Credit Quality of Kansas Farms

Allen M. Featherstone,

Michael R. Langemeier,

and

Kent J. Haverkamp *

Selected Paper prepared for presentation at the

Southern Agricultural Economics Association Annual Meetings

Orlando, Florida, February 5-8, 2006

* Professor of agricultural economics at Kansas State University; Professor of agricultural economics at Kansas State University, and Master of Science in Agricultural Economics graduate at Kansas State University. Contact person, Allen Featherstone, Department of Agricultural Economics, 313 Waters Hall, Kansas State University, Manhattan, KS, 66506-4011, phone 785-532-4441, fax 785-532-6925, email afeather@ksu.edu.

Credit Quality of Kansas Farms

Abstract

The objective of this paper is to examine credit migration of individual Kansas farms from 1980-2003. Individual farm data collected from the Kansas Farm Management Data Bank are employed. From 1980 to 2003 these farms had an average credit rating equivalent to a Standard and Poor's B classification, which represents a vulnerable to adequate borrower. Farms in consecutive periods showed the largest tendency to remain in the same ratings category, with smaller tendencies to increase or decrease in credit quality. When movement did take place, there was a high likelihood of only a one category movement.

Keywords: Credit migration, credit quality

Credit Quality of Kansas Farms

Risk management is an important task for financial institutions. Recent guidelines presented in the New Basel Accord (Accord) will provide a benefit to financial institutions that properly assess risk. The Accord requires financial institutions to assess their risks, to link these risks to capital management, and comply with safety and soundness regulations (Roessler).

The Accord works to provide a greater level of safety and soundness in lending. A bank's credit risk is of great importance. Banks persistently work to improve their risk management and measurement capabilities to more appropriately price risk. Risk rating systems, sometimes called credit scoring models, are used to provide a more uniform management of a bank's assets. These models also reduce processing costs and fill the need for a faster and more consistent decision-making process.

Virtually all banks use some type of risk rating system (Siddiqi and Klein). Due to the Accord, many existing models will be examined and improvements will be made to provide each financial institution with a model that best fits their needs. The Accord recognizes the diversity among financial institutions and offers considerable flexibility in institutional approaches to implementing the provisions it lays out (Barry 2001).

In modeling credit risk, financial institutions rely on many variables, including liquidity ratios, profitability ratios, repayment capacity, company size, and other business performance measures, along with non-economic measures such as character. The significance of these variables varies depending upon the financial institution itself. Banks use different models to better fit the customers and loans that they typically handle. For example, rural banks handle more agricultural loans than urban banks. Robust statistical credit scoring models are very sturdy and can withstand significant shifts in the economy (Rowland).

Typically, a bank will give ratings similar to that of an equity index such as Standard and Poor's (S&P) which, from best to worst is AAA, AA, A, BBB, BB, B, CCC (Jafry and Schuermann). Loan applicants with the best rating (AAA) have a very low probability of default or low risk of non-repayment, while applicants with the worst rating (CCC) have a high probability of default or high risk of non-repayment.

Credit scoring models have wide practical applicability to loan pricing in the farm lending industry (Goodwin and Mishra). Successful agricultural lending, characterized by high risks, increased lender competition, and improved borrower information, requires skillful credit assessment (Splett et. al.). A model can help take out much of the subjectivity of the loan decision-making process and provide an efficient and time-saving device to the lender.

The objective of this paper is to examine credit migration of individual Kansas farms. Credit migration is the movement of a credit rating from one period to another. This concept determines a borrowers' creditworthiness and how the change in credit quality of a loan affects the ability of the borrower to repay their debt. The result of utilizing the migration concept allows a richer, more comprehensive perspective on credit risk and loan losses than relying solely on the measurement of historic default rates (Barry, Escalante, and Ellinger). Tracking the movement of loans from one risk rating class to another allows the study of migration patterns and their effect on the probability of default.

To study this, individual farm data collected from the Kansas Farm Management Data Bank will be employed. Using this information, yearly financial ratios for each farm is used to determine credit risk. This will provide the probability of default for each of the farms in the data set during each year. These probabilities will then be used to create a classification system for the probability of default. For convenience purposes, Standard & Poor's probability of default calculations will be incorporated to give ratings to each farm. The movement of their credit rating from one classification to another over a consecutive two year period (for example: from BBB in 1991 to BB in 1992) will then be studied. The effect of this rating change on the ability of the farmer to repay his/her debt will be analyzed. Additional research will explore the effects of farm income and past creditworthiness on credit ratings and the observed ratings for different types of farm businesses.

Literature Review

Credit scores have become a staple of loan processing today. They provide separation of applicants into categories of good versus bad, or profitable versus loss. Benefits of scoring include increased objectivity, consistency, speed in processing, and cost efficiency. It also offers management more control over the decision making of their employees. If models are applied accurately and consistently, portfolio management will be more effective (Crouhy, Galai, and Mark).

A credit scoring model should be 1) able to contribute to the bank's loan classification system in screening loan applicants, able to diagnose credit weaknesses, and able to price loans based on credit quality; 2) accurate enough to contribute to sound lending decisions and loan classification; 3) objective in it's ability to price loans; 4) simple enough for loan officers to compute and interpret credit scores for screening applicants; and 5) be statistically valid (Fischer and Moore).

Migration analysis is a relatively recent, probability based measurement concept that is consistent with the modern approaches to economic capital management by financial institutions (Crouhy, Galai, and Mark). The credit score reflects the combined effects of several key factors, including profitability and repayment capacity. Changes in loan quality during the term of the loan have an impact on the ability of the borrower to repay. A weakness of many risk rating systems is that they are based on historical financial information generated under conditions that may not be applicable in the future (Roessler). These changes in creditworthiness over time must be accounted for so that the lenders are not susceptible to new risks. Credit models are increasingly interested in not just the probability of default, but in what happens to a credit on its way to default (McNulty and Levin).

Past studies on credit scoring models indicate a strong tendency for ratings to remain in the same credit class from one period to another. They also show a higher likelihood for loans to be downgraded rather than upgraded. Jafry and Schuermann confirm these tendencies in a 2003 study on credit migration. Their study also finds a high degree of precision when estimating ratings with no migration and a lesser precision in estimating when migrations do occur. Little is currently known about the movements of risk ratings over time for agricultural loans and other farm businesses, thus information regarding the migration rates of agricultural loans and their effects on the probability of default is limited (Barry, Escalante, and Ellinger).

In 2002, Barry, Escalante, and Ellinger used Illinois farm level data from 1985 to 1998 for a credit migration study. Three financial indicators, including a credit scoring model, a profitability variable, and a repayment capacity variable, were used to study the migration rates. The credit scoring model used for this study was reported by Splett, Barry, Dixon, and Ellinger and consisted of five rating classes. Four approaches to measurement were attempted. These were: A year-to-year transition, a two-year moving average, a three-year moving average, and a three-year average to fourth year approach.

They found that the use of farm record data rather than lender data could yield a greater degree of migration across classes (Barry, Escalante, and Ellinger). The study listed three reasons for this: 1) farm data omits the influence of a lenders discretionary judgment 2) includes government financed farms 3) lenders may employ various types of credit enhancements (collateral, government loan guarantees, co-signers, insurance) to modify credit risks of individual borrowers.

The results of the Barry, Escalante, and Ellinger study were consistent with previous research in this area, suggesting that farm data can be used for migration analysis as well as lender data. However, the probability of a farm to retain their original ratings was generally lower than those reported for other studies. It was suggested this may be due to high variability of farm performance or that it could reflect characteristics of farm data versus loan data that had been used in the previous studies.

The migration approach is used by Moody's and Standard and Poor's (S&P) as they study the accuracy of their bond and loan ratings over time (Crouhy, Galai, and Mark). Often, financial institutions use credit models that correlate to Moody's or S&P ratings when they lack sufficient data to create their own migration systems.

