

DEVELOPMENT OF A RISK INDEX FOR PCA LOANS AND LOAN PORTFOLIO

David Bieber

**Proceedings of a Seminar
Sponsored by North Central Regional Project NC-161
“Evaluating Financial Markets for Agriculture”**

**FINANCIAL MARKETS FOR AGRICULTURE:
MACRO, INSTITUTIONAL, AND POLICY ISSUES**

**St. Louis, Missouri
October 31-November 1, 1984**

Copyright 1984 by Author. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

DEVELOPMENT OF A RISK INDEX FOR PCA LOANS AND LOAN PORTFOLIO

David Bieber

Throughout the financial community the topic of risk has received much attention. Extending credit, whether through loans, credit cards, or accounts receivable, involves taking risks. The managing of these risks is a major objective of the financial community. To accomplish this objective, various tools have been developed to assess and manage risk. Many organizations have used a credit score or risk index as a part of their risk management strategy. This paper discusses the development of a risk index.

This paper is divided into three major sections. (1) The first part discusses the development of credit scoring in the general financial community. In this section the Equal Credit Opportunity Act and its ramifications for credit scoring will be explained. (2) The second part of this paper deals with various risk indexes that have developed in agricultural finance. (3) The third section of this paper describes the present risk index project underway at the Farm Credit Banks of St. Louis.

Risk Index in General Financial Community

In reviewing the development of risk indexing in the general financial and business community, one finds a tremendous growth in the use of statistically based credit scoring models. Many credit card applications are now analyzed by credit scoring models. William Fair has estimated that between 20 and 30 percent of all consumer credit decisions are made using credit scoring. Most of the consumer credit granters including banks, finance companies, oil companies, retail merchants, travel and entertainment cards now score their applicants (Noel Capon, 1982). Sears, for example, offers two types of credit card plans for each of its over 800 stores. These 1600 credit scoring models are the primary means of determining whether or not a card is given and what the appropriate authorization limit should be (Consumer Reports, May 1983; Reichert, 1981).

In selecting the characteristics for the model the company must abide by the Equal Credit Opportunity Act (ECOA) which clearly states certain factors that cannot be used. The 1974 act and subsequent amendments make it illegal to discriminate on the grounds of race, color, nationality, sex, and marital status. Credit scores cannot use age to bar older people from obtaining credit. In other words, age is a

David Bieber is a research analyst for the Farm Credit Banks of St. Louis. Helpful comments and suggestions by Peter Barry and Ken Obrecht are gratefully acknowledged. Any opinions, findings, conclusions, or recommendations expressed in this paper are those of the author and do not necessarily reflect the views of the Farm Credit Banks of St. Louis or reviewers.

prohibited characteristic under the act, but age can be used as a predictive characteristic provided that the elderly receive the maximum number of points awarded to any age category. The act specifies that lenders can utilize credit scoring techniques that are "demonstrably statistically sound" and "empirically derived" if they do not include those factors that are explicitly prohibited (Consumer Report, May 1983; Reichert, 1981).

The Board of Governors of the Federal Reserve System has been given the responsibility of developing the criteria for determining when a credit scoring system is statistically sound and empirically derived. The Board determines a scoring system to be "empirically derived" if it evaluates an applicant's credit worthiness by distributing points for specific applicant attributes on the basis of an empirical comparison of the institution's actual experience with both creditworthy and non-creditworthy borrowers (Reichert, 1981).

The Board of Governor's ruling does not specify the exact statistical methodology for making the necessary empirical comparison, but three criteria must be met to be "demonstrably statistically sound:"

1. The credit data used in risk index development should represent either the institutions entire population of applicants or a properly drawn sample from this population which includes both creditworthy and non-creditworthy applicants.
2. Prior to implementation, the predictive accuracy of the credit scoring system must be validated using actual applicant data. In other words, the risk index must be able to distinguish between creditworthy and non-creditworthy applicants at a statistically significant level. No specific statistical test or level of significance has been determined by the Board of Governors.
3. Once the credit scoring system is operational, it must be revalidated at appropriate time intervals to insure that the applicant attributes and associated scoring points currently in use are still appropriate. No precise time interval is specified but logic would suggest that revalidation is appropriate when there has been substantial change in underlying economic and credit conditions (Reichert, 1981).

In general, the credit scoring systems that have been developed have focused on the following two categories of credit:

1. Consumer lending including installment type lending and credit cards,
2. Commercial loans including term loans, regular commercial and industrial loans, and loans to small business.

Most of the credit scoring systems have focused on the credit granting decision, but some have dealt with loan receiving and review functions

(Eisenbeis, 1978). The credit score has mostly been used in consumer lending, particularly for credit card applications.

