can offer to a credit institution. Therefore we expect, a priori, that the probability of a farmer using credit will directly related to the size of his farm (Bagi, 1983). Furthermore, as the literature emphasized, farm operators' with more assets are less likely to externally rationed (Jappelli, 1990). It is also possible that internal savings would increase with farm size. Consequently, large operations may be considered more credit worthy. The likelihood that they will be internal credit rationed may decrease.

Financial characteristics

Net farm income Net Farm Income is the amount available for family living, income taxes, and savings. High net farm income indicates higher debt repayment capacity. As the literature stated, farm operators with high net farm income is less likely to be externally constrained. Moreover, farm operators may be able to re-organize their farms successfully, under the repayment conditions associated with credit, thus farm operators with high net farm income are negatively hypothesized to be internal credit rationed.

Debt to asset ratio (DAR) One important solvency measure is the ratio of total debt to assets. This measures the firm's total obligations to creditors as a

percent of the total assets. A high DAR may indicate financial stress and therefore an increased likelihood for credit rationing.

Gross income per dollar of expense (GTE) The GTE for this study is measured by taking the ratio of gross income per dollar of expense. The GTE is an indicator of cost control and an overall measure of efficiency in use of resources. Other things being equal, a higher ratio indicates a high net income (Lee et al., 1988). Thus lenders may be more willing to extend credit to the individuals with high net income or with high GTE. Therefore GTE is expected to negatively related to credit rationing.

Liquidity ratio Liquidity management is a principal means by which farmers cope with variations in cash flows that arise from uncertain commodity prices, yields and production costs (Barry, Baker and Sanint, 1981). Cash and near-cash items such as financial investments are considered as highly liquid assets. Thus a ratio of these highly liquid assets to the total available assets gives an approximate measure of the firm's liquidity. The liquidity ratio specifies the value of highly liquid assets relative to total assets (Barry et al., 1987). The higher the ratio, the greater the firm's ability to meet short -term obligations. A highly liquid farm business is less liable to be credit rationed.

Mean net worth Net worth indicates the value of the claims on assets by the owner. The greater the net worth the greater capacity to absorb or cover the financial and production risk. The literature has indicated that the probability of credit decreases as mean net worth increases. Thus it is expected that the probability

of credit rationing decreases as mean net worth increases.

Returns on assets (ROA) [1]

This provides a measure of the profitability of the production and marketing activities of the business that is separated from the financing function (Barry et al., 1987). Increase of net farm income holding interest expenses and total assets indicates, increase of ROA. As the net farm income increases the probability of an individual being internal and/or external credit rationed declines.

Reasons to limit borrowing

1991 Farm Finance Survey gathered, information about particular reasons for limited borrowing by farm operators, at situations, when lender offered credit available to them. The models will include those reasons as explanatory dummy variables.

1. To maintain credit reserve.

   An individual's unused capacity to borrow funds is known as the credit reserve. It is a central feature in the process of understanding the use of debt capital (Baker, 1968). The quantitative expression for credit reserve was described as the difference between capital limits imposed by external credit rationing and the amount actually borrowed by the person (Barry and Baker, 1971). It is considered the decision to maintain a credit reserve as a form of risk averse behavior in response to uncertainty (Barry and Baker, 1971). Thus as a risk averse individual, becomes uncertain about the conditions in which they operate, they tend to ration credit internally. Thus the decision to maintain

[1] $\text{ROA}=\frac{(net\ farm\ income+interest\ paid-family\ living\ expenses)}{value\ of\ farm\ assets}$

credit reserve could be hypothesized directly to the probability of internal credit rationing. Moreover an individuals, whose credit reserve is almost exhausted, are inclined more to be externally credit rationed.

2. High interest rates.

   High interest rates reduce the demand for loans. Presumably higher interest rates make more investments financially infeasible, and thus result in external credit rationing. More importantly the risk averse individuals, tend to refuse borrowing, when they view the terms for available credit specified by the institution are so stringent. So that high interest rates are expected to contribute positively for the probability of an individual to be internally and/or externally credit rationed.

3. Lenders' unwillingness.

   Farmers may not request for financing, when they are aware of possible rejection by the lenders. Thus as the literature stated probability of credit rationing increases with the lenders' unwillingness.

4. Planning to transfer.

   The close household-business relationship of most farms and ranches closely links the life cycle of the firm to the life cycle of the operator. Thus the farm operator's objectives may change over the life of the firm (Barry et al., 1987).

   The farm operators reached transfer stage, are long on experience and capital but short on energy and length of planning horizon. Expansion of wealth and income generating capacity may become less important and investments with faster pay backs are preferred (Lee et al., 1988). Thus as the theoretical model

indicated, the percent of farmers without debt increases with the age. Whittaker (1991) indicated that for the eldest age group, sixty-five years and older about seventy percent do not hold any farm debt. Thus farm operators those who are planning to transfer in near future, may not request for farm debt.

Model Specification

The multinomial technique was used to estimate two basic sets of probability prediction models for the credit constrained groups described in Tables 3.3 and 3.4 respectively. The explanatory variables of the models include the variables representing demographic and financial characteristics of the farm operators as well as the indicated reasons to limited borrowing.

Two basic prediction models for credit rationing were developed with different explanatory variables. Furthermore two comprehensive models were developed by combining all the significant variables in the two basic models. The estimated models are listed as follows;

(1) For credit rationing classification one;

$$\begin{aligned} log\frac{P_{j1}}{P_m} &= \alpha + \beta_1 Age + \beta_2 TS_1 + \beta_3 TS_2 + \beta_4 NFI \\ &\quad + \beta_5 GTE + \beta_6 MNW + \beta_7 DAR + \beta_8 LIQ \\ &\quad + \beta_9 INT + \beta_{10} CRE. \end{aligned}$$

(2) For credit rationing classification two;

$$\log \frac{P_{j2}}{P_m} = \alpha + \beta_1 Age + \beta_2 TS_1 + \beta_3 FS + \beta_4 Edu + \beta_5 MNW + \beta_6 DAR + \beta_7 LIQ + \beta_8 CRE.$$

(3) The comprehensive model for credit rationing classification one;

$$log\frac{P_{j1}}{P_m} = \alpha + \beta_1 Age + \beta_2 TS_1 + \beta_3 TS_2 + \beta_4 FS + \beta_5 Edu + \beta_6 NFI + \beta_7 GTE + \beta_8 MNW + \beta_9 DAR + \beta_{10} LIQ + \beta_{11} INT + \beta_{12} CRE.$$

(4) The comprehensive model for credit rationing classification two;

$$log\frac{P_{j2}}{P_m} = \alpha + \beta_1 Age + \beta_2 TS_1 + \beta_3 TS_2 + \beta_4 FS + \beta_5 Edu + \beta_6 NFI + \beta_7 GTE + \beta_8 MNW + \beta_9 DAR + \beta_{10} LIQ + \beta_{11} INT + \beta_{12} CRE.$$

where:

α= Intercept.

