AN EVALUATION OF BANK CREDIT POLICIES FOR FARM LOAN PORTFOLIOS USING THE SIMULATION APPROACH

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CERTIFICATE OF ORIGINALITY

This thesis contains no material which has been accepted as part of the requirements for any other degree or diploma in any other university or any material previously published or written by another person unless due reference is made.

Keith Bramma
12 March 1999
ABSTRACT

The aim of this study is to evaluate the risk-return efficiency of credit policies for managing portfolio credit risk of banking institutions. The focus of the empirical analysis is on a range of possible policy options using a simulation model that represents an operating environment of lenders servicing the Australian farm sector. Banking institutions resort to a range of internal policy instruments to manage potential loss of income and capital in event of borrower default. The use of internal policy mechanisms occurs because well-developed derivative markets for managing credit risks are limited. Efficacy of credit policy maximises the capacity of banks to absorb loan losses when they occur and minimises the possibility of bank failure. By corollary, efficient credit policy also extends the limits to which banks can make finance available to borrowers, and to offer lower lending rates in a competitive lending environment. To this end, decision-makers in banks have been focusing on applying the portfolio theory concepts of risk measurement, diversification and pricing for risk to credit policy development. However, there have been limited empirical applications of portfolio theory to credit policy formulation in the literature. In this study, insurance theory principles and agency relationships between a borrower and a lender are integrated into the portfolio theory framework. This framework is used to assess the nature of the relationships between each type of credit risk and credit policy.

Credit risk is viewed as being comprised of two components: expected loss and unexpected loss. Expected loss equals the income and capital loss expected in event of default weighted by the probability of default. Unexpected loss is the extent to which deviations in realised loan losses occur from their expected values. When many borrowers are combined to form a portfolio, borrowers may be graded on a common basis through the expected loss spectrum for default risk and security risk using a two-dimensional risk classification matrix structure. The extent to which unexpected losses on individual loan securities are correlated defines systematic risk while the remaining portfolio risk constitutes unsystematic risk. Systematic risk among loan securities occurs as a result of correlation of loss probabilities between different types of borrowers. Since the probability of default of borrowers is directly related to their income distributions, correlations of loss distributions occurs as a result of a common
set of exogenous factors affecting income distributions of borrowers in different regions and industries. Beta risk on loan securities is therefore assessed on the basis of securities classified for regional and industry segmentations.

Promised interest rates charged on loan securities are comprised of four key components when priced for credit risk: the risk free rate, the default risk premium, the security risk premium and the portfolio risk premium. For a particular borrower, the default risk premium and the security risk premium are added together to give a certainty-equivalent risk premium. This risk premium allows lenders to be compensated for expected losses on loan securities held by a borrower. If each credit risk class includes many region-industry segments with each segment containing a large number of similar sized borrowers, lenders may force the unsystematic component of portfolio risk to zero. A key pre-condition behind risk spreading is independence between the covariances of loss rates across regions and industries. If independence is achieved, the income received through the certainty-equivalent risk premium exactly matches the expected loss rate on the risk class. Under these conditions, the expected return on each risk class in a competitive capital market is the risk free rate of interest.

The portfolio risk premium is a function of the market risk premium for bearing portfolio risk and beta risk on loan securities in a particular region-industry segment. Portfolio risk premiums may be formulated using low or high order definitions of regions and industries depending on the nature of data available to measure beta. A portfolio risk premium is added to the certainty-equivalence promised interest rate to give the promised interest rate charged to a borrower. This pricing behaviour allows the expected returns on loan securities to reflect differences in beta risk associated with different region-industry segments.

Pricing for credit risk is efficient so long as risk concentrations are not excessive and the default risk of borrowers remains independent of the promised rate of interest. At the portfolio level, excessive risk concentrations for most lending institutions may arise as a result of dissimilar sized borrowers and disproportionate numbers of borrowers in different low-order definitions of regions and industries. Maximum portfolio concentration limits may therefore be defined for different categories of borrowers in order to limit excessive risk concentrations. Minimum portfolio limits may be used to
assure risk spreading across a sufficient number of region-industry segments within a risk class. Lenders also manage the impact of unexpected losses on their portfolio returns through adequate allocations of equity capital on particular portfolio segmentations.