In summary, previous studies in this area have shown the importance of credit migration and the effects that migration has on portfolio management. Ratings tend to remain the same from one period to another. However, if a change does occur it is more likely to be a decrease rather than increase. As noted by the New Basel Accord, credit models are important to the safety and soundness of the financial industry. Providing fast, efficient, and reliable data to lenders enables better decision-making. Similar tools and practices that were examined in previous studies will be used for this project. Farm record data will be examined, a probability of default will be calculated, credit scores will be assigned, and migration rates will be evaluated.

Theoretical Model

Financial institutions continually strive to create profit through managing and pooling risk. They create this profit by lending money to their customers. In return, the borrower must repay the loan balance plus a ‘fee’ for the use of their services and money. This ‘fee’ is included in the loan price or interest rate. Borrowers receive different loan prices because the lender must account for the individual borrower’s risk level. A loan that is considered to be more risky to the financial institution is charged a higher interest rate than a loan that is considered to be less risky.

Credit scores are found using financial data from the potential borrower. This helps to assess the risk that a loan will enter default status. By assessing the risks of each loan and assigning an appropriate credit rating to each borrower, the lender is able to manage risks more effectively. Managers of financial institutions implementing a credit scoring model have more consistency in the response from their employees, and therefore have more control and consistency in managing the risks that their company is becoming involved in.

One way to think of credit models is to relate them to a well-known benchmark such as Standard and Poor’s (S&P). Relating a farms’ creditworthiness to the rating classes used by S&P benefits the research in several ways. The S&P model has been established, used, and validated in the marketplace and the use of its classes provides a consistency in the marketplace (Roessler). This consistency allows the researcher the ability to compare results across studies. Since the S&P model is one of the most commonly used, lenders and borrowers will have a better grasp of what the ratings indicate.

Table 1 reports the KMV estimated default frequency (EDF) of loans in each S&P ratings category. KMV is a company that provides software to rating agencies such as S&P to determine their portfolio's probability of default. The table was constructed using year-end 2001 data (Lopez).

The ability of a borrower to repay an obligation changes from year to year. Recent studies have looked at the movement of a credit rating in one year to the rating in the next year. The score is capable of improving to a higher class, declining to a lesser class, or remaining the same. The movement of the score over time is indicative of the ability of the borrower to repay their loan obligations and the credit quality of the institution. This study will examine credit migration and analyze the potential impact on the borrowers' ability to repay.

The farm record data used for this study are expected to provide an accurate representation of the financial data received by a lender from a borrower. These data are obtained from the Kansas Farm Management Data Bank and are used to calculate the probability of default and the corresponding score for each farm during each year of the study. The probability of default for each loan in the sample is calculated from an equation derived from binary logit regression using actual loan origination data. The equation for calculating probability of default is as follows:

$$Ln(\text{probability of default}/[1-\text{probability of default}]) = \beta_0 + \beta_1(\text{Repayment Capacity Percentage}) + \beta_2(\text{Owner Equity Percentage}) + \beta_3(\text{Working Capital Percentage})$$

This equation was estimated by Featherstone, Roessler, and Barry using 157,853 loans from the Seventh Farm Credit District portfolio to determine the ability of financial performance ratios to predict the probability of default for customers of the Seventh Farm Credit District using loan origination data. Table 2 presents the results from the estimation. An increase in repayment capacity, owner's equity or the working capital percentage will reduce the probability of default. For more detail information see Featherstone, Roessler, and Barry.

This study will use this default model to examine Kansas farms and to separate the farms into credit classes for each year. Two groups of data will be used for this study. The first group consists of all farms that reported data. This will be used to examine credit quality of individual Kansas farms during each year as well as overall Kansas farm creditworthiness. The second group will consist of bivariate farm data. This will incorporate two subsequent years of data for each farm. This will be used to evaluate the migration of Kansas farms from one credit rating to another in subsequent years.

Methodology and Empirical Model

Farm data are used to calculate yearly financial ratios (Owner Equity Percentage, Working Capital Percentage, and CDRC) for each farm using the credit rating model of Featherstone, Roessler, and Barry. These ratios are used to find the probability of default for the individual farms. Each farm is assigned a credit rating based upon their probability of default for each model year. Data were obtained from the Kansas Farm Management data bank for the years of 1980 through 2003. A total of 51,382 observations were used for the 24 year period.

The farm record data were used to find profitability ratios to be used in a default analysis. The variables used include: farm identifier, year, gross farm income, economic depreciation, total expenses, net farm income, cash interest paid, income taxes, unpaid family and operator labor, non-farm wage, average current assets, average breeding livestock value, average non-current accounts receivable, average machinery and equipment, average buildings and improvement, average owned land value, average total assets, average current liabilities, average intermediate liabilities, average long-term liabilities, value of production, total acres, irrigated crop acres, non-irrigated crop acres, pasture acres, capital managed, and average net worth (Langemeier).

Farm data were used to provide information on the creditworthiness of the Kansas farms. An adjustment was used to convert Kansas Farm Management data on machinery and land into a consistent market value series (Dumler, Kastens, and Dhuyvetter). Some components of the loan decision-making process for a lender were not used. Lenders often utilize various tools to reduce a borrowers' credit risk such as attaching co-signers or collateral to the loan. The farm record data is used in order to provide a consistent understanding of the creditworthiness of each farm.

Two data sets are used for this study. One consists of all farm data from 1980-2003 and the other will contain bivariate farm data during this same time period. Using these two data sets allow for analysis of overall Kansas farm credit quality as well as the migration of credit ratings from one class to another. The all farms data set consists of all farms that reported data in each year. Due to the variability in the number of farms that reported data in each year, the number of farms analyzed varies for each year. The farms' probability of default and corresponding credit rating were estimated for each year that they provided data.

Not all farms report data during every year, and thus not all could be used for the bivariate study. Only farms that provided two consecutive years of data were used in the bivariate study. For instance, if a farm provided data for 1995, 1996, and 1997, then migration for 1995 to 1996 and migration from 1996 to 1997 could be studied. Therefore, the number of observations varied for each two year period.

Definition of Variables

Capital Debt Repayment Capacity (CDRC) – This variable is used to determine repayment capacity. It measures the ability of the borrower to repay principal and interest on term loans by comparing their cash flow to their debt requirements. The larger the ratio, the greater their ability to meet repayment needs.

CDRC is calculated by dividing repayment capacity by the sum of annual principal and interest payments on term loans, working capital deficiency (WCD) and capital asset replacement (CAR). Repayment Capacity is the result of net farm income from operations plus non-farm income plus term interest plus depreciation minus income taxes minus family living expenses minus non-farm expenses.

Annual principal payments on term loans is calculated by summing the result of intermediate liabilities divided by four and long term liabilities divided by twenty. This assumes an average length of four years for intermediate liabilities and an average length of twenty years for long-term liabilities.

Working Capital Deficiency is calculated by taking Working Capital Target minus Working Capital and dividing the difference by four. The Working Capital Target is adjusted gross income multiplied by fifteen percent. If the Working Capital Target is greater than Working Capital, then the difference is the Working Capital Deficiency. If the Working Capital Target is less than Working Capital, then there is no deficiency.

Capital Asset Replacement is the sum of Market Value of Machinery and Equipment multiplied by fifteen percent and the Market Value of Buildings and Improvements multiplied by five percent less Annual Principal Payments on Machinery, Equipment, Buildings and Improvements. Annual Principal Payments on Machinery, Equipment, Buildings and Improvements were calculated by dividing intermediate liabilities by four. This is used due to an estimated four year average lifespan for intermediate liabilities, which are used for these purchases. If the CAR result is greater than zero then that result is the required Capital Asset Replacement amount. If the result is less than zero, no Capital Asset Replacement requirement exists.

Owner Equity Percentage (OE) – This provides a measure of a borrower's solvency. This ratio is calculated by dividing net worth by total assets. In this analysis the OE will be restricted between 0 and 100%.