TS_1=Transfer in 5 years (A dummy variable)

TS_2=Transfer in 10 years (A dummy variable)

Edu =The level of formal education (1=high school, 2= community college, 3= college, 4= post graduate)

NFI =Net Farm Income ($)

GTE =Gross income per dollar of expenses ($/$)

MNW =Mean Net worth ($)

DAR =Debt to assets ratio ($/$)

LIQ =Liquidity ratio ($/$)

INT =High interest rates (A dummy variable)

CRE =Willingness to maintain credit reserve (a dummy variable)

$P_{j1,2}$ = Probability of i th individual to categorized in to j th group, for j=1,2,3 according to classification one or two.

CHAPTER 4. RESULTS AND DISCUSSION

This chapter presents the results of the logit maximum likelihood estimating equations. The variables included in the model correspond to operator and financial characteristics as well as specified reasons to limit borrowing. The first part of this chapter describes the results of the models one and two, specified in chapter three. The second part of the chapter contains the results obtained from comprehensive models.

Model One

Model one tests, adequacy of credit to rural farm sector by incorporating the information of the credit rationing classification one as endogenous dependent variable. Table 4.1 presents estimated logit coefficients and variable specific chi-square statistics. The model chi-square statistic was 1122 with 33 degrees of freedom, indicating that the amount of variation explained by the model was significantly different from zero at the 0.001 level. The "pseudo-R^2" gives an indication of the goodness of fit. The pseudo R square[1] for model one was 0.90, giving an adequate indication for the

[1] Pseudo R^2 is defined as :
Pseudo $R^2 = [1 - (\frac{L_\omega}{L_\Omega})^{\frac{2}{n}}]/1 - (\frac{L_\omega}{L_{max}})^{\frac{2}{n}}$: where L_ω is the maximum of likelihood function using only a constant, L_Ω is the maximum using all variables and L_{max} is the maximum possible (Cragg and Uhler, 1970).

goodness of fit. Maximum likelihood estimates indicated the direction of a variable's influence on probability. However the interpretations of the individual parameters, must be done with care, since left hand side is the logarithm of the odds of the choice, not actual probability. Variable chi-square statistics are presented within the paranthesis. Virtually all parameters are significantly different from zero at least at the 10 percent confidence level.

The signs of the parameters are generally as expected to priori reasoning. For instance the results demonstrate that the older farm operators are more likely to be in Group four relative to Groups one, two and three. Farm operators intend to transfer in five years are less likely to shift in to Groups one and three relative to Group four, they are more likely to shift in to Group two relative to Group four. The likelihood coefficients associated with NFI indicates, the greater the NFI the smaller the probability that an individual to be classified in to Groups one and two relative to Group four. The coefficients of GTE (Gross income/Total expenses) imply that an individual with higher GTE has a lesser probability to fall in to Group one relative to Group four. Greater the net worth of an operator, the smaller the probability of a farm operator to be in Groups one and two, relative to Group four, while probability to be in Group three relative to Group four increases. Furthermore the probability of farm operator to fall in to Groups one, two and three relative to Group four increases with high debt to assets ratio. The results also indicates that higher liquidity ratio, decreases the probability that an individual to fall in to Groups one, two and three relative to Group four. The results indicates that the limited borrowing due to high interest rates was directly related to the probability to be in Group one relative to be in Group four. Those farm operators, indicated willingness to maintain credit reserve,

Table 4.1: Maximum likelihood estimates for the model one[a]

Variables	Chi-square value	$\log\frac{P_1}{P_4}$	$\log\frac{P_2}{P_4}$	$\log\frac{P_3}{P_4}$
Intercept	25.2***	3.7**	-1.3*	3.5***[b]
		(1.5)	(0.9)	(0.8)
Age	63.2***	-0.07***	-0.007	-0.08***
		(0.02)	(0.01)	(0.02)
Transfer in 5years	7.5**	-0.5*	0.05	-0.5***
		(0.3)	(0.3)	(0.2)
Transfer in 10years	9.7**	-0.6***	0.3*	0.06*
		(0.2)	(0.2)	(0.1)
Net Farm Income	5.4*	-1.3E-6	-3.2E-6	3.1E-6*
		(4.2E-6)	(2.9E-6)	(1.7E-6)
Liquidity Ratio	8.6*	-3.03	-3.7***	-1.7*
		(2.3)	(1.6)	(1.0)
Debt/Assets	12.1**	0.6	0.6*	1.2***
		(0.7)	(0.4)	(0.3)
Mean Net worth	13.1**	-9.9E-7	-1.7E−6**	1.1E−6***
		(1.3E-6)	(8.9E-7)	(4.3E-7)
GTE	5.4*	-1.3*	0.01	-0.4*
		(0.7)	(0.04)	(0.3)
Credit Reserve	34.7***	-0.3*	-0.02	-0.6***
		(0.2)	(0.1)	(0.1)
High Interest Rates	7.7**	0.08	-0.3***	-0.2*
		(0.2)	(0.1)	(0.1)

[a]Source:1991 Iowa Farm Finance Survey.

[b]*=significant at 10 percent,**=significant at 5 percent,***= significant at 1 percent level.

as one reason for limited borrowing, are less likely to be classified into Groups one, two and three relative to Group four.

For further interpretations logit coefficients were translated in to probability prediction equations which are usually referred to as multinomial logit model (Equations 3.3 and 3.4), using the mean values of independent variables, for specified values of "X". Partial derivatives of Equations 3.3 and 3.4, are calculated using the derived probabilities (P_{ij}^{I} *s and* P_{im}) and regression co-efficients, as specified in Equations 3.10 and 3.11. Figures 4.1, 4.2, 4.3 show, how the probability of classifying in to specified groups vary with age, debt/assets, and farm size, while other variables are held at mean values.

Accordingly a typical farm operator in the sample would have 0.809 probability to classifying into Group four. The next most likely group to be categorized would be Group three, followed by Groups two and one. The results also indicate, that the probability of an operator to be internally credit constrained exceeds the probability of being external credit constrained. Moreover the probability of farm operator to be liquidity constrained is approximately eight percent.