At the borrower level, credit controls may be used to ensure that borrower default risk remains independent of the promised interest rate being charged over a limited range of the expected loss spectrum. A risk pricing limit may be set for different portfolio segments at the point where promised interest rates begins to affect default risk. Credit quality limits may be formulated in terms of a maximum acceptable expected probability of default and a minimum acceptable expected security coverage. Loan proposals that do not satisfy credit quality limits are either rejected or revised in the credit screening process. Revision of loan applications may occur in circumstances where default risk is not independent of pricing or where loans are insufficiently secured. In these cases, credit quality may be improved by obtaining more collateral coverage or through reducing maximum credit limits. A minimum credit reserve limit may be devised to permit lenders to price new borrowers for credit risk in the region of acceptable credit quality in accordance with risk constraints implied by a credit risk classification system. If borrowers do default, maximum credit limits may be extended or loan repayments may be rescheduled to improve the dynamic profile of the lender’s risk and returns on loan securities.

Since the risk-return efficiency of various credit policy parameters involves empirical investigation, a dynamic portfolio model is outlined to enable the analysis of different credit policy options. The decision problem facing a lender in selecting credit policy is modelled as a choice between portfolio return distribution functions arising from different credit policy regimes. Stochastic dominance (SD) efficiency criteria are used to choose between credit policy alternatives. The SD criteria considers the total return distribution and requires only general assumptions to be made about the nature of the risk-return preferences of decision makers in banks.

The portfolio theory framework is couched in terms of the capital budgeting approach to generate a portfolio return distribution function for a particular credit policy regime. Using this framework, borrowers are segmented by credit risk class, region, industry
and loan maturity to give categories of loan securities with relatively homogeneous
distribution functions for bank returns. Each credit risk class defines risk constraints
on which a stochastic simulation model of the average borrower in a portfolio segment
may be developed. The credit risk classification system links a borrower’s financing
decision to their production and investment decisions in line with credit policy. The
simulation method for credit scoring allows alignment of borrowers with differing
credit quality characteristics to a credit risk classification system, and offers an
alternative technique to existing credit scoring methods in the literature. In the
dynamic model, the stochastic simulation method is used to generate loan security
returns through time. Loan return outcomes predicted for a given borrower income
scenario are weighted by the number of borrowers in the segment to give measures of
portfolio performance in absolute dollar terms.

The computable simulation model developed in this study uses farm surveys data to
generate a portfolio environment that is representative of lenders servicing the
Australian farm sector. This model is used to examine the risk-return efficiency of two
aspects of credit policy: risk pricing limits in loan reviews and a loan restructuring option
versus a ‘no restructuring’ option. The findings suggest that banks servicing the
Australian farm sector will earn more profit without additional portfolio risk if the
maximum limit to which pricing accounts for default risk in loan reviews is positively
linked to volatility of gross incomes of farm business borrowers. Importantly, this
finding is contingent on well-defined credit underwriting standards to be applied in loan
originations. In particular, credit-underwriting standards must be formulated so as to
procure farm business borrowers of high credit quality with loans that are fully secured
using fixed assets. The credit scoring results indicate that for farm business borrowers in
Australia to achieve acceptable credit quality, they must have high levels of productivity
compared to the region-industry average. The results of simulations also show that a
flexible rather than a rigid policy approach to problem loan management provides for
large net benefits since such a strategy reduces the sensitivity of non-pricing aspects of
credit policy on the dynamic profile of credit risk of farm business borrowers.

With further research, the simulation model may be used to identify sets of efficient
credit policies in which trade-offs in portfolio risk and bank returns occur. With this
information, pricing and lending guidelines that embodies the optimal credit policy set may be formulated for application by line personnel in credit approval and loan review processes.
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# TABLE OF CONTENTS

## ABSTRACT

## ACKNOWLEDGMENTS

### 1. INTRODUCTION

1.1 Importance of efficient credit policy  
1.2 The credit policy formulation challenge  
1.3 Research methods for credit policy development  
1.4 Objectives and structure of thesis

### 2. PRINCIPLES OF PORTFOLIO THEORY

2.1 Introduction  
2.2 Measurement of risk  
2.3 Portfolio theory  
2.4 Capital Asset Pricing Model  
2.5 Capital structure  
2.6 Summary

### 3. PORTFOLIO THEORY AND CREDIT RISK

3.1 Introduction  
3.2 Expected returns and insurance theory  
3.2.1 Credit risk and insurance theory principles  
3.2.2 Portfolio theory implications of insurance  
3.3 Information on loan security returns  
3.4 Credit market efficiency and agency theory  
3.5 Cost of capital  
3.6 Summary