The typical approach in developing a credit scoring system has been to categorize sample loans into two mutually exclusive groups, "good loans" which are those that will be repaid or are current, and "bad loans" which are slow paying, delinquent, or in default. The bad loans are perceived as risky while the good loans are not. Usually a discriminant function or related procedure is estimated from a pool of loans that have already been granted. A classification rule is then formulated which is to distinguish between the groups of good or bad loans which minimizes the over all error rates or costs of misclassification (Eisenbeis 1981).

History of Risk Indexing in Agricultural Finance

The use of risk indexing has moved more slowly into agricultural finance than consumer lending. Part of the reason for this difference may be the size of the line of credit, the specific characteristics of agricultural lending, and the lack of a large mass market. In recent years, however, agricultural finance has gradually moved into the credit scoring arena. For example, MABSCO Agricultural Services, Inc., uses a credit score for its loan standards. MASI, for short, is a joint venture of 12 state bankers' organizations. The source of the funds is Rabobank Nederland. A local bank takes 20 percent of each loan while Rabobank takes 80%. The MASI credit scoring system uses the following ratios:

1. Current Ratio
2. Intermediate Assets (1-7 yr. life) / Intermediate Liabilities (1-7 yr. maturity)
3. Total Liabilities / Net Worth
4. $[\text{Current Net worth} / \text{Beginning Net Worth}] / n / \text{Prior Year Net Worth}$
5. Loan Amount / Value of Security

These five ratios are then scored and combined to come up with a weighted score. MASI does not use this index as a final criteria, but they do use it as a convenient indicator of credit strength.

In the early 1970's the Federal Intermediate Credit Bank of St. Louis and the Agricultural Economics Department at the University of Missouri had cooperated jointly to develop a workable credit scoring program for the 6th Farm Credit district. The program's objective was to design a credit score that could electronically score loans in order to eliminate a high percent of "acceptable" loans from manual examination. This credit score was designed mainly for analysis after the loan decision had been made. The credit scoring system had the following three components:

1. Repayment Index: $\frac{\text{Repayment Made and Marketable Inventory}}{\text{Repayment Anticipated}}$
2. Current Ratio: $\frac{\text{Current Assets}}{\text{Total Assets}}$
3. Debt to Asset Ratio: $\frac{\text{Total Debts}}{\text{Total Assets}}$

In the mid 1970's Farmbank Research worked on a Farm Credit systemwide risk analysis study. A major objective of this analysis was to identify the elements of risk which exist in the PCA/FICB system and make inter-district comparisons of the management of these risks. A conceptual framework was developed for the risk indexing procedures; enterprise data and borrower data from several districts were gathered. Statistical risk indexing procedures were developed and tested for theoretical soundness. Meetings with FICB credit officers were held to determine if risk indexing results were consistent with credit officers judgements on the relative riskiness of loans. Based on credit officer input in 1978 the risk index was determined to warrant pilot testing at the PCA level. Pilot districts and PCAs were selected to provide further testing. This risk analysis project analyzed the following four component indexes:

1. Risk associated with borrower's financial position,
2. Risk associated with price and yield variability in the enterprises in which the borrower is engaged,
3. Risk associated with potential losses in the event of foreclosure,
4. Risk associated with the personal characteristics and traits of the borrower (manfactor).

In June, 1983 Jean Lufburrow completed her masters thesis at the University of Illinois on credit risk and farm loan pricing. In her study she collected data from five PCAs in Illinois. She then used a probit model to determine which financial ratios discriminated among borrowers according to three levels of credit risk. She found the following variables to be significant:

1. Liquidity: $\frac{\text{Current assets} - (\text{current liabilities} + \text{amount of new loan})}{\text{Total PCA line of credit}}$
2. Leverage: $\frac{\text{Total debt}}{\text{Equity}}$
3. Security: $\frac{\text{PCA collateral}}{\text{Total PCA line of credit}}$
4. Repayment: $\frac{\text{Projected net cash flow} + \text{projected grain inventory}}{\text{Total PCA line of credit}}$
5. History: $\frac{\text{Three year average of principal repayment made}}{\text{Principal due that year}}$

The credit score for a borrower is found by inserting these five financial factors into an equation generated by the model which includes an intercept term and the coefficients of the factors with appropriate signs. This credit score provides an objective standard to aid in risk classifications of borrowers for pricing purposes.

The Present Risk Index Project

Discussions with management personnel during the development of the risk analysis project have led to a clarification of the major objectives. First, the risk index should be practical, but theoretically sound. Second, it is not to replace judgement, but it is a quantifiable way of assisting our judgement. Third, in developing the risk index we should minimize paperwork by computerizing the process. A risk index should be useful at various levels of the loan process, especially at the loan officer level. The risk index should be simple and useable by management at various levels. With the index we could establish cutoff points for various levels of documentation, loan analysis, and loan approval authority.