Working Capital Percentage (WC) – This ratio measures a firm's liquidity position as it relates to its revenue. It is calculated by dividing working capital by the adjusted gross income. Working capital is the result of current assets minus current liabilities. Adjusted gross income is gross receipts minus purchases for resale. This ratio is used to make sure the borrower has sufficient liquidity.

Adjusting for outlying data was also an issue in calculating the profitability ratios. The method employed by Featherstone, Roessler, and Barry was used. All outlying values were adjusted to be within three times the standard deviation above and below the mean of the ratio (Table 2).

Empirical Results and Analysis

Three financial ratios determine the probability of default for each Kansas farm. Working capital percentage is a measure of liquidity, owner equity percentage is a measure of solvency, and the CDRC is a measure of repayment capacity. These ratios provide a summary of a borrowers' ability to repay debt obligations. The probability of default is calculated and applied to a credit rating model to separate borrowers into classes based upon the risk level associated with lending money to them. Research on all farms data and bivariate data was conducted for this study using 24 years of farm record data.

All Farms Data

A data set containing all farms was used to provide insight into the credit quality of Kansas farms. The overall credit quality of the sector is of much interest to a lender. This study found the probability that each farm in the sample would default on its' debt and assigned a credit rating to the farm based upon that probability. These ratings could then be analyzed to determine creditworthiness of each farm as well as overall credit-worthiness of Kansas farms in each year and compare them over time.

The probability of default and the corresponding credit rating were calculated for 51,382 Kansas farms over a 24-year period. A summary of the financial indicators used in the all farms data study is reported in Table 4. The number of farms studied in each year varied from 1,845 in 2003 to 2,488 in 1980. The mean probability of default of 3.0% results in a B average credit rating for Kansas farms in this sample which compares with a BB- found by Featherstone, Roessler, and Barry for approved loans.

Figure 1 examines the average financial ratios for each year of the all farms data set. The average value of owner equity percentage has the smallest amount of variation and remained relatively constant throughout the sample period. Average owner equity values ranged from 59% to 70% for each year. The CDRC has the most variability of the three ratios. Average values of this variable for each year range from 14% to 102%. The average working capital percentage remained within -11% and 18% on average for the sample period.

Table 5 reports the probability of default and its' standard deviation for each year of the sample. The average standard deviation for the sample period was 2.88. The highest average probability of default observed was 3.75%, which occurred in 1985 and indicates a B credit rating on average. The lowest was 2.49% in 1997 which indicates an average credit rating of B+.

For the all farms data set, a credit rating for all farms was estimated for each year of the study using the probability of default. The probability of default for Kansas farms rose sharply in the mid-1980s (Figure 2). The 1990s experienced a decreased likelihood of default with a sample low of 2.49% in 1997. The early 2000s resulted in lower credit ratings than the 1990s. Dry growing conditions and rising energy prices resulted in a decline in net farm income (Albright). As a consequence, the average probability of default for Kansas farms has increased over the past several years. However, the probability of default has not increased to the highs observed in the 1980s.

During the mid-1980s an increased number of farms are in lower categories such as CCC-, CC, C, and D as a result of this (Table 6). In the 1990s, over 92% of the farms studied were rated higher than a B-.

Table 7 illustrates the distribution of credit ratings for the entire period. The results indicate a high percentage of farms in six rating categories; BB+, BB, BB-, B+ B, and B-. Between 78 and 90% of the observations were located in this range in each year of the sample period. The highest rated farm was a BBB+ rating and the lowest farm was in the D category.

To achieve high ratings such as BBB+, BBB, and BBB- a farm must have excellent liquidity, solvency, and repayment capacity. Table 8 summarizes the average financial ratios observed for each rating category. From these results, the differences between high and low rated farms become quite distinctive. Ratings are listed from most desirable to least desirable in the table. A steady decrease in each financial ratio can be observed. As these financial ratios decrease, the probability of default increases and thus the farms' credit rating drops.

Bivariate Data

A bivariate data set was used to determine the probability of a farm remaining in the same ratings category, upgrading to a higher category, or downgrading to a lower category. As in the all farms data set, probability of default was found and a corresponding credit rating was assigned. Ratings in consecutive years were analyzed to determine the probability of a ratings change. This information is meant to help lenders understand the credit capabilities of Kansas farms and how the probability of non-repayment changes during the term of the loan.

A total of 42,154 Kansas farms reported data in subsequent years and were included in this data set. This is less than the all farms data set due to some farms not reporting data in all years of the sample. As in the all farms data set, the mean probability of default for the bivariate data also indicates an average farm rating of B. The credit rating for the bivariate data is lower than the all farms data. The other ratios were similar to the all farms means (Haverkamp).

Credit ratings were found for all farms with two consecutive years of data so that the transition of the rating from one year to the next could be studied. The majority of farms were located between the BB+ and B- categories consistent with the all farms data set. The highest rated farm found was a BBB+ rating, and the lowest rated farm was in the D category.

Each farm’s credit score was compared to their score in the following year. Frequencies of the farm to retain its previous credit rating, improve in credit quality, or decline in quality were calculated. On average, the sample was found to retain its initial credit rating 57.67% of the time (Table 9). It was also found that farms would migrate to the next immediate class (up or down) 34.12% of the time and would change by more than one ratings category 8.25% of the time. There is a high probability that the farms’ rating in one year will not change by a large amount in the following year. This is consistent with previous studies in that ratings remain unchanged most frequently, with the probability of moving to distant classes declining as one gets further from the original rating. This also suggests that a credit score given today is a good indicator of the ability of a farm to repay its’ financial obligations in the short term.

A summary of the one-year migration patterns of Kansas farms is given in Table 10. The left column displays the initial rating given to the farm in the first of the two years being observed. The top row of the matrix represents the credit score in the second of the two years being observed. Percentage terms inside the matrix represent the percent of farms that remained in the same rating category or moved to another category and should add to 100% horizontally. Farms with an initial rating of BB+ remain a BB+ in year two 63.66% of the time. Farms with this rating decrease to a BB rating 22.23% of the time and increased to a BBB- rating 12.29% of the time.

Farms with the highest initial ratings, BBB+, BBB and BBB-, are more likely to experience a downgrade in credit quality than an upgrade (Table 10). Farms with the lowest initial ratings tend to upgrade in creditworthiness rather than downgrade. For example, a farm with an initial rating of C has a 14.08% chance of remaining a C in the next year, a 16.90% chance of declining to a D rating, and a 69% chance of upgrading to at least a CC rating. One must be careful when examining this, as further downgrade may result in a farm exiting the sample due to bankruptcy.

In addition to the one-year transition rates, the transition rates over a two-year and five-year period were also analyzed. These transition rates were found using the one-year rates and matrix algebra. The results for the two and five years can be seen in Tables 11 and 12 respectively. The probability of a farm retaining the same credit rating over a two-year period is less than the probability of retaining the same rating over a one-year period. Using the BB+ rating again, Table 11 shows a 47.00% chance of remaining in the same class, a 16.26% chance of upgrading to a BBB-, and a 29.10% chance of downgrading to a BB. Continuing to use BB+ as an example, Table 12 shows a 30.87% chance of remaining in the same class, a 16.62% chance of upgrading to a BBB-, and a 30.25% chance of downgrading to a BB.

Table 13 shows the percentage of farms that upgrade, downgrade, or stay in the same class over a two-year period. Farms were predicted to move to the next immediate class, up or down, 36.52% of the time, and to a more distant class 35.05% of the time over the average two-year period. Table 14 displays the percentage of farms that upgrade, downgrade, or stay in the same class over a five-year period. Farms were predicted to migrate to the next immediate class (up or down) 29.22% of the time , and migrated to a more distant class 54.03% of the time over the average five-year period.

The results of studying longer periods suggest a greater degree of movement than in the short term. There is an increased possibility of farms moving to a more distant ratings category as time passes. This implies that the length of a loan agreement must be taken into consideration when determining the price of a loan. Everything else equal, long-term loans should be priced higher, as more risk is assumed due to the effects of time. The results also imply that there is a greater likelihood of a farm improving in credit quality than declining over time. As the farms become less likely to retain their initial rating, they become more likely to upgrade than downgrade (Table 14). The probability of a farm retaining the same credit rating over a five-year period is less than the probability of retaining the same rating over a two-year period.