### 4. PORTFOLIO MODEL OF ILLIQUID LOAN SECURITIES

4.1 Introduction  
4.2 Portfolio model of loan securities with certain repayments  
4.3 Portfolio model of loan securities with uncertain repayments  
4.3.1 Model of a borrower  
4.3.2 Bank portfolio segment returns  
4.3.3 Valuation model of portfolio  
4.4 Limitations of multi-period portfolio model  
4.5 Summary

### 5. PORTFOLIO APPROACH TO CREDIT RISK MANAGEMENT

5.1 Introduction
5.2 Credit risk pricing 66
  5.2.1 Promised interest rate and unsystematic risk 66
  5.2.2 Promised interest rate and systematic risk 69
  5.2.3 Pricing limits 72
5.3 Credit risk control 75
  5.3.1 Credit quality limits 75
  5.3.2 Risk concentration limits 79
  5.3.3 Collateral and the maximum credit limit 80
5.4 Summary 83

6. LOAN PRODUCT DYNAMICS AND CREDIT RISK MANAGEMENT 85
6.1 Introduction 85
6.2 Loan product construction 85
  6.2.1 Term loan product types 85
  6.2.2 Minimum credit reserve limit and initial leverage 88
  6.2.3 Maximum credit limit dynamics 93
6.3 Loan product reconstruction 94
  6.3.1 Problem loan resolution policy options 94
  6.3.2 No restructuring 96
  6.3.3 Reschedule through lengthening the maturity term 97
  6.3.4 Deferral of term loan interest and principal payments 98
  6.3.5 Restructuring with credit extension 100
  6.3.6 Impact on portfolio risk 101
6.4 Summary 102

7. CREDIT POLICY EVALUATION 104
7.1 Introduction 104
7.2 Decision problem 104
7.3 First-order stochastic dominance 107
7.4 Second-order stochastic dominance 109
7.5 Third-order stochastic dominance 110
7.6 Limitations of evaluation approach 111
7.7 Summary 115

8. CREDIT RISK EVALUATION 117
8.1 Introduction 117
8.2 Credit screening process 117
8.3 Loan review process 121
9. CREDIT SCORING MODELS

9.1 Introduction

9.2 Parametric statistical approaches
9.2.1 Overview
9.2.2 Multiple discriminant analysis
9.2.3 Linear probability model
9.2.4 Logit probability model
9.2.5 Probit probability model

9.3 Parametric non-statistical and non-parametric approaches
9.3.1 Overview
9.3.2 Goal programming
9.3.3 Recursive partitioning algorithm
9.3.4 Neural network approach

9.4 A simulation approach
9.5 Limitations of credit scoring models
9.6 Summary

10. CREDIT SCORING AND DEFAULT RISK CLASSIFICATION

10.1 Introduction

10.2 Parametric approaches

10.3 Non-parametric approaches

10.4 Simulation approach

10.5 Summary
11. SIMULATION MODEL

11.1 Introduction
11.2 Structure of simulation model
11.3 Farm model
  11.3.1 Economic environment
  11.3.2 Gross farm income module
  11.3.3 Farm costs module
  11.3.4 Loan fees and charges module
  11.3.5 Taxation payments module
  11.3.6 Use of surplus funds module
  11.3.7 Productivity relative ratio dynamics
11.4 Bank model
  11.4.1 Economic environment
  11.4.2 Portfolio segment module
  11.4.3 Portfolio module

12. DATA

12.1 Region and industry specifications
12.2 Gross farm income
12.3 Farm costs
12.4 Personal expenses
12.5 Land and buildings
12.6 Salvage value of farm assets
12.7 Farm population
12.8 Number of overdraft transactions
12.9 Interest rates and discount rate

13. EXPERIMENTAL AND STATISTICAL DESIGN

13.1 Introduction
13.2 Experimental design
  13.2.1 Factors and levels
  13.2.2 Experiment size
13.3 Computer program
13.4 Statistical design
  13.4.1 Sampling design
  13.4.2 Stopping rules
13.5 Verification and validation
  13.5.1 Verification of computer program
  13.5.2 Validation of simulation model
14. RESULTS 231
14.1 Introduction 231
14.2 Credit policy simulation results 231
14.3 Stochastic efficiency analysis 235
14.4 Factors determining stochastic efficiency outcomes 242
14.5 Credit screening simulation results 249
14.6 Impact of experimental design 250
14.7 Impact of statistical design 252
14.8 Future credit policy simulations 253