The signs of the partial probabilities present in Table 4.2, provide meaningful information and are consistent with the signs of the logit coefficients presented in Table 4.1. For instance as age advances from the mean the probability of the operator falling in to Groups one and three would decrease, while likelihood of shifting in to Groups two and four would increase. (As shown by the Figure 4.1) Figure 4.2 indicates, the likelihood of a farm operator shifting in to Groups one, two, and three increases, with high debt to asset ratios. while the likelihood of shifting to group four decreases (Figure 4.2).

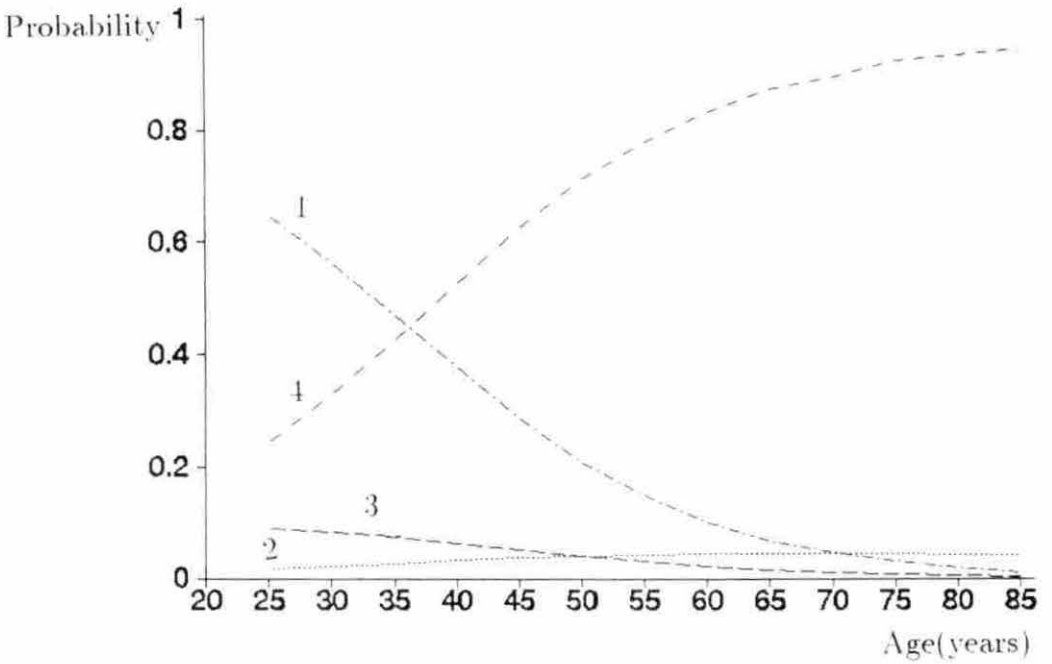

Figure 4.1: Probability of classifying in to credit constrained/unconstrained categories by age

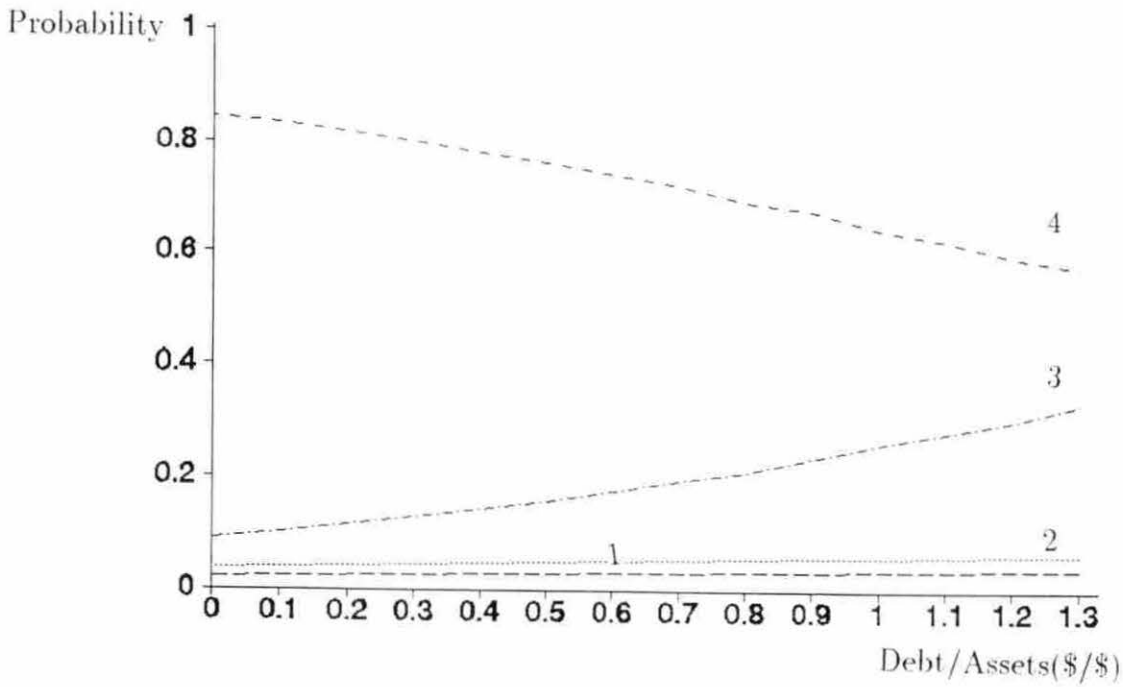

Figure 4.2: Probability of classifying in to credit constrained/unconstrained categories by debt to asset ratio

Table 4.2: Probabilities and partial derivatives at the sample means for the model one[a]

	Group 1	Group 2	Group 3	Group 4
Probabilities	0.020	0.0400	0.14	0.8
Age	-0.001	0.0002	-0.01	0.1
Transfer in 5years	-0.003	0.0191	-0.01	0.3
Transfer in 10years	-0.015	0.0127	0.01	-0.1
Net Farm Income	-4E-8	-1.5E-7	3.5E-7	-1.6E-7
Liquidity Ratio	-0.064	-0.1448	-0.16	0.3
Debt/Assets	0.012	0.0211	0.13	-0.2
Mean Net worth	-2.6E-8	-7.8E-8	1.36E-7	-3.2E-8
GTE	-0.032	0.0044	-0.04	0.7
Credit Reserve	-0.006	0.0029	-0.06	0.1
High Interest Rates	0.028	-0.0133	-0.01	0.1

[a]Source:1991 Farm Finance Survey.

Model Two

Model two is also designed, to test the adequacy of credit to rural farm sector, by incorporating the information of credit rationing classification two (Table 3.4). The logit co-efficients and the variable chi-squares of both financial and demographic variables are presented in Table 4.3. The model chi-square is 1283 with 27 degrees of freedom, which is significant at the .001 confidence level. Pseudo R^2 was 0.873. With this model additional variables appeared to be significant, while some of the variables in the model one became nonsignificant.