The distributions of credit rating observations were similar to that of the all farms data set in that a large concentration of farms rated between a BBB- and a CCC+. A regression using the number of observations was analyzed to look for correlation between the credit ratings observed in the all farms and bivariate data sets. The correlation was 0.9993, which indicates that the two data sets are highly correlated.

The average probability of default in the bivariate data set varied from 2.49% in 1997 to 3.75% in 1985. Table 15 displays the changes in average probability of default from one year to the next. The average change from one year to the next is 0.11%.

Comparative Results

Additional research was conducted to relate size of farm and type of operation to the credit ratings that were found to examine patterns in the relationship between these variables and the probability of default. Total acres operated and the values of production were used as measures of farm size. To examine any pattern, the average of each variable was found for each credit rating (i.e. BBB+, BBB, BBB-, etc.). The results for the total acres operated and value of production variables are shown in Figures 3 and 4 respectively.

Total acres operated do not have a large impact on the probability of default as Figure 3 has a slight bell-shape. Farms operating a large number of acres tend to be rated in one of the middle classes. From the analysis of the value of production data (Figure 4), a more obvious bell-shape can be seen. This indicates that farms with the highest values of production tend to be rated in the middle categories.

Farms were separated into classes based upon their average value of production in order to analyze the average financial ratios for each group of farms (Table 17). It can be seen that the average probability of default increases and then decreases as the value of production rises. The working capital percentage appears to explain this, as it decreases and then increases. As the value of production rises, values of owner equity percentage show a steady decrease, and values of CDRC show a steady increase.

Farm type and credit ratings was examined to determine if a type of farm tends to be rated higher than others. First, three types, non-irrigated crops, irrigated crops, and mixed livestock, were studies Table 18. Non-irrigated farms have a slightly lower probability of default than irrigated farms and mixed livestock. The probability of defaults given for each group is equivalent to a B credit rating.

The results for all types of farms can be seen in Table 19. Excluding types of farms with under 200 observations, Crop, Beef Backgrounding and Finishing farms have the lowest probability of default and Crop, Beef Backgrounding farms have the highest probability of default with a difference in probability from highest to lowest of approximately 1.15%. The average values for the financial ratios used to find the farms' probability of default are also shown in the table.

A regression was conducted to examine the statistical significance between probability of default and farm type (Table 20). The regression use Crop, Non-Irrigated as the base farm type. The other farm types' coefficients show their relation to the base farm type.

The probability of default for each region in Kansas was also calculated. The state was separated into the six farm management association regions, Central, Northwest, Northeast, Southwest, Southeast, and South Central. Table 21 displays the average probability of default for each region during each year of the study as well as the overall average probability of default and corresponding credit score. The results indicate a slightly lower probability of default for farms in southwest Kansas. The highest probability of default was for farms located in central Kansas. However, all regions are within 0.50% probability and the region with the lowest probability in each year changes frequently. Thus, there is not expected to be a large difference in credit quality between regions.

Using regression analysis it was determined that the region in which a farm is located has a statistically different probability of default (Table 22). The southwest region was used as the base region, thus, the intercept is the average probability of default for a farm in the southwest region. The coefficient values for the other regions are the difference between their own average probability of default and the average probability of default for the southwest region. For example, the central region has an average probability of default that is 0.495% higher than the average probability of default in the southwest region.

Conclusion and Recommendations

A credit quality model estimated by Featherstone, Roessler, and Barry using binary logit regression was used to find the probability of default for each Kansas farm. Using this probability model, credit ratings were assigned to each farm. The all farms data set consisted of over 52,000 observations from 1980 through 2003. From 1980 to 2003 these farms had an average credit rating equivalent to a B, which represents a vulnerable to adequate borrower. Borrowers of this type can currently meet all financial obligations but are dependent upon current conditions to meet future obligations. Farms typically must work with a greater degree of risk than a typical business. Due to these risks and uncertainties this rating appears valid.

A bivariate data set consisted of over 42,000 observations. It examined the movement of a farms credit rating in consecutive periods, as well as over two-year and five-year periods. Farms in consecutive periods showed the largest tendency to remain in the same ratings category, with smaller tendencies to increase or decrease in credit quality. When movement did take place, there was a high likelihood of only a one category movement. Farms were less likely to retain their initial rating in the two and five-year studies and had an increased likelihood of moving to a more distant ratings class. The increased risks that come with longer time frames is responsible for this. These results were similar to previous research using farm-level data.

Research relating the size of a farm to its' credit rating uncovers a bell-shape relationship. Both value of production and total acres operated have the highest average values for the middle credit ratings (BB+, BB, BB-, B+, B, B-) and lower values on average for the highest (BBB+, BBB, BBB-) and lowest (CCC+, CCC, CCC-, CC, C, D) credit ratings. This indicated that the largest farms are typically rated in a middle credit category.

Additional analysis compared the probability of default of different types of farms as well as the probability of default for farms in different regions of the state. Findings indicate that the probability of default differs based upon the type of farm being analyzed. This result demonstrates a need to examine the riskiness of the farm business when making loan considerations. Results of studying different regions within the state showed some disparity in their probabilities of default. While all regions had probabilities within a range of 0.50%, differences were statistically significant.

References

Albright, M. "Kansas Agriculture: An Economic Overview." Kansas State University Risk and Profit Conference, Manhattan, KS (2001). *http://www.agecon.ksu.edu/kfma/New%20Web/Reports/KS%20Farm%20Economy%20Summary%20-%202000.PDF*

Barry, P.J. "Modern Capital Management by Financial Institutions: Implications for Agricultural Lenders." *Agricultural Finance Review, 61* (2001): 103-122.

Barry, P.J., C.L. Escalante, and P.N. Ellinger. "Credit Risk Migration Analysis of Farm Business." *Agricultural Finance Review, 62* (2002): 1-11.

Basel Committee on Banking Supervision, "Overview of The New Basel Capital Accord." Consultative Document (2001): 1-37. *www.bis.org/publ/bcbsca02.pdf.*

Crouhy, M., D. Galai, R. Mark. *Risk Management.* McGraw-Hill: New York, 2001.

Dumler, T., T. Kastens, K. Dhuyvetter. "Converting KMAR Machinery Investment Data to a Market Value Series." Staff Paper, Kansas State University, 2001.

Featherstone, A.M., L.M. Roessler, and P.J. Barry. "Determining the Probability of Default and Risk Rating Class for Loans in the Seventh Farm Credit District Portfolio." *Review of Agricultural Economics*, Forthcoming 2006.

Goodwin, B.K. and A.K. Mishra. "An Analysis of Risk Premia in US Farm-Level Interest Rates." *Economic Research Service, USDA* (2000).

Jafry, Y. and T. Schuermann. "Measurement and Estimation of Credit Migration Matrices." Working Paper, University of Pennsylvania, 2003: 1-55.

Langemeier, M.R. "Kansas Farm Management SAS Data Bank Documentation." Staff Documentation, Kansas State University, 2003.

Lopez, J.A. "The Empirical Relationship Between Average Asset Correlation, Firm Probability of Default and Asset Size." Working Paper, Federal Reserve Bank of San Francisco, San Francisco CA, 2002. *http://www.frbsf.org/publications/economics/papers/2002/index.html*

McNulty, C. and R. Levin. "Modeling Credit Migration." *RISK* (2000).

Roessler, L.M. "Determining the Probability of Default of Loans in the Seventh Farm Credit District." Thesis for Master of Agribusiness, Kansas State University, 2003.

Rowland, J.B. "Confidently Evaluate Small Businesses with Credit Scoring." *Business Credit 105, 3* (2003): 26-31.

Splett, N.S., P.J. Barry, B.L. Dixon, and P.N. Ellinger. "A Joint Experience and Statistical Approach to Credit Scoring." *Agricultural Finance Review, 54* (1994): 39-54.

