1987

Four Essays On The Economics Of Financial Distress: Bond Ratings, Bank Failures And Deposit Insurance

Brian Frederick Smith

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FOUR ESSAYS ON THE ECONOMICS OF FINANCIAL DISTRESS: BOND RATINGS, BANK FAILURES AND DEPOSIT INSURANCE

by

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Submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy

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March 1987

ISBN 0-315-36609-5

ABSTRACT

The dissertation incorporates four separate essays addressing the economics of financial distress. While essays one and two examine the capital market reaction to security rating changes and bank failures, the last two offer methods for deposit insurance corporations to better handle distress among member financial institutions.

The first essay measures the impact of rating changes on equity returns. Pooled cross-section time series analysis allows testing of significance of changes in systematic risk as well as price. Tests of monthly and daily data indicate that there are no shifts in the systematic risk of firms experiencing rating changes after controlling for the effects of contemporaneous events. On average, a one-time drop in share price is observed for rating reductions, while no significant reaction is found for rating increases.

The second essay uses pooled cross-section time series analysis to investigate the capital market reaction to the failure of three Ontario trust companies, the bailout of the Canadian Commercial Bank (CCB) and subsequent runs on deposits. Even though the trust companies' collapse was triggered by problems isolated to the troubled institutions, the prices of the non-failed trust companies' shares fell. The prices of the non-failed Schedule "A" chartered banks also fell upon announcement of the CCB bailout. However, news of runs on deposits at other banks only affected the price of common stocks of small bank with low security ratings.

The third essay presents several important extensions to previous option pricing models of deposit insurance premiums and applies them to the credit unions of British Columbia. The analysis suggests that variable rate premiums can be determined for financial institutions without publicly traded equity and also to measure the exposure of lenders-of-last-resort such as the Canada Deposit Insurance Corporation.

The fourth essay examines the criteria that underlie the choice of action by a deposit insurance corporation in handling distressed member financial institutions. Incorporating these criteria, an early warning system that predicts not only the likelihood of financial distress but also the type of financial assistance required is developed.

ACKNOWLEDGEMENTS

I would especially like to thank my supervisor, Dr. Robert W. White for the invaluable guidance he has provided in the preparation of this dissertation. Many thanks are also extended to the other members of the Finance Area Group at the University of Western Ontario for their helpful comments, the Ontario Institute of Chartered Accountants, Gulf Canada and the Social Sciences and Humanities Research Council for their financial support and the librarians and secretaries at Western for their constant assistance. To my wife, Jacquie, my parents and grandparents, I dedicate this work because without their love and support over the years the words that follow would not have been written.

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CHAPTER I

INTRODUCTION

Over the past twenty years, financial distress, especially among our financial institutions has grown increasingly commonplace. Volatile interest rates, default on loans to agricultural and energy producers, sovereign risk as well as increasing financial deregulation have replaced the much stabler banking era of the 1950's and 1960's. In this new environment, the interdependent roles of the capital markets and the government, principally through the deposit insurance corporations, must be reexamined. It is the purpose of this dissertation through the following four essays to contribute to such analysis. The four essays are:

1. The adjustment of stock risk and return to security rating changes;
2. The capital market impact of recent Canadian bank failures;
3. Variable rate deposit insurance premiums; and
4. Early warning system predicting both financial distress and type of financial assistance required.

In the following sections, the problems addressed, method of analysis and findings of the four essays are summarized separately.

1. Chapter Two (First Essay)

The first essay examines whether security rating agencies such as Moody's and Standard and Poor's bring new and significant information to the capital markets when they announce a rating revision. The essay first outlines arguments for and against the hypothesis that the rating

agencies have monopolistic information. If monopolistic information is present, both the systematic risk and prices of common shares should be affected because, as is discussed, both of them are correlated with security ratings. In order to capture shifts in systematic risk and price, a pooled cross-section time series model is developed. Unlike methods employed in earlier studies, pooled cross-section time series analysis also provides a means of distinguishing the impact of rating changes from those of contemporaneous events.