Variables including intention to transfer in 10 years, NFI, GTE and high interest rates were not significant, while farm size and education became significant. Accordingly large farm operators would more likely to be in group one, two and three, relative to group four. Figure 4.3 shows clearly, the probability of shifting in to Groups one, two and three increases with farm size. Group three farm operators are more likely to operate larger operations. More educated farm operators would more likely to be in Group one and two relative to group four. Except these two variables results of the other parameters are the same for both models.

As with model one the typical farm operator would have the greatest probability of falling in to Group four. Next most likely to be in Group three, followed by Groups two and one. The results of this classification also state, the probability of a farm operator to be internal credit rationing is higher than a farmer to be external credit constrained. The probability of a farm operator being credit rationed would be approximately twelve percent, not significantly different from the results of classification one (Table 4.4).

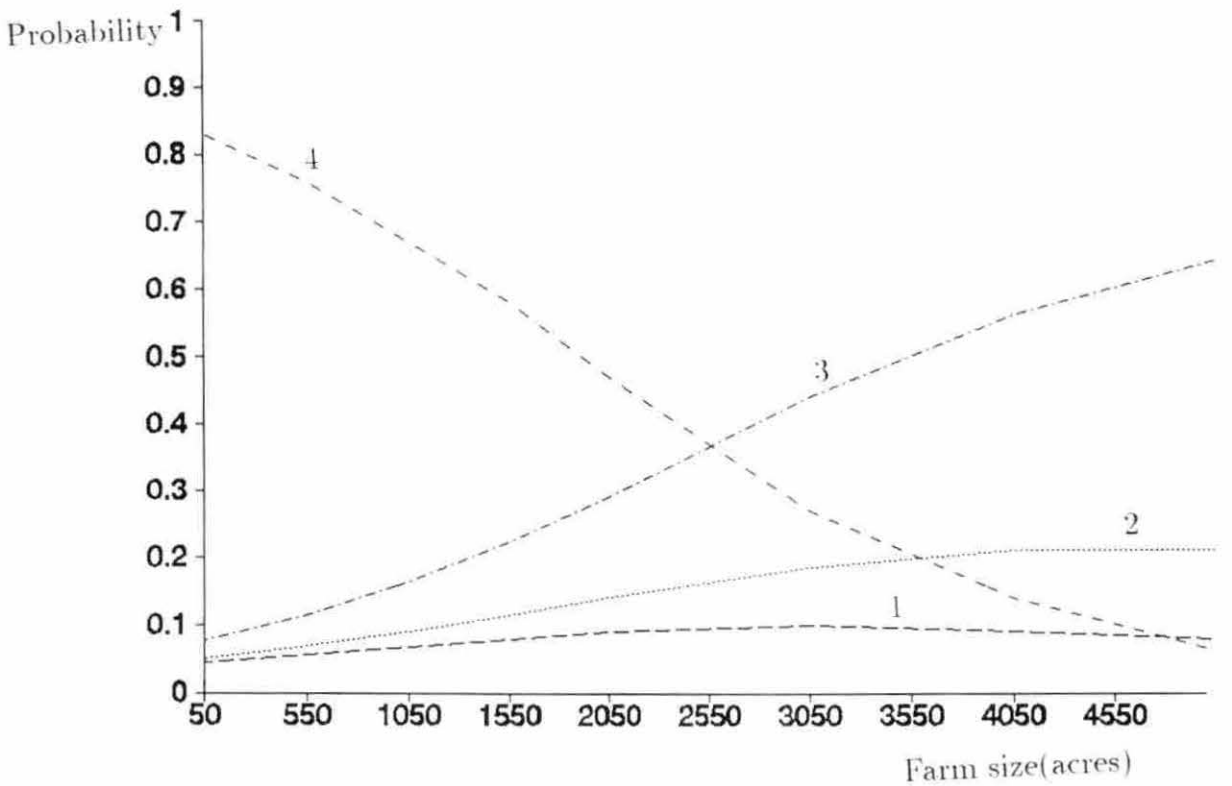

Figure 4.3: Probability of classifying in to credit constrained/unconstrained categories by farm size

Table 4.3: Maximum likelihood estimates for the model two[a]

Variables	Chi-Square value	$\log\frac{P_1}{P_4}$	$\log\frac{P_2}{P_4}$	$\log\frac{P_3}{P_4}$
Intercept	17.21***	2.2119*	0.1954	3.4171***[b]
		(1.1677)	(0.9257)	(0.8629)
Age	68.45**	-0.0875**	-0.0474***	-0.0962***
		(0.0178)	(0.0122)	(0.0129)
Transfer in 5years	10.05**	-0.6159**	0.5481*	-0.3461*
		(0.2657)	(0.3720)	(0.2130)
Farm Size	9.68**	0.000635*	0.00814**	0.00094***
		(0.000456)	(0.000363)	(0.000331)
Education	7.00*	0.0678	0.1955*	-0.1614*
		(0.1529)	(0.1107)	(0.1147)
Liquidity Ratio	7.64*	-2.9330*	-2.4747**	-1.9754*
		(1.9119)	(1.2073)	(1.1473)
Debt/Assets	10.68***	1.4721***	0.5312	1.0361***
		(0.5055)	(0.4461)	(0.4249)
Mean Net worth	7.38*	8.187E-8	-1.36E−6**	7.318E−7*
		(7.881E-7)	(7.152E-7)	(4.698E-7)
Credit Reserve	36.25***	-0.5263***	-0.0983	-0.6690***
		(0.1638)	(0.1257)	(0.1194)

[a]1991 Iowa Farm Finance Survey.

[b]*=significant at 10 percent,**=significant at 5 percent,***= significant at 1 percent.

Table 4.4: Probabilities and partial derivatives calculated at the sample means for the model two[a]

	Group 1	Group 2	Group 3	Group 4
Probabilities	0.053	0.062	0.106	0.779
Age	-0.0037	-0.00184	-0.00824	0.1376
Transfer in 5years	-0.03	0.036	-0.0326	0.027
Farm Size	2.4E-5	3.91E-5	7.95E-5	-1.41E-4
Education	0.00365	0.01232	-0.0168	0.000849
Liquidity Ratio	-0.1280	-0.1217	-0.09082	0.7075
Debt/Assets	0.06655	0.0195	0.0835	-0.1680
Mean Net worth	5E-9	-8.4E-7	7.5E-8	4E-9
Credit Reserve	-0.0223	3.65E-4	-0.0593	0.08117

[a]Source:1991 Farm Finance Survey.