Table 1. The Mapping of S&P Credit Ratings to KMV EDF Values	
S & P Rating	KMV EDF Value (%)
AAA	(0.00, 0.02]
AA+	(0.02, 0.03]
AA	(0.03, 0.04]
AA-	(0.04, 0.05]
A+	(0.05, 0.07]
A	(0.07, 0.09]
A-	(0.09, 0.14]
BBB+	(0.14, 0.21]
BBB	(0.21, 0.31]
BBB-	(0.31, 0.52]
BB+	(0.52, 0.86]
BB	(0.86, 1.43]
BB-	(1.43, 2.03]
B+	(2.03, 2.88]
B	(2.88, 4.09]
B-	(4.09, 6.94]
CCC+	(6.94, 11.78]
CCC	(11.78, 14.00]
CCC-	(14.00, 16.70]
CC	(16.70, 17.00]
C	(17.00, 18.25]
D	(18.25, 20.00]

Source: Lopez 2001

Table 2. Logistic Regression Results of Probability of Default for All Loans in the Portfolio

Variable	Estimate	Standard Error	Chi-Square	Pr > Chi-Square
Intercept	-2.3643	0.700	1139.3093	<.0001
CDRC	-0.00135	0.000329	16.7658	<.0001
OE	-0.0217	0.00108	408.8323	<.0001
WC	-0.00399	0.000420	90.0451	<.0001
Likelihood Ratio (H_0:B_i=0)			732.7583	<.0001
-2 Log L	28,132.288			
Number of Observations	157,853			
Number Defaulted	2,892			
Percent Defaulted	1.83%			
Volume Defaulted	$477,427,989.00			
Percent Volume Defaulted	2.03%			

Goodness of Fit Statistics

R^2	Max Rescaled R^2	Correct	Sensitivity	Specificity
0.0046	0.0277	65.4%	55.6%	65.6%

Source: Featherstone, Roessler, and Barry

Table 3. Adjustments to Financial Ratios

Ratio	Max	Min
CDRC	379.86%	-70.03%
Owner Equity	100%	0%
Working Capital	305.38%	-222.62%

Table 4. Summary of Farms' Financial Indicators for All Farms Data 1980-2003

	Mean	**Standard Deviation**
Number of Farms	2138	143.72
Probability of Default	3.03%	2.87%
Working Capital %	5.07%	83.91%
Owner Equity %	64.13%	27.68%
CDRC	52.86%	110.17%

Table 5: Probability and Standard Deviation by Year

Year	Average Credit Rating	Mean Probability of Default	Standard Deviation	Number of Farms
1980	B+	2.58%	2.28	2,488
1981	B	3.02%	2.81	2,483
1982	B	3.18%	3.05	2,332
1983	B	3.34%	3.31	2,099
1984	B	3.49%	3.44	2,062
1985	B	3.75%	3.79	2,025
1986	B	3.74%	3.86	2,009
1987	B	3.32%	3.39	2,029
1988	B	2.93%	3.02	2,136
1989	B	2.94%	2.93	2,142
1990	B+	2.79%	2.63	2,123
1991	B	3.08%	2.90	2,110
1992	B+	2.81%	2.59	2,147
1993	B+	2.87%	2.62	2,164
1994	B	2.97%	2.70	2,199
1995	B	3.08%	2.95	2,197
1996	B+	2.71%	2.57	2,198
1997	B+	2.49%	2.21	2,190
1998	B+	2.75%	2.51	2,179
1999	B+	2.77%	2.48	2,128
2000	B+	2.85%	2.53	2,118
2001	B	3.02%	2.74	1,996
2002	B	3.23%	3.01	1,983
2003	B	3.06%	2.86	1,845

Table 6. Observations of Credit Ratings in Each Year

	Credit Rating														
Year	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	CC	C	D	TOTAL
1980	2	17	109	303	467	408	428	334	300	93	15	7	1	3	1	2488
1981	3	11	114	249	414	415	382	338	335	170	28	12	1	4	7	2483
1982	3	13	100	239	412	328	365	314	309	190	30	17	0	3	9	2332
1983	4	11	86	227	351	308	317	253	297	166	43	18	2	4	12	2099
1984	1	7	82	211	342	287	280	274	313	187	35	16	1	10	16	2062
1985	2	6	104	195	313	274	265	251	301	213	38	24	2	9	28	2025
1986	2	18	93	209	305	266	277	245	272	208	46	29	2	10	27	2009
1987	6	12	111	254	334	283	277	230	244	204	34	23	2	7	8	2029
1988	7	16	104	306	393	318	306	240	230	166	22	17	0	7	4	2136
1989	5	18	110	306	393	318	306	240	230	166	22	17	0	7	4	2142
1990	3	14	119	270	376	314	337	263	259	141	13	8	0	3	3	2123
1991	2	11	120	227	336	298	324	296	279	180	18	8	1	4	6	2110
1992	5	12	109	264	362	331	347	293	255	143	11	7	1	3	4	2147
1993	2	20	96	253	367	309	360	315	272	139	16	10	0	1	4	2164
1994	3	17	90	236	387	300	390	304	287	155	15	10	0	3	2	2199
1995	2	7	95	253	368	322	354	292	293	170	17	7	2	5	10	2197
1996	2	10	110	294	437	321	338	257	269	139	9	3	1	2	6	2198
1997	1	7	113	294	444	347	350	289	222	110	9	2	0	0	2	2190
1998	1	7	111	234	429	316	362	310	262	126	10	2	0	4	5	2179
1999	0	2	101	249	415	316	344	257	286	126	25	3	0	2	2	2128
2000	1	7	94	242	420	307	324	260	290	154	12	5	0	1	1	2118
2001	2	6	83	211	398	292	269	240	298	171	13	8	1	3	1	1996
2002	1	11	90	184	390	261	275	246	306	178	20	14	0	1	6	1983
2003	1	16	80	220	348	273	262	186	249	185	15	5	0	2	3	1845
% of TOTAL	0.12%	0.54%	4.72%	11.54%	17.91%	14.62%	15.26%	12.70%	12.96%	7.55%	1.00%	0.53%	0.03%	0.19%	0.33%	

Table 7. Observations of Credit Ratings for All Farms Data 1980-2003

Class	Number of Farms	Percent of Farms
BBB+	61	0.12%
BBB	276	0.54%
BBB-	2424	4.72%
BB+	5931	11.54%
BB	9201	17.91%
BB-	7512	14.62%
B+	7839	15.26%
B	6527	12.70%
B-	6658	12.96%
CCC+	3880	7.55%
CCC	516	1.00%
CCC-	272	0.53%
CC	17	0.03%
C	98	0.19%
D	171	0.33%
Total	51,382	100.00%

Table 8. Average Financial Ratios for Each Rating 1980-2003

Rating	Working Capital %	Owner Equity %	CDRC
BBB+	300.02	97.85	369.51
BBB	274.07	92.59	220.57
BBB-	205.92	98.38	125.07
BB+	85.37	94.99	154.31
BB	33.77	86.63	75.48
BB-	4.63	73.8	48.77
B+	-14.28	62.41	31.54
B	-27.87	48.67	16.37
B-	-57.44	35.12	4.45
CCC+	-81.05	13.74	-2.35
CCC	-138.59	6.27	-14.96
CCC-	-175.12	3.79	-17.91
CC	-153.94	3.19	-21.25
C	-209.07	1.2	-12.39
D	-221.31	0.2	-36.72

Table 9. One Year Movement of Credit Ratings

Movement	Number	Percent of Total
Total Upgrades	8,817	20.92%
Total Downgrades	9,026	21.41%
Total Same	24,311	57.67%
Total	42,154	100%