To meet these objectives a risk team was established. Six credit officers from different associations in the district were chosen. Through their participation the following benefits are arising:

- A communication link between the PCAs and the bank has been established during development.
- Creative input from the end user has occurred.
- There is a greater tendency to accept the results of the risk analysis project if the PCAs are an integral part of the development process.
- The association involvement will make the risk index easier to implement in the field.

As the risk team met for the first time, a conceptual framework was discussed. There are three requirements for the successful development of an objective and quantifiable measure of risk in agricultural loan portfolios:

1. A definition of risk that is consistent with the objectives of management.
2. The development of a conceptual framework that:
 - a. identifies the sources of credit risk,
 - b. specifies measurable variables to represent these risks, and
 - c. weighs each measure according to its bearing on credit risk.

3. The selection and use of data and mathematical or statistical techniques that are consistent with the requirements established by the conceptual framework.

Risk is the likelihood or probability that an unfavorable event will occur. Since lending money takes place in an uncertain environment with the chance of an unfavorable event occurring, lending involves taking risk. Some lenders feel that loan losses are the measure of risk. This idea may lead to a management philosophy of trying to avoid risk. The concept of managing risk is important. Lenders are paid through part of their interest charge to identify, assess, and manage risk not to avoid it.

As a loan is dispersed there exist four possible repayment outcomes. Bruce Bullock devised a diagram displayed in Figure 1 showing the four possible repayment outcomes. From these possible outcomes three types of risk can occur. They are as follows:

1. Risk of repayment problems
2. Risk of loan closeout and possible loss
3. Risk of loss.

Each of these risks costs the lender something in terms of time, manpower, and possibly loss of principal and interest. The loan manager must understand the concept of risk management so that the lending function is properly rewarded for the risks being taken.

In identifying the sources of credit risk, the risk analysis team discussed the following points. First, a repayment measure is very important, and the Capital Debt Retirement Capacity is a good way to get at it. There was some concern, however, that one bad year could weigh heavily on the average. Ownership equity was also cited as a measure, but there was some question as to its weight. The weight for a collateral measure was also questioned. Subjective factors, such as man factor, were discussed and the group decided to use only objective factors. The risk team determined the following potential factors:

Repayment: $\frac{1}{4} \times \text{Working Capital Deficit} + \text{Total Annual Capital Obligation} = \text{Required Capital Debt Retirement Capacity (CDRC)}$