Comprehensive Model One

Comprehensive model one intends to confirm the findings of model one. It fits all the explanatory variables find in models one and two, with the dependent variable describing the information of credit rationing classification one.

The results indicate variables including farm size, education, NFI and GTE are non significant, with the comprehensive model one. However the interpretations of the NFI and GTE presented in model one still hold for this model, since signs of the coefficients are unchanged. The sign of the parameter associated with the level of formal education in the case of Group two, is positive though not significant. The estimates associated with the farm size confirmed the results given in model two. The farm operators with larger operations are more likely to shift in to Groups one, two and three, relative to operators in Group four (Table 4.5).

As with previous models, a typical farm operator would have the greatest probability to shift in to Group four. The probability of a farm operator to be internally constrained is higher than a farm operator to be externally constrained. The probability of farm operator to be credit constrained is approximately eight percent, as same as the result given in model one. Thus the comprehensive model one, does not necessarily improve the predictions for credit rationing (Table 4.6).

The signs of the partial probabilities are consistent with those of the likelihood estimates given in Table 4.5. As expected the probability of being external credit constrained is inversely related to age, transfer in five and ten years, willingness to maintain credit reserve, NFI, GTE, net worth and liquidity. Probability of external credit rationing (Group one) increases with high interest rates and debt to assets. Probability of internal credit rationing (Group two) decreases with age, education,

Table 4.5: Maximum likelihood estimates for the comprehensive model one[a]

Variables[b]	Chi-Square value	$\log\frac{P_1}{P_4}$	$\log\frac{P_2}{P_4}$	$\log\frac{P_3}{P_4}$
Intercept	20.69***	3.222*	-1.4268	3.6121***[c]
		(1.8107)	(1.1136)	(0.9153)
Age	56.74***	-0.0663***	-0.0062	-0.0902
		(0.0238)	(0.0148)	(0.0123)
Transfer in 5years	7.05*	-0.3837	0.0550	-0.4836***
		(0.3435)	(0.2783)	(0.1954)
Transfer in 10years	7.71**	-0.5478**	0.2937*	0.0755
		(0.2458)	(0.2181)	(0.1577)
Farm Size	3.62	0.000227	0.000019	0.000577*
		(0.00618)	(0.000498)	(0.000308)
Education	1.84	-0.1483	0.0245	-1.265
		(0.2115)	(0.1332)	(0.1068)
Net Farm Income	3.77	-1.81E-6	-3.24E-6	2.295E−6*
		(4.395E-6)	(2.958E-6)	(1.716E-6)
Liquidity Ratio	8.87**	-4.427*	-3.698**	-1.6426*
		(2.917)	(1.602)	(1.0764)
Debt/Assets	8.92**	0.6687	0.6509*	1.1299***
		(0.7443)	(0.4941)	(0.3848)

[a]1991 Iowa Farm Finance Survey.

[b]Pseudo R^2:0.90;likelihood-ratio test statistics (X^2) :1128; degrees of freedom:36.

[c]*=significant at 10 percent, **=significant at 5 percent,***= significant at 1 percent.

Table 4.5 (Continued)

Mean Net worth	9.46**	-9.26E-7	-1.74E−6*	9.517E−7**
		(1.314E-6)	(9.383E-7)	(4.56E-7)
GTE	4.41	-1.2615*	0.0118	-0.4189*
		(0.7559)	(0.0440)	(0.3050)
Credit Reserve	34.61***	-0.3896*	-0.0183	-0.6425***
		(0.2147)	(0.1498)	(0.1122)
High Interest Rate	8.03**	0.1273	−0.3355***	−0.1714*
		(0.2173)	(0.1408)	(0.1111)

NFI, mean net worth and liquidity ratio.

Comprehensive Model Two

Comprehensive model two intends to confirm the results of model two, by estimating all the variables found in models one and two. With the comprehensive model two, variables including transfer in ten years, high interest rates, NFI, GTE are nonsignificant. But still the interpretations for high interest rates and GTE hold for this model. The results of NFI is inconsistent with respect to external credit rationing. The signs of the parameter estimates of age, transfer in five years, farm size, willingness to maintain credit reserve, high interest rates, liquidity ratio, debt to asset ratio and GTE are the same as the previous models, thus same interpretations hold for this model (Table 4.7).

As with the previous models, the typical farm operator would have the greatest probability to shift in to Group four. The probability of farm operators to be credit constrained is approximately twelve percent, same as the model two (Table 4.8).

Table 4.6: Probabilities and partial derivatives calculated at the sample means for the comprehensive model one[a]

	Group 1	Group 2	Group 3	Group 4
Probabilities	0.027	0.052	0.019	0.902
Age	-0.00168	-0.00123	-0.00164	0.00345
Transfer in 5years	-0.0099	0.00372	-0.008873	-0.01497
Transfer in 10years	-0.0148	0.01517	0.0014	-0.00173
Farm Size	5.641E-6	5.2E-8	1.0023E-5	-1.63E-5
Credit Reserve	-0.0098	0.00028	-0.01175	0.02135
High Interest Rates	0.0039	-0.0165	-0.00293	0.0156
Education	-0.0033	-0.00199	-0.023	0.2413
NFI	-4.4E-8	-1.59E-7	4.7E-8	1.57E-7
GTE	-0.0329	0.00276	-0.0071	0.0373
Mean Net worth	-2.2E-8	-8.5E-8	2.E-8	8.8E-8
Debt/Assets	0.016	0.03	0.02	-0.066
Liquidity ratio	-0.4533	-0.1744	-0.0247	0.309

[a]Source:1991Farm Finance Survey.

Table 4.7: Maximum likelihood estimates for the comprehensive model two[a]

Variables[b]	Chi-Square value	$\log\frac{P_1}{P_4}$	$\log\frac{P_2}{P_4}$	$\log\frac{P_3}{P_4}$
Intercept	19.57***	3.6246***	0.6214	4.0647***[c]
		(1.3789)	(0.9762)	(0.9989
Age	68.81***	-0.0946***	-0.0526***	-0.0960***
		(0.0186)	(0.0129)	(0.0132)
Transfer in 5years	9.63**	-0.6024**	0.5582*	-0.3288*
		(0.2679)	(0.3730)	(0.2146)
Transfer in 10 years	3.82	-0.2784	-0.02543*	-0.0765
		(0.2142)	(0.1556)	(0.1627)
Farm Size	8.88**	0.000388	0.000851**	0.000921***
		(0.000488)	(0.000377)	(0.000344)
Education	6.57**	0.0752	0.01949*	-0.1532
		(0.1546)	(0.1115)	(0.1156)
Net Farm Income	4.38	2.9092E-6	-3.08E-6	5.397E-8
		(2.204E-6)	(2.273E-6)	(2.038E-6)
Liquidity Ratio	6.52*	-3.0216*	-2.2922*	-1.7161*
		(1.9685)	(1.2194)	(1.1533)
Debt/Assets	7.72**	1.2332***	0.5170	0.9367**
		(0.5153)	(0.4449)	(0.4311)

[a]1991 Iowa Farm Finance Survey.