Table 10. Average One-Year Transition Rates for Kansas Farms 1980-2002

Initial	Credit Rating in Following Year (%)														
Rating	**BBB+**	**BBB**	**BBB-**	**BB+**	**BB**	**BB-**	**B+**	**B**	**B-**	**CCC+**	**CCC**	**CCC-**	**CC**	**C**	**D**	**Sum**
BBB+	27.50%	22.50%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BBB	4.90%	38.73%	51.47%	3.43%	1.47%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BBB-	1.28%	6.50%	64.46%	25.09%	2.36%	0.26%	0.00%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BB+	0.00%	0.18%	12.52%	63.49%	22.17%	1.21%	0.22%	0.06%	0.12%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BB	0.00%	0.05%	0.67%	15.91%	65.29%	15.36%	2.08%	0.45%	0.13%	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BB-	0.00%	0.00%	0.05%	0.98%	20.64%	53.66%	21.09%	2.86%	0.63%	0.08%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
B+	0.00%	0.00%	0.03%	0.17%	2.51%	20.96%	53.19%	19.33%	3.45%	0.35%	0.02%	0.00%	0.00%	0.00%	0.00%	**100%**
B	0.00%	0.00%	0.00%	0.07%	0.52%	2.50%	22.80%	50.12%	22.31%	1.52%	0.13%	0.00%	0.00%	0.00%	0.00%	**100%**
B-	0.00%	0.00%	0.00%	0.02%	0.15%	0.58%	3.14%	19.28%	59.47%	16.38%	0.52%	0.36%	0.02%	0.02%	0.06%	**100%**
CCC+	0.00%	0.00%	0.00%	0.10%	0.14%	0.31%	1.04%	2.64%	22.73%	62.49%	7.01%	2.12%	0.07%	0.59%	0.76%	**100%**
CCC	0.00%	0.00%	0.00%	0.00%	0.00%	0.28%	0.55%	0.55%	2.21%	44.20%	25.97%	13.26%	1.10%	3.31%	8.56%	**100%**
CCC-	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.58%	0.58%	1.16%	28.90%	20.23%	23.12%	2.31%	10.40%	12.72%	**100%**
CC	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.33%	16.67%	8.33%	16.67%	0.00%	16.67%	33.33%	**100%**
C	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.41%	21.13%	19.72%	23.94%	2.82%	14.08%	16.90%	**100%**
D	0.00%	0.00%	0.00%	0.00%	0.00%	1.12%	1.12%	1.12%	1.12%	12.36%	19.10%	14.61%	2.25%	17.98%	29.21%	**100%**

Table 11. Average Two-Year Transition Rates for Kansas Farms 1980-2002

Initial	Credit Rating Two Years Later														
Rating	**BBB+**	**BBB**	**BBB-**	**BB+**	**BB**	**BB-**	**B+**	**B**	**B-**	**CCC+**	**CCC**	**CCC-**	**CC**	**C**	**D**	**Sum**
BBB+	9.31%	18.15%	57.56%	13.32%	1.51%	0.13%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BBB	3.90%	19.46%	56.00%	16.65%	3.50%	0.40%	0.04%	0.03%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BBB-	1.50%	7.04%	48.69%	32.70%	8.77%	0.97%	0.17%	0.09%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BB+	0.17%	1.01%	16.26%	47.00%	29.10%	4.90%	0.99%	0.27%	0.20%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BB	0.01%	0.12%	2.90%	20.81%	49.40%	18.91%	5.85%	1.40%	0.46%	0.12%	0.01%	0.00%	0.00%	0.00%	0.00%	**100%**
BB-	0.00%	0.02%	0.33%	4.48%	25.32%	36.47%	23.64%	7.26%	2.12%	0.33%	0.02%	0.00%	0.00%	0.00%	0.00%	**100%**
B+	0.00%	0.00%	0.08%	0.83%	7.44%	23.29%	37.28%	21.26%	8.41%	1.29%	0.08%	0.02%	0.00%	0.00%	0.01%	**100%**
B	0.00%	0.00%	0.02%	0.23%	1.74%	7.59%	24.81%	33.94%	25.60%	5.51%	0.33%	0.13%	0.01%	0.02%	0.04%	**100%**
B-	0.00%	0.00%	0.00%	0.09%	0.51%	1.87%	8.23%	22.19%	43.52%	20.63%	1.71%	0.73%	0.04%	0.18%	0.28%	**100%**
CCC+	0.00%	0.00%	0.01%	0.16%	0.34%	0.83%	2.65%	7.63%	28.55%	46.76%	7.02%	3.09%	0.21%	1.06%	1.70%	**100%**
CCC	0.00%	0.00%	0.00%	0.05%	0.14%	0.60%	1.32%	2.30%	12.47%	45.24%	14.92%	9.68%	0.91%	4.69%	7.67%	**100%**
CCC-	0.00%	0.00%	0.00%	0.03%	0.06%	0.43%	1.17%	1.78%	8.61%	38.04%	16.64%	13.38%	1.36%	7.38%	11.14%	**100%**
CC	0.00%	0.00%	0.00%	0.02%	0.04%	0.50%	0.95%	2.56%	9.73%	27.92%	16.40%	14.20%	1.71%	10.45%	15.52%	**100%**
C	0.00%	0.00%	0.00%	0.02%	0.03%	0.32%	0.70%	1.27%	6.98%	34.60%	17.69%	14.91%	1.56%	8.76%	13.15%	**100%**
D	0.00%	0.00%	0.00%	0.03%	0.28%	1.29%	1.77%	1.87%	5.13%	28.38%	18.10%	15.12%	1.72%	10.38%	15.91%	**100%**

Table 12: Average Five-Year Transition Rates for Kansas Farms 1980-2003

Initial Rating	Credit Rating Five Years Later															
	BBB+	**BBB**	**BBB-**	**BB+**	**BB**	**BB-**	**B+**	**B**	**B-**	**CCC+**	**CCC**	**CCC-**	**CC**	**C**	**D**	**Sum**
BBB+	1.72%	7.23%	39.35%	32.33%	14.98%	3.04%	0.85%	0.29%	0.15%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BBB	1.52%	6.65%	37.21%	32.59%	16.47%	3.72%	1.16%	0.40%	0.20%	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BBB-	1.03%	4.65%	29.81%	33.68%	21.61%	5.88%	2.10%	0.73%	0.36%	0.09%	0.00%	0.00%	0.00%	0.00%	0.00%	**100%**
BB+	0.42%	2.00%	16.62%	30.87%	30.25%	11.40%	5.16%	1.93%	0.94%	0.26%	0.02%	0.00%	0.00%	0.00%	0.00%	**100%**
BB	0.13%	0.68%	7.41%	21.46%	32.66%	18.11%	11.11%	5.00%	2.57%	0.72%	0.07%	0.02%	0.00%	0.00%	0.01%	**100%**
BB-	0.03%	0.19%	2.56%	10.63%	24.05%	21.76%	19.54%	11.53%	7.14%	2.20%	0.20%	0.08%	0.00%	0.02%	0.04%	**100%**
B+	0.01%	0.06%	0.87%	4.61%	14.24%	18.97%	23.10%	17.77%	14.03%	5.36%	0.54%	0.24%	0.02%	0.07%	0.12%	**100%**
B	0.00%	0.02%	0.29%	1.81%	7.00%	12.62%	20.47%	21.21%	22.55%	11.42%	1.32%	0.62%	0.04%	0.21%	0.34%	**100%**
B-	0.00%	0.00%	0.11%	0.73%	3.06%	6.77%	14.17%	19.78%	28.79%	20.56%	2.91%	1.47%	0.12%	0.59%	0.92%	**100%**
CCC+	0.00%	0.00%	0.09%	0.48%	1.64%	3.63%	8.60%	14.72%	28.50%	30.08%	5.43%	3.03%	0.26%	1.37%	2.15%	**100%**
CCC	0.00%	0.00%	0.04%	0.30%	1.02%	2.31%	5.53%	10.36%	24.51%	35.24%	8.31%	5.20%	0.49%	2.65%	4.12%	**100%**
CCC-	0.00%	0.00%	0.03%	0.24%	0.85%	2.02%	4.79%	8.99%	22.52%	36.20%	9.49%	6.16%	0.59%	3.25%	5.03%	**100%**
CC	0.00%	0.00%	0.03%	0.22%	0.83%	2.04%	4.74%	8.57%	21.12%	35.70%	10.06%	6.79%	0.67%	2.67%	5.67%	**100%**
C	0.00%	0.00%	0.02%	0.21%	0.72%	1.78%	4.28%	8.25%	21.60%	36.84%	10.09%	6.67%	0.65%	3.56%	5.51%	**100%**
D	0.00%	0.00%	0.05%	0.35%	1.17%	2.30%	4.59%	7.82%	20.06%	36.05%	10.33%	7.01%	0.69%	3.80%	5.88%	**100%**