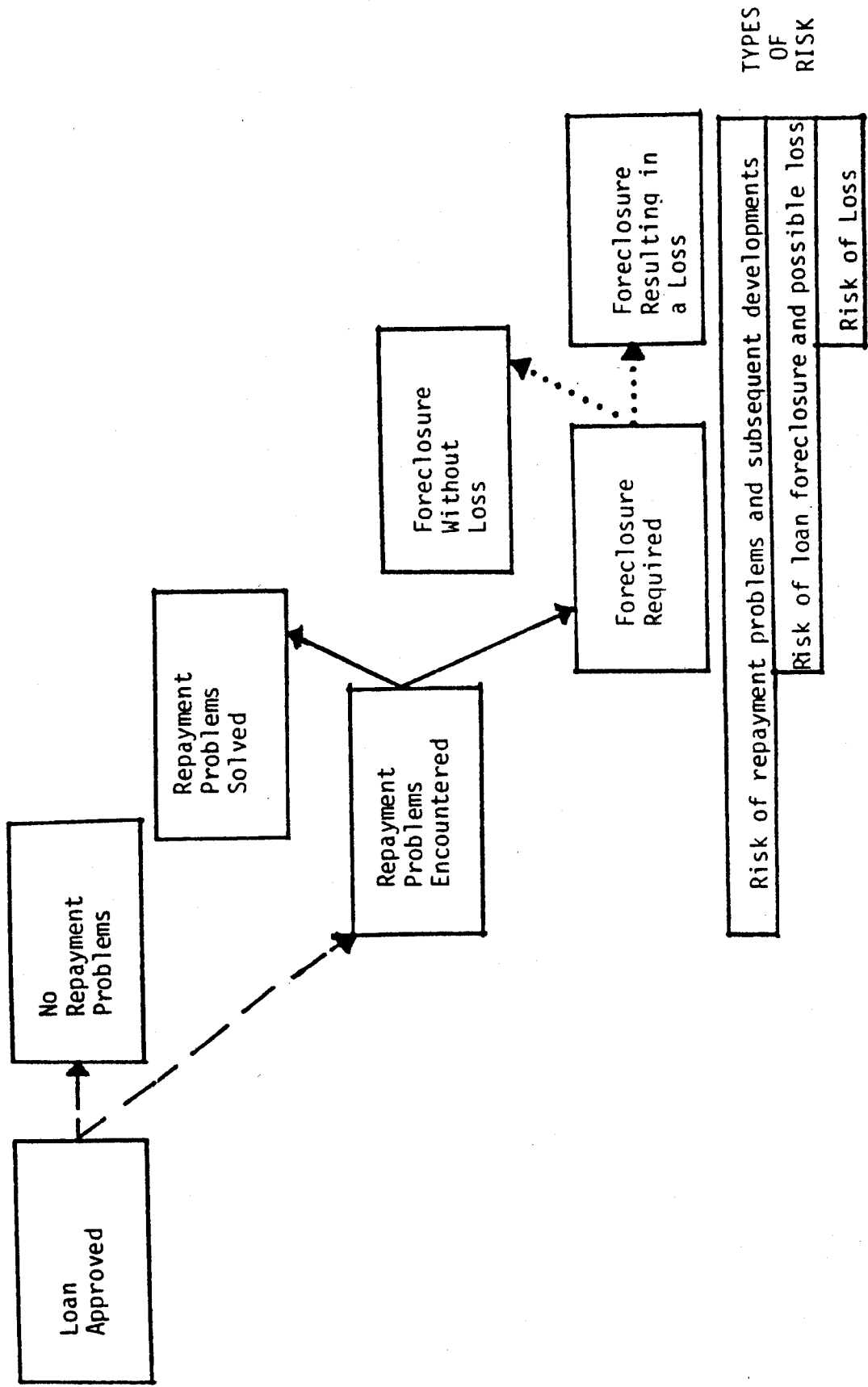
Normal CDRC / Required CDRC x 100

- a. 5 year CDRC
- b. 5 year CDRC but drop high and low years

Liquidity: Working capital and current ratio

Leverage: 1. Ownership equity
2. Net worth / peak loan balance

Figure 1. Possible Repayment Outcomes of Individual Loans in Portfolio



- Collateral:
- a. Collateral at peak / peak outstanding balance
 - b. Collateral at application / line of credit at application
 - c. Collateral at application / (outstanding balance at application + accrued interest)

Exposure relative to production:

- a. Value of farm production / total liabilities
- b. (Value of farm production + net nonfarm income) / total liabilities

Since the meeting, data from a sample of loans are being gathered. The initial sample size had been targeted at 180 loans with an equal distribution of acceptable, problem, and vulnerable/loss loans. The sample has come up short in the weak loan category. Presently more data are being gathered to augment this segment of the sample. Once the sampling is completed, various statistical procedures will be used to help determine which factors are significant and their relative weights. The risk team will then analyze this information to formulate a risk index.

Concluding Comments

Credit scoring systems can be an effective tool for analyzing different levels of risk. Consumer lending institutions have been a major user of credit scoring, especially in the credit card approval process. With the present financial climate in agriculture, risk analysis has become increasingly important. A risk index can be useful as a red flag mechanism during the loan process. The risk index can point out specific areas of weakness where the lender and borrower can reduce the level of risk. This approach can be mutually beneficial.

REFERENCES

- Bullock, J. B. "Identification and Measurement of Risk in Agricultural Loan Portfolios." *Farmbank Services, Farm Credit System*, 1980.
- Capon, Noel. "Credit Scoring Systems: A Critical Analysis." *Journal of Marketing*. Vol. 46, Spring 1982, pp. 82-91.
- Eisenbeis, Robert A. "Problems in Applying Discriminant Analysis in Credit Scoring Models." Board of Governors of the Federal Reserve System.
- Etherton, Doug. "Developing Proxy Measures of Lender Risk in FICB/PCA Loan and Loan Portfolios." Research Department, Federal Intermediate Credit Bank of St. Louis, March 18, 1982.
- "Identification and Measurement of Risks in FICB and PCA Loan Portfolios." *Farmbank Research and Information Service*, September 1976.
- Lufburrow, Jean. "Credit Risk and Farm Loan Pricing: Concepts, Measures, and Analysis", MS Thesis University of Illinois, June 1983.
- Lufburrow, J., P. J. Barry, and B. L. Dixon. "Credit Scoring for Farm Loan Pricing." *Agricultural Finance Review*. 44, 1984, pp. 8-14.
- Morsman, Edgar M., Jr. *Effective Loan Management*. Robert Morris Associates, 1982.
- Reichert, Alan K. "An Examination of the Conceptual Issues Involved in Developing Credit Scoring Models in the Consumer Lending Field." Federal Reserve Bank of Chicago, 81-3.
- Tongate, Ron. "Risk Indexing: A Valuable Tool for Today's Lender." *Agri Finance*. March 1983, pp. 12,13, 76.
- "What Makes You a Good Credit Risk?". *Consumer Reports*. May 1982, pp. 254-259.