15. CONCLUSIONS 256
15.1 Conclusions 256
15.2 Issues for further research 265

REFERENCES 268

APPENDICES
A Loan fees and charges schedules 283
B Taxation schedules 290
C Discount rate and loan pricing model 292
D Accounting linkages between the farm model and the bank model 299
E Data and parameter assumptions 314
F Productivity relative ratio and the credit screening model 334
G Credit policy simulation results by region-industry segment 347
H Productivity relative ratio estimation results 352
I Glossary of parameters and variables in simulation model 354
TABLES

12.1 Industry definitions 187
12.2 Region-industry specifications and codes 189
12.3 Overdraft transaction numbers assumptions 194
12.4 Interest rate assumptions 195
12.5 Loan pricing model and discount rate parameters 196
13.1 Credit risk rating system configuration 199
13.2 Credit limits expressed as a percentage of fixed assets 201
13.3 Minimum credit reserve limit assumptions 202
13.4 'Interest only with credit extension' resolution policy assumptions 203
13.5 Credit policy experimental design 203
13.6 Farm models for a particular credit policy set 204
13.7 Outline of computer programs 205
13.8 Stopping rule values in the loan review model 219
13.9 Stopping rule values in the credit screening model 220
13.10 Summary of Durbin-Watson tests for first-order serial correlation of gross income 228
14.1 Summary of policy estimation results 231
14.2 Region-industry segments exhibiting first-order stochastic dominance for credit policy set 4 with key sensitivities 238
14.3 Region-industry segments exhibiting first-order stochastic dominance for credit policy set 6 with key sensitivities 239
14.4 Region-industry segments exhibiting first-order stochastic dominance for credit policy set 2 with key sensitivities 240
14.5 Region-industry segments exhibiting third-order stochastic dominance with key sensitivities 241
14.6 Summary of productivity relative ratio estimation results 249

A.1 Loan security registration fees schedule 289
B.1 Marginal taxation rates and taxable income tiers schedule 290
E.1 Gross farm income data 314
E.2 Gross farm income covariance matrix data 317
E.3 Farm costs data 321
E.4 Personal expenses data 324

E.5 Land and buildings and salvage value of farm assets data 326
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.6</td>
<td>Farm population data</td>
<td>329</td>
</tr>
<tr>
<td>E.7</td>
<td>Number of new entrants in a credit risk class for $x_s &lt; 10$</td>
<td>332</td>
</tr>
<tr>
<td>E.8</td>
<td>Interest rates data for historical model</td>
<td>332</td>
</tr>
<tr>
<td>E.9</td>
<td>Overdraft transaction drawings and deposit numbers assumptions</td>
<td>333</td>
</tr>
<tr>
<td>G.1</td>
<td>Summary statistics of distributions for net present value of bank returns by region-industry segment</td>
<td>347</td>
</tr>
<tr>
<td>H.1</td>
<td>Estimated values for the productivity relative ratio in the historical model</td>
<td>352</td>
</tr>
<tr>
<td>H.2</td>
<td>Estimated values for the productivity relative ratio in the projection model</td>
<td>353</td>
</tr>
</tbody>
</table>
FIGURES