Table 13. Two-Year Movement in Credit Ratings

Movement	Percent of Total
Upgrade	39.30%
Downgrade	32.37%
Same Class	28.33%
Total	100.00%

Table 14. Five-Year Movement in Credit Ratings

Movement	Percent
Upgrade	48.02%
Downgrade	35.28%
Same Class	16.70%
Total	100.00%

Table 16: Change in Average Probability of Default for Bivariate Data

Year	Change in Average Probability of Default	Number of Observations
1980-1981	0.15%	2018
1981-1982	0.15%	1912
1982-1983	0.06%	1751
1983-1984	0.09%	1698
1984-1985	0.10%	1690
1985-1986	-0.04%	1683
1986-1987	-0.25%	1730
1987-1988	-0.23%	1800
1988-1989	0.06%	1793
1989-1990	-0.04%	1795
1990-1991	0.19%	1831
1991-1992	-0.15%	1831
1992-1993	0.06%	1880
1993-1994	0.07%	1925
1994-1995	0.03%	1943
1995-1996	-0.24%	1935
1996-1997	-0.09%	1960
1997-1998	0.17%	1917
1998-1999	0.02%	1923
1999-2000	0.03%	1886
2000-2001	0.09%	1827
2001-2002	0.10%	1774
2002-2003	-0.13%	1651

Table 17. Relating Value of Production to Financial Ratios

Value of Production	Average Probability of Default	Average Working Capital %	Average Owner Equity %	Average CDRC	Average Number of Farms
< $25,000	3.08	40.36	74.70	-3.29	68.63
$25,000 to $50,000	3.16	19.96	69.88	5.92	201.25
$50,000 to $75,000	3.18	6.08	67.05	16.26	246.13
$75,000 to $100,000	3.14	5.13	64.77	32.95	249.83
$100,000 to $125,000	3.14	-3.56	63.56	45.88	219.63
$125,000 to $150,000	3.09	-1.11	62.59	70.90	191.67
$150,000 to $175,000	2.99	0.72	62.75	62.74	159.29
$175,000 to $200,000	2.99	2.33	62.03	71.20	127.63
> $200,000	2.80	6.17	61.58	87.50	670.67

Table 18. Probability of Default for Different Farm Types

Farm Type	Probability of Default	# of Observations
Crop, Non-Irrigated	2.92	27,032
Crop, Irrigated	2.94	3,645
Mixed Livestock	3.17	20,618

Table19. Summary of Average Credit Ratings for Different Types of Farms

TYPE OF FARM	PROBABILITY OF DEFAULT %	CREDIT RATING	Working Capital %	Owner Equity %	CDRC	# of OBSERVATIONS
Crop, Beef Backgrounding and Finishing	2.39	B+	48.89	61.04	72.16	701
Crop, Beef	2.76	B+	-0.41	67.03	84.24	2234
Crop, Dairy	2.88	B+	-30.44	70.07	54.49	845
Crop, Feeder Pig Finishing	2.90	B	35.20	58.99	68.61	239
Crop, Non-Irrigated	2.92	B	15.05	60.33	57.99	27032
Crop, Irrigated	2.94	B	16.99	59.66	77.73	3645
Beef Backgrounding and Finishing	3.00	B	53.63	50.91	70.40	336
Crop, Cow Herd	3.10	B	-27.00	70.73	35.38	4218
Cow Herd	3.11	B	-51.45	74.98	36.42	575
Farrow-to-Finish Swine	3.12	B	-1.61	60.48	64.93	492
General Farm	3.15	B	-15.32	65.84	49.72	3154
Cow Herd, Ranch Stock	3.19	B	-20.23	73.86	51.85	454
Crop, Farrow-to-Finish Swine	3.22	B	10.48	61.42	67.03	938
Dairy	3.22	B	-55.54	67.26	39.23	2297
Beef Backgrounding	3.52	B	27.93	52.31	49.67	834
Crop, Beef Backgrounding	3.54	B	19.71	53.82	39.09	2252

Table 20. Regression Results for Farm Type

Variable	Estimate	Standard Error	t value	P-value
Intercept	2.95808	0.16800	17.5900	< .0001
Beef Backgrounding	0.56442	0.24248	2.3200	2.060E-02
Beef Backgrounding and Finishing	0.05442	0.24248	0.2200	8.227E-01
Farrow to Finish Swine	0.17817	0.24248	0.7300	4.635E-01
Cow Herd, Stock Ranch	0.15442	0.24248	0.6400	5.251E-01
Crop, Irrigated	0.02401	0.24248	0.1000	9.213E-01
Cow Herd	0.20901	0.20859	0.8600	3.898E-01
Crop, Beef Backgrounding	0.49567	0.24248	2.0400	4.190E-02
Crop, Beef	-0.23433	0.24248	-0.9700	3.350E-01
Crop, Beef Backgrounding & Finishing	-0.61099	0.24248	-2.5200	1.220E-02
Crop, Cow Herd	0.15359	0.24248	0.6300	5.273E-01
Crop Dairy	-0.13933	0.24248	-0.5700	5.664E-01
Crop Farrow to Finish Swine	0.22584	0.24550	0.9200	3.582E-01
Crop, Feeder Pig Finishing	-0.12156	0.24550	-0.5000	6.208E-01
Dairy	0.24942	0.24248	1.0300	3.049E-01
General	0.07942	0.24248	0.3300	7.437E-01

Goodness of Fit Statistics		ANOVA	
R^2	Adjusted R^2	F	Significance F
0.2167	0.1847	7.227	4.301 E -14

Table 21. Probability of Default for Kansas Regions

Year	Central	Northeast	Northwest	South Central	Southeast	Southwest
1980	2.88	2.52	2.57	2.39	2.76	2.30
1981	3.35	2.62	3.34	2.86	3.20	2.85
1982	3.17	3.14	3.32	3.11	3.37	2.83
1983	3.63	3.51	3.14	3.25	3.54	2.71
1984	3.85	3.84	3.48	3.30	3.68	2.69
1985	4.08	4.05	3.75	3.64	3.96	2.89
1986	3.81	3.76	4.44	3.64	4.00	3.17
1987	3.15	3.37	3.49	3.60	3.38	2.88
1988	2.88	3.07	3.06	3.13	2.89	2.61
1989	2.99	2.87	3.00	3.29	2.88	2.65
1990	2.76	2.75	3.07	3.15	2.77	2.31
1991	3.33	2.91	3.05	3.36	3.13	2.64
1992	3.16	2.46	3.04	3.11	2.69	2.62
1993	3.25	2.59	2.91	3.18	2.87	2.45
1994	3.33	2.72	2.91	3.37	2.88	2.61
1995	3.55	2.89	3.04	3.28	3.00	2.71
1996	3.07	2.49	2.68	2.88	2.61	2.60
1997	2.66	2.33	2.78	2.54	2.30	2.64
1998	2.90	2.46	2.91	2.94	2.68	2.77
1999	2.86	2.66	2.61	2.94	2.82	2.60
2000	3.02	2.60	2.79	2.99	2.88	2.79
2001	3.16	2.64	2.88	3.42	2.97	3.14
2002	3.52	2.86	3.28	3.64	3.02	3.23
2003	3.37	2.61	2.96	3.35	2.94	3.16
Avg. Prob. of Default	3.21	2.94	3.05	3.18	3.02	2.74
Avg. Credit Rating	B	B	B	B	B	B+
Avg. Number of Farms	297	423	212	364	557	281