[b]Pseudo R^2: 0.87; likelihood-ratio test statistic (X^2): 1267; degrees of freedom:36.

[c]*=significant at 10 percent,**=significant at 5 percent,***=significant at 1 percent.

Table 4.7 (Continued)

Mean Net worth	6.81*	2.668E-8 (7.22E-7)	-1.31E-6* (7.187E-7)	7.222E-7* (4.833E-7)
GTE	4.63	-.651 (0.5358)	0.0362 (0.0306)	-0.5088* (0.3540)
Credit Reserve	34.63***	-0.5093*** (0.1652)	-0.09111 (0.1267)	0.6620*** (0.1205)
High Interest Rate	1.42	0.0458 (0.1648)	-0.0290 (0.1217)	-0.1254 (0.1189)

The probability of external credit rationing (Group one) is inversely related to age, transfer in five years, transfer in ten years, credit reserve, GTE and the liquidity ratio, and it is directly related to the farm size, credit reserve, high interest rates, education, NFI, mean net worth and debt to asset ratio. The probability of internal credit rationing, still declines with high NFI, net worth and liquidity ratio.

Summary

In this study, the multinomial logit technique was used to predict the probability of credit rationing occur in the rural farm sector. According to all four models, the probability of internal credit rationing exceeds the probability of external credit rationing.

The results show that the probability of a farm operator being external credit rationed is directly related to the debt to asset ratio and high interest rate and it is inversely related to age, plans to transfer, liquidity position, Gross income per dollar

Table 4.8: Probabilities and partial derivatives calculated at the sample means for the comprehensive model two[a]

	Group 1	Group 2	Group 3	Group 4
Probabilities	0.052	0.068	0.096	0.784
Age	-0.004	-0.0023	-0.0075	0.0138
Transfer in 5years	-0.03	0.0396	-0.02917	0.0195
Transfer in 10years	-0.0124	-0.0146	-0.00358	0.0306
Farm Size	1.152E-6	4.6E-5	7.2E-5	-1.3E-4
Education	0.00378	0.013	-0.0149	-0.00192
Net Farm Income	1.54E-7	-2.06E-7	1.0E-8	4.2E-8
Liquidity ratio	-0.1322	-0.1233	-0.1188	0.3745
Debt/Assets	0.05428	0.0222	0.0717	-0.1483
Mean Net worth	2.0E-9	-8.7E-8	7.18E-8	1.4E-8
GTE	-0.02968	0.00791	-0.04114	0.0628
Credit Reserve	-0.0214	3.46E-4	-0.0543	0.0754
High Interest Rates	0.002986	-0.00118	-0.0109	0.00911

[a]Source:1991 Farm Finance Survey.

of expenses, and credit reserve. The impacts of education, net farm income and mean net worth on probability of external credit rationing are ambiguous.

The probability for internal credit rationing is negatively related to the age, net farm income, liquidity position and net worth. This probability increases with greater willingness to maintain credit reserve and with GTE. The effect of education on internal credit rationing is not clear.

These conclusions are consistent with the expectations, for instance, the repayment ability of loans is greatly influenced, by the income generating capacity of the farm business. Thus farm operators,

with low NFI are more probable to be credit constrained. The results also imply, that lower the GTE, the greater the probability to be externally credit constrained, indicating the inverse relationship between the efficiency in use of resources and the probability of external credit rationing. The results also confirmed the farm operators categorized into Groups one, two and three are younger than those in Group four, thus as anticipated these farm operators have a higher debt to assets ratio than that of the operators found in Group four.

CHAPTER 5. SUMMARY AND CONCLUSIONS

This study investigated the form of credit rationing occurs in the current farm sector. To analyze this problem, two classifications for credit rationing were developed based on the information of 1991 Iowa Farm Finance Survey.

Farm operators who borrowed institutional credit but indicated, limited profits due to inadequate credit or desire to borrow more at current rates of interest and non borrowers who responded that they have limited profits due to inadequate credit or a desire to borrow more were classified as externally and internally credit constrained farm operators respectively. The multinomial logit technique was used as an endogenous criterion function, to develop several prediction models, incorporating the information of classifications.

The results from the analysis of this survey data provide important considerations for future agricultural policy. The prediction models revealed, that the probability of a farm operator to be in group one or to be externally credit rationed is approximately three percent. The farm operators of this group are characterized by young energetic individuals with high debt to asset ratio, smaller gross income per dollar of expense, liquidity ratio and credit reserve and those who indicated high interest rates as one reason for limited borrowing.

Group two farm operators, who are internally credit rationed also seem to be

with high debt to asset ratio, smaller Net farm income, mean net worth and liquidity ratio. The probability of shifting in to this group is approximately 5.5 percent, which is greater than the probability of external credit rationing. In contrary to the previous literature, these internal credit rationed farm operators are comparatively older, and with large farming operations.

Group three farm operators, who performed the best with the highest return on assets, returns on equity, Net farm income with smallest debt to asset ratio, can be considered as the most profitable and solvent group of the sample. These operators are making very acceptable cash flow returns on assets and their use of debt enhances their return on equity. The probability of shifting in to group three would be approximately eight percent.

Group four represents farm operators who neither borrow nor indicated a desire for credit. These operators are mostly older (average age is 60 years), earn smaller Net farm income, returns on assets, reports a very low debt to asset ratio and operates comparatively smaller farming units. Probability of shifting in to this group is approximately seventy five percent.

Conclusions

The results of the study high light several important factors which should be considered when evaluating the form of credit rationing exist in the rural farm sector.

1. Only a minority, i.e. approximately ten percent of farm operators are con strained in their farming operations by inadequate credit.

2. The probability of internal credit rationing exceeds the probability of external credit rationing. Thus, the decline in use of credit in rural farm sector, is largely a result of decline in demand for credit by farm operators. Credit rationing by banks does not appear to be a significant economic issue. According to the results of the study, approximately seventy five percent of the sample did not even request, financing for expansionary purposes.

   This result may be due to the fact, that this study utilized the information collected over 1989-1991, during a period, both farm borrowers and lenders were wary about handling debt, for several reasons. First, both groups were just recovered from the loan losses occurred during the farm financial crisis of 1980s. Secondly, this period resembled the beginning of general economic recession. Thirdly, farm loan rate was peaked in 1989, well above the commercial lending rate.