Tests of monthly and daily data indicate that share prices fall upon news of rating reductions while no significant impact is observed for rating upgrades. The coefficients measuring the shifts in price upon announcement of contemporaneous events also suggest an asymmetric reaction to favourable/unfavourable news. No shifts in the systematic risk of common shares of firms experiencing rating changes are detected.

2. Chapter Three (Second Essay)

In the second essay, the issue of bank distress contagion is explored through the examination of the reaction of shareholders of non-failed financial institutions to announcements involved in two recent sets of failures in Canada--three Ontario trust companies in late 1982 and January 1983 and the Alberta bank crisis of 1985. The essay develops hypotheses that assert that changes in price and systematic risk would result from these announcements of financial distress and that these impacts would differ across securities. Pooled cross-section time series is employed to test these hypotheses.

The announcement of questionable lending by and the Ontario government takeover of three provincially chartered trust companies led to an adverse reaction by the shareholders of non-failed trust companies.

The essay contends that the bailout of the Canadian Commercial Bank (CCB) and the subsequent runs on deposits would have an effect on non-distressed institutions because problems identified were shared by them. The price of the shares of all non-failed Schedule "A" chartered banks fell on average on the day of and three days following the announcement of the CCB bailout reflecting a drop in confidence in the banking system. In wake of the news regarding the extremely poor quality of the CCB loan portfolio in Western Canada, the market and multi-factor model's betas of the banks with significant exposure to the oil and gas sector rose. Furthermore, news of runs on deposits at Canada's Schedule "A" banks had a significantly negative effect on the price of common stocks of banks with low security rating. As the banks of higher security ratings were unaffected by such news, a shareholder bias linking stability to size is revealed.

3. Chapter Four (Third Essay)

The motivation for variable rate deposit insurance is well established in the literature of financial economics. However, the theoretical models, principally those developed from Merton's 1977's treatment of deposit insurance as a put option on a bank's assets, have not been widely accepted as working valuation tools. The third essay extends the original Merton formulation to bring it several steps closer to implementation.

The essay first reviews the rationale for variable rate deposit insurance. Then, the assumptions of Merton's model are discussed and modified to better correspond to the conditions under which the British

substantiated by the studies of Fama, Fisher, Jensen and Roll (1969), Waud (1970) and Scholes (1972) and White and Lusztig (1980). The model also assumes that the impact of each variable is homogenous across securities and over time.

The alpha shift variables for rating upgrades and downgrades was included to capture the impact of changes in the alpha coefficient of the market model. The variable took the value zero up to the day of publication and one thereafter. Because no impact is expected, coefficients of these variables significantly different from zero will weaken conclusions drawn from the model.

The pooled cross-section time series model employs the variable $[\hat{a}_j + \hat{b}_j \ln (1 + R_{mt})]$ which represents the return generated by the market model. For each rating change, $\hat{a}_j$ and $\hat{b}_j$ were estimated using the market model with returns on the 240 trading days from the 300th to 61st observation before the announcement date. Any observations prior to a previous rating change were eliminated and a minimum of 60 observations was required to estimate $\hat{a}_j + \hat{b}_j$.

In order to select thirty days as the number of daily observations before and after each rating change required to estimate the pooled cross-section time series model, several criteria were used. First, most of the contemporaneous events were concentrated in the month and a half before and after a rating change. In addition, a sufficient number of observations was needed to reduce estimation error.

In the absence of any company-specific information and measurement error, the value of the coefficient δ_1 should be one for all securities. An alternative formulation for the pooled cross-section time series model would be to have separate intercept and market

discriminant analysis, the simultaneous logit model is chosen. The model is applied to all credit unions in Ontario over the years 1980 through 1985 and exhibits both explanatory and predictive ability. An unequivocal result from the analysis of empirical data is that the provincial deposit insurance corporation tends to stabilize larger credit unions while liquidating or merging smaller institutions. This observation may justify the chartered bank shareholder bias noted in the second essay linking size to stability in the face of runs on deposits at other banks.