Table 22. Regression of Probability of Default and Region

Variable	Coefficients	Standard Error	P-value
Intercept	2.74375	0.07727024	2.79773E-71
Central	0.495	0.109276621	1.26588E-05
Northeast	0.16125	0.109276621	0.142325839
Northwest	0.360416667	0.109276621	0.001237797
South Central	0.437916667	0.109276621	9.99737E-05
Southeast	0.307083333	0.109276621	0.005672201

Goodness of Fit		ANOVA	
R Square	0.170828	F	5.686
Adjusted R Square	0.1407854	Significance F	8.433 E -05

Figure 1. Average Financial Indicators for All Farms Data 1980-2003

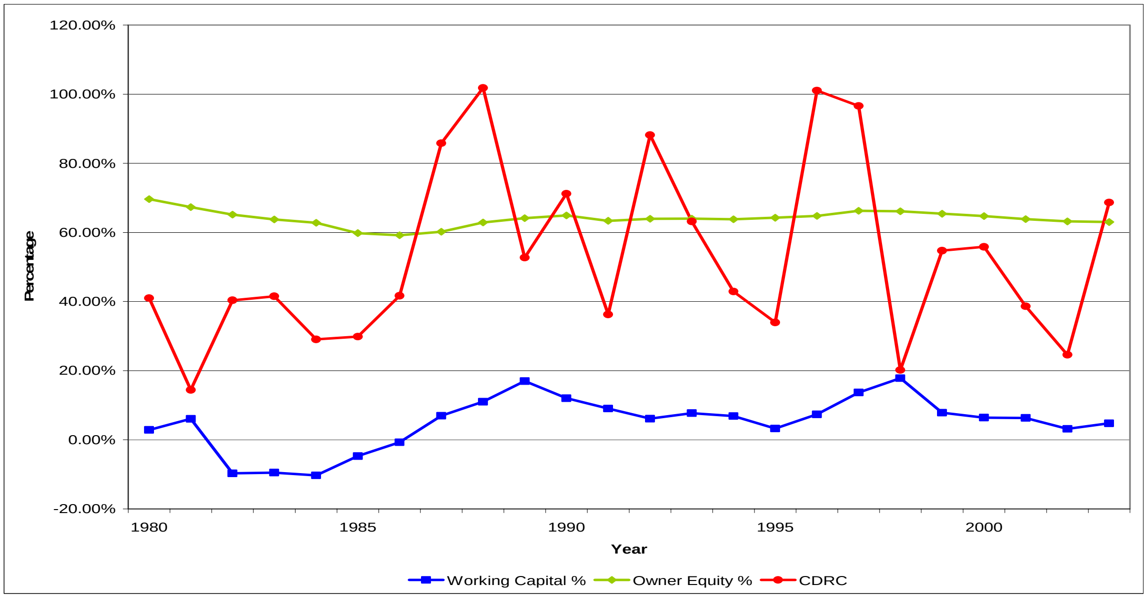

Figure 2. Average Probability of Default for Kansas Farms 1980-2003

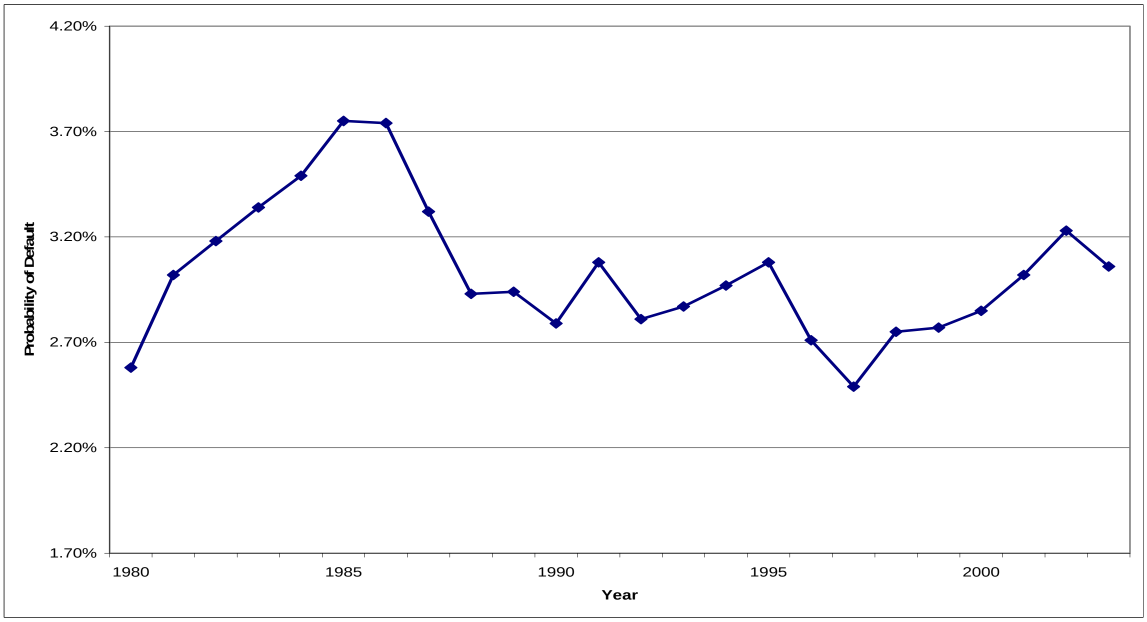

Figure 3. Kansas Credit Ratings and Total Acres Operated

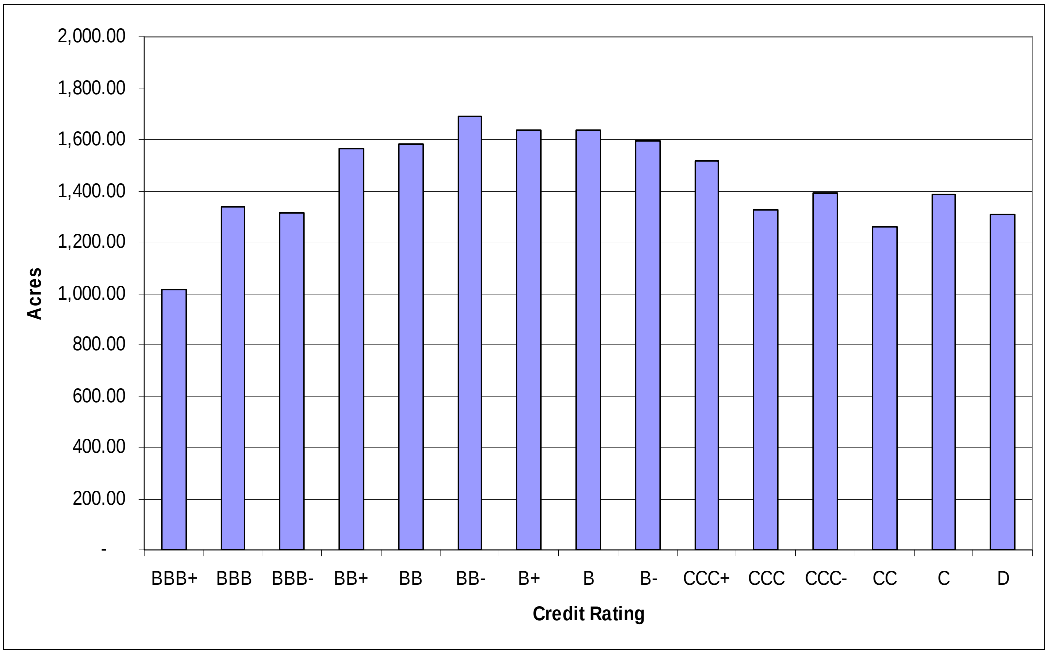

Figure 4. Kansas Credit Ratings and the Value of Production