Policy Implications

This study clearly delineates, why the growth of credit in rural areas has slowed during late 1980s to early 1990s. Decomposing the sample of farm operators according to credit rationing classifications, reveals that approximately fifteen percent of the farm operators are doing well financially. Their use of debt enhances the profitability of the farm businesses. Overall three to five percent of the population is externally credit constrained. Approximately five to seven percent of the sample is internally constrained. Seventy percent of the operators in the sample do not actively participate in the credit market.

The credit rationing classifications that categorized farm operators in to different

groups, provide valuable considerations for policy implications; increase credit availability to externally constrained farm operators, decrease the uncertainties of the internally constrained farm operators and provide required incentives for the older farm operators to transfer-out and attract potential energetic young operators.

Public credit policies are being advocated on the grounds that rural financial markets do not supply the capital that rural farm businesses need. These programs may increase the tendency for farm operators to stay employed in agriculture and to attract potential new, young entrants in to farming, whom were blocked by expectations of bleak financial prospects and steep start-up costs of farming. However the models indicated that the probability of external credit rationing is comparatively very small in the farm sector, thus public credit policy may be only marginally helpful.

Promoting the incentives to use risk management strategies, such as hedging, options, forward contracting and spreading sales or purchases may also help to protect farm operators against price uncertainties. Reduced risks and uncertainties may contribute to ease the internal constraints, to some extent, and may lead to increase the use of credit.

The results also have indicated that the majority of the farming population left with a concentration of elderly citizens, who control over smaller farming units and resources, with very little credit. Thus policies providing incentives to transfer or sellout the operations of retiring farm operators to a family member or other competent young farmer often provides a reliable source of financial help and management assistance for the beginner. Furthermore this may increase use of additional credit and resources, utilize capital more productively and thereby to enhance the efficiency

of the farm operation.

Research Implications

This study points out, that the majority of the farming population, is comprised with farm operators, who did not actively participate in credit markets. The results emphasized that this group is characterized by older farm operators, with smaller farming units. This raises the issue, whether this result is unique to our particular sample data or whether farming an occupation characterized by an unusually large proportion of older farm operators, who are not keen in borrowing? Thus inclusion of large sample, obtained from different major farming areas, would be helpful in determining, the solution for this question.

The results also revealed, that about, ten percent of the sample data, seem to be liquidity constrained. Majority of these liquidity constrained operators are internally credit rationed. Comparison between the demographic and financial characteristics, yield many valuable information. Yet, further insight of these internal credit rationed farm operators could be obtained by studying, their previous experiences with lenders, apprehensive view about using debt and existing economic conditions. Future research could be conducted by examination of individual internally credit rationed operators, with respect to these aspects.

This research employed the logistic regression procedure to predict the probability of credit rationing. The logistic regression is a standard statistical method used in classifications. The use of an alternative, non parametric technique, may be useful in determining the validity of the obtained results. For instance, CART (Classification and Regression Tree) is an interesting and often powerful alternative to paramet-

ric methods in classification and regression. This method arrives at predictions by constructing binary trees. Future research can be conducted, by implementing, such more sophisticated and accurate analytical methods in constructing, prediction rules, using the same classifications, for credit rationing in the rural farm sector.

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APPENDIX A. SURVEY INSTRUMENT

1991 Farm Finance Survey

1. In what county is most of your farming operation located? _____ 001

2. What is your age? 002

3. How many dependents are you supporting (including yourself)? 003

4. How many of these dependents are under age 18? 004

5. What is the highest level of education that you have completed?

Wife (005)	☐	high school	☐	comm. college	☐	college	☐	post graduate
Husband (006)	☐	high school	☐	comm. college	☐	college	☐	post graduate

6. How many years have you been farming? 007

7. During the 1990 crop year, how many acres did you:

   a. Own 008
   b. Rent from others 009
   c. Rent to others 010

8. Approximately what percent of your 1990 gross farm sales came from each of these sources?

   a. Crops ..... 020 %
   b. Beef ..... 021 %
   C. Pork ..... 022 %
   d. Dairy ..... 023 %
   e. Other farm enterprises ..... 024 %

9. Since January 1989, what changes have you made in your farming operation? (please estimate the percentage change in capacity)

	Increase %	Decrease %
a. Land base	030	230
b. Livestock facilities	031	231
c. Machinery and equipment capacity	032	232
d. Breeding herd	033	233

10. Which of the following statements best describes your plans for your farm business for the indicated time period?

	Check all that apply	1991-1995	1996-2000
a.	Continue present operation as is	040	240
b.	Expand land base	041	241
c.	Expand breeding herd	042	242
d.	Expand machinery capacity	043	243
e.	Rent land out and retire	044	244
f.	Transfer farm operation to a family member and retire	045	245
g.	Sell out and retire	046	246
h.	Other _____	047	247

11. Since January 1989, have you ever requested financing to expand your farm business?

Yes (050) ☐
No (skip to 18) ☐

12. Was your farm business expansion request approved?

Yes (051) ☐
No (skip to 16) ☐

13. Were you required to make changes in your request for expansion financing in order to receive financing?

Yes (052) ☐
No (skip to 15) ☐

14. Estimate the percentage change from your original financial request for farm business expansion that you were required to make.

		Increase (%)	Decrease (%)
a.	The size of the expansion	060	260
b.	Down payment	061	261
c.	Term of the loan	062	262
d.	Interest rate	063	263
e.	Collateral	064	264

15. Estimate what percent of your expansion financing was obtained from the following lenders and indicate how long you have done business with each?

	Financing provided (%)	Years with lender
a. Your own funds (equity) including trade-in value of machinery	070	NA
b. Local bank	071	081
c. Larger urban bank	072	082
d. Farm credit system	073	083
e. FmHA	074	084
f. Insurance company	075	085
g. Merchant or dealer	076	086
h. Individual	077	087
i. Other	078	088
	100%	

If you answered 15, skip to 17

16. If your loan for the expansion was not approved, check all reasons that apply.

a. Income from expansion was too variable	090
b. Insufficient documentation (budget or cash flow)	091
c. Previous loss experience	092
d. Insufficient cash flow	093
e. Insufficient collateral	094
f. Current debt levels were too high	095
g. Not a profitable expansion	096
h. Lack of experience with this enterprise	097
i. Loan was wrong purpose for this lender	098
j. Other (please indicate) _____	099

17. Did you contact more than one lender about financing your expansion?

Yes (101)	
No	

18. Has inadequate financing limited the profitability or growth of your farm business?

Yes (102)	
No (skip to 20)	