2.1 Portfolio diversification and risk reduction 12
2.2 Efficient frontier 13
2.3 Efficient frontier and the capital market line 14
2.4 Security market line 17
2.5 Effect of leverage on equity beta 20
2.6 Effect of leverage on the weighted average cost of capital 21
2.7 Effect of leverage on the weighted average cost of capital with corporate taxes 22
3.1 Relationship between the promised interest rate and bank expected rate of return 26
3.2 Effect of leverage on the weighted average cost of capital with corporate taxes and bankruptcy and agency costs 41
4.1 CSR distribution and the expected probability of default 56
4.2 Credit risk classification system in a 4x4 matrix form 59
5.1 Relationship between the default risk premium and the expected probability of default 68
5.2 Relationship between the risk premium, the expected probability of default and the expected security cover ratio 69
5.3 Relationship between the promised interest rate, bank expected rate of return and the risk premium 72
5.4 Relationship between the promised interest rate and the expected interest rate with dependency between the expected default probability and the promised interest rate 75
5.5 Relationship between credit quality limits and the risk pricing limit 77
5.6 Credit risk classification matrix system with credit quality limits for borrower entrants 78
5.7 Relationship between the security risk premium and proportion of assets pledged as collateral given certainty equivalence 81
5.8 Relationship between the security risk premium and the credit limit given certainty equivalence 82
6.1 Relationship between liquidity and the minimum credit reserve limit 91
6.2 Relationship between the minimum credit reserve limit and the expected probability of default 92
7.1 First-order stochastic dominance 108
7.2 Second-order stochastic dominance where cumulative probability distribution functions cross twice (area A > area B) 110
8.1 Credit screening process 118
8.2 Structure of credit risk classification system in the credit screening process 121
8.3 Loan review process 122
8.4 Structure of credit risk classification system in the loan review process 123
9.1 Logit probability model 131
9.2 Hypothetical tree for two-group classification under the recursive partitioning algorithm 136
10.1 Logit probability model and the default risk classification system 143
10.2 Relationship between the optimal discriminant cut-off score, the expected probability of default and the default risk classification system 145
10.3 Family of probability distribution functions for CSR by security risk grade 152
10.4 Relationship between the productivity relative ratio and the expected probability of default 155
10.5 Relationship between the productivity relative ratio, expected security cover ratio, the expected probability of default and default risk class 156
10.6 Definition of default risk and security risk class regions for the productivity relative ratio, expected probability of default and expected security cover ratio for region-industry $j$ 156
11.1 Schematic diagram of simulation model 161
11.2 Schematic diagram of the historical and projection modules of the simulation model 163
12.1 Map of Australia with region-industry codes 190
13.1 Expected probability of default distribution 217
14.1 Histogram for credit policy with $rpl=5\%$ and ‘no restructuring’ option 233
14.2 Histogram for credit policy with $rpl=5\%$ and ‘restructuring’ option 233
14.3 Histogram for credit policy with $rpl=2.5\%$ and ‘no restructuring’ option 233
14.4 Histogram for credit policy with $rpl=2.5\%$ and ‘restructuring’ option 234
14.5 Histogram for credit policy with $rpl=7.5\%$ and ‘no restructuring’ option 234
14.6 Histogram for credit policy with $rpl=7.5\%$ and ‘restructuring’ option 234
14.7 Cumulative frequency functions for credit policy sets 1 to 6 235
14.8 Scatter plot of credit policy evaluation results against key sensitivities for the broadacre sector 244
14.9 Scatter plot of credit policy evaluation results against key sensitivities for the dairy industry 244
14.10 Scatter plot of credit policy evaluation results against key
<table>
<thead>
<tr>
<th>Section Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.11</td>
<td>Scatter plot of credit policy evaluation results against key sensitivities</td>
<td>245</td>
</tr>
<tr>
<td></td>
<td>for broadacre sector in the pastoral zone</td>
<td></td>
</tr>
<tr>
<td>14.12</td>
<td>Scatter plot of credit policy evaluation results against key sensitivities</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>for broadacre sector in the high rainfall zone</td>
<td></td>
</tr>
<tr>
<td>14.13</td>
<td>Credit screening results for the projection model</td>
<td>252</td>
</tr>
<tr>
<td>D.1</td>
<td>Scenarios for calculation of bank returns and bank loan assets</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>if no restructuring option offered to defaulting exposures</td>
<td></td>
</tr>
<tr>
<td>D.2</td>
<td>Calculation of loan repayments and loan drawings on the</td>
<td>304</td>
</tr>
<tr>
<td></td>
<td>overdraft facility for the bank model</td>
<td></td>
</tr>
<tr>
<td>D.3</td>
<td>Scenarios for calculation of bank returns and bank loan assets</td>
<td>307</td>
</tr>
<tr>
<td></td>
<td>if restructuring occurs when defaulting exposures are fully secured</td>
<td></td>
</tr>
<tr>
<td>D.4</td>
<td>Scenarios for calculation of bank returns and bank loan assets</td>
<td>311</td>
</tr>
<tr>
<td></td>
<td>under restructuring option that includes defaulting exposures not fully</td>
<td></td>
</tr>
<tr>
<td></td>
<td>secured</td>
<td></td>
</tr>
<tr>
<td>F.1</td>
<td>Relationship between permissible values of the productivity relative ratio</td>
<td>341</td>
</tr>
<tr>
<td></td>
<td>and expected taxable income</td>
<td></td>
</tr>
<tr>
<td>F.2</td>
<td>Relationship between productivity relative ratio and expected</td>
<td>347</td>
</tr>
<tr>
<td></td>
<td>taxable income for a particular security risk class</td>
<td></td>
</tr>
</tbody>
</table>