19. Please rate the extent to which the following factors were effected by limited borrowing.

Please circle

	Affect				
	Severely affected				Not affected
a. Modernization facilities and equipment 270	1	2	3	4	5
b. Full utilization of facilities or machinery to fullest extent 271	1	2	3	4	5
c. Ability to fully employ existing labor force 272	1	2	3	4	5
d. Ability to generate adequate family income 273	1	2	3	4	5
e. Ability to take advantage of future economic opportunities 274	1	2	3	4	5
f. Ability to employ and support additional operator or family 275	1	2	3	4	5
g. Other (please indicate) _____ 276	1	2	3	4	5

20. Would you be willing to take on additional debt if your lender offered to make credit available?

Yes ..... (119) ☐
No ..... ☐

21. Why have you limited your borrowing?

Check all that apply

a. Interest rates are too high	120 ☐
b. I want to maintain cash reserves	121 ☐
c. I want to maintain a credit reserve	122 ☐
d. Profit margins were insufficient	123 ☐
e. My lender is unwilling to offer additional credit	124 ☐

22. Which risk management strategies do you use?

Please circle

	Frequency of Use				
	Never		Sometimes		Always
a. Multiple peril crop insurance 280	1	2	3	4	5
b. Hail insurance 281	1	2	3	4	5
c. Hedging 282	1	2	3	4	5
d. Forward contracting 283	1	2	3	4	5
e. Commodity options 284	1	2	3	4	5
f. Crop share leases 285	1	2	3	4	5
g. Participate in government programs 286	1	2	3	4	5

23. From your 1990 tax records (form 1040, 1040F, 1040E, and form 4797) or your farm account book, please list the following information:

	1990 dollar values
1040 Form	
a. Total income, (line 27)	140
b. Wages and salaries, (line7)	141
c. Interest and dividends, (line 8a + 8b + 9)	142
d. Capital gains or losses (lines 13 + 14 + 15)	143
1040F Form	
d. Gross income, (line11)	144
e. Interest expense, (lines 23a + 23b)	145
f. Depreciation (line 16)	146
g. Total expenses, (line 35)	147
1040E Form	
h. Net farm rental income received	148
4797 Form	
i. Sale of breeding stock (line 18)	149

24. What was the approximate market value of farm and financial assets you have owned the past two years? (please use financial statements if available)

	Jan. 1990	Jan. 1991
a. Cash in checking, savings accounts	150	160
b. Financial investments (CDs, mutual funds)	151	161
c. Crops and livestock for sale (including CCC crops under loan)	152	162
d. Machinery, equipment, breeding stock	153	163
e. Land and buildings	154	164
f. Total assets	155	165

25. Please list your outstanding loan balances for farm real estate and farm non-real estate debt by type of lender on January 1, 1990 and 1991.

	Non-real Estate Debt		Real Estate Debt	
	Jan. 1990	Jan. 1991	Jan. 1990	Jan. 1991
a. Bank.....	170	180	190	200
b. Farm credit system ..	171	181	191	201
c. FmHA	172	182	192	202
d. Insurance company..	173	183	193	203
e. Individual	174	184	194	204
f. Merchant or dealer...	175	185	195	205
g. Other loans (incl. CCC)	176	186	196	206
h. Total debt.....	177	187	197	207

Comments: _____

_____

_____

_____

_____

_____

Note: *If you have a question that requires an answer from the ISU Economics Department please complete the following:*

I authorize Iowa Agricultural Statistics to forward my name and address to Dr. Robert Jolly, ISU, Economics Department, for response to my questions.

Name: _____

Address: _____ Iowa _____ Date _____
Town Zip

APPENDIX B. FINANCIAL RATIOS

Profitabilty Ratios

Return on assets (ROA)

Computation: ROA= $\frac{net\ farm\ income + interest\ paid - family\ living\ expenses}{value\ of\ farm\ assets}$

Interpretation: The ratio estimates pre-tax earnings per dollar of investment. It can be used as an index of profitability that is independent of the in which the firm is financed. Changes in asset values can cause the ratio to fluctuate. Family living expenses are used as proxy for the value of unpaid labor and management. Note that the ROA measures only the income return on assts, capital gains are not included.

Return on equity (ROE)

Computation: ROE= $\frac{net\ farm\ income - family\ living\ expenses}{net\ worth}$

Interpretation: ROE is a profitability index that reflects the pre-tax earnings on assets as well as the financial structure of the business. It measures the return per dollar of owner equity. The ROE will be influenced by changes in asset values, indebtedness and interest rates.

Cost of debt (COD)

Computation: COD= $\frac{interest\ paid}{total\ liabilities}$

Interpretation: The COD is the weighted interest rate on debt. The weights are based on the total outstanding loan balances for each observation.

Solvency Ratios

Debt to assets ratio(DAR)

Computation: DAR=$\frac{total\ liabilities}{total\ assets}$

Interpretation: This ratio measures the indebtedness of the farm in percentage terms.

Net capital ratio (NCR)

Computation: NCR=$\frac{total\ assets}{total\ liabilities}$

Interpretation: The long-run solvency position of a business is indicated by the net capital ratio. It reflects the likelihood that sale of all assets would produce sufficient cash to cover all debt outstanding.

Leverage ratio (LR)

Computation: LR= $\frac{total\ liabilities}{owner\ equity}$

Interpretation: It specifies the dollars of debt for every dollar of equity, the higher the ratio the greater the financial leverage and lower the solvency.

Interest coverage ratio (ICR)

Computation: ICR=$\frac{net\ farm\ income\ +\ interest\ paid\ -\ family\ living\ expenses}{interest\ paid}$

Interpretation: This ratio measures the relationship between capital earnings and interest paid on debt. The higher the ratio, the lesser the burden of interest on income.

Efficiency Ratios

Gross ratio(GR)

Computation:GR= $\frac{total\ expenses}{gross\ income}$

Interpretation: The lower this value, the more efficient the farm business.

Turn over ratio (TO)

Computation: TO= $\frac{total\ gross\ income}{value\ of\ farm\ assets}$

Interpretation: This ratio measures the sales volume generated per dollar of assets. The TO ratio is an index of the efficiency with which the capital stock is utilized.

Current ratio (CR)

Computation: CR=$\frac{total\ current\ assets}{total\ current\ liabilities}$

Interpretation: The current ratio indicates the extent to which current assets, if liquidated would cover current liabilities outstanding.

Fixed ratio (FR)

Computation: $\mathrm{FR}=\frac{long\ term\ assets}{real\ estate\ liabilities}$

Interpretation: This ratio measures the relationship between long term assets and liabilities. It is an index of the degree to which long-term equity reserves might be available for refinancing.