CHAPTER II

The Adjustment of Stock Risk and Returns To Security Ratings Changes

I. INTRODUCTION

The purpose of this paper is to determine whether announcements of security rating changes carry monopolistic information by examining their effect on security returns. As most evidence indicates that the capital markets are efficient in their weak and semi-strong forms but not in their strong form, only the release of monopolistic information should have an impact on security pricing.[1]

Those who contend that rating agencies such as Moody's and Standard and Poor's are not providing new information to the capital markets argue that the information used to determine ratings is almost all publicly available. Furthermore, as Weinstein (1977) and Stickel (1986) discuss, rating changes lag behind the time they should be performed for several reasons. Unless notified of significant news regarding the companies they evaluate, rating agencies review the ratings of securities only on a periodic basis. Even after a decision to change a rating is made by Standard & Poor's, the decision is discussed with the underwriter and the affected company officials, who may appeal the proposed rating. Even though there is no formal appeal process before announcement, it is likely that an intended rating change of Moody's will be revealed in the examination process and discussed with company officials and the underwriter.

On the other hand, there are strong arguments why rating agencies do possess monopolistic information. First, the rating agencies may obtain information not available to the public through their discussions with company officials and examination of unpublished financial forecasts. In addition, Danos, Holt and Imhoff (1984) demonstrated that bond raters had expertise in evaluating the financial forecasts provided by management. They were able to detect subtle differences in the forecasts and thus their judgement would be valued by the capital market even if the forecasts were based completely on publicly available information.

Relationship of Bond Rating to Capital Asset Pricing Theory

A corporate fixed-income security rating is a measure of the likelihood of default. In order to assess this likelihood, rating agencies evaluate the historical and forecast financial condition of a company. As indicated by discussions with officials of Moody's and Standard and Poor's reported in articles by Fraser (1973), Clark (1976), Moody's Bond Record (July 1976) and Ross (1976), important criteria include leverage, coverage of interest or dividend payments, level of earnings and variability of earnings. Researchers have also established significant relationships between a series of historical measures of a firm's performance capturing these variables and a company's security ratings. Papers demonstrating these connections include, Pogue and Soldofsky (1969), Pinches and Mongo (1973), Reilly and Joehnk (1976), and Haugen (1979).

The systematic risk of a company's common equity should bear a strong relationship to the ratings of its debt and preferred shares for several reasons. First, as Bowman (1979) illustrated, there is a theoretical relationship between a firm's systematic risk and the

firm's leverage and accounting beta. If one assumes that there is a positive correlation between the earnings of a company and the return of the market, then a positive relationship between earnings variability and a firm's systematic risk also follows.[2] As both systematic risk and corporate security ratings are determined by leverage, accounting beta and earnings variability, a relationship should exist between them. Changes in corporate security ratings will be signals of shift in leverage, accounting beta and earnings variability which would in turn affect the beta of the common stock. Downgrades of security ratings are signals of increases in leverage, accounting beta and earnings variability which raise systematic risk. Upgrades of security ratings are signals of decreases in leverage, accounting beta and earnings variability, which lower the systematic risk. Consequently, changes in systematic risk and shifts in security rating are inversely related.

Using monthly security data, Melicher and Rush (1974) observed this inverse relationship. In attempting to explain increases in beta over two consecutive five-year periods, a negative but insignificant coefficient of a variable capturing increases in ratings was determined. Haugen (1979) found a strong correspondence between the ratings on common stocks and subsequent betas.

Additional empirical evidence of the shifts in systematic risk accompanying rating changes is inferred from the results of Pinches and Singleton (1978). If rating changes contain monopolistic information with regard to a shift in the systematic risk of a security, then the announcement of these events will be a signal to investors to adjust their expected beta. Pinches and Singleton examined the cumulative average residuals from the market model over the months before, of and

after the security rating changes. They noted that the residuals of common stocks of companies with improvements in security ratings generated a pattern of cumulative residuals that increased up to the announcement date and decreased subsequently. The opposite pattern was observed for rating reductions. An explanation may lie in their use of observations from both before and after rating shifts to estimate betas. Because systematic risk would likely decrease following the announcement of a rating increase, a beta estimated over the whole time period would be an under-estimate of the systematic risk before the announcement and an over-estimate after. This would lead to positive market model residuals for the period before the upward rating shift and negative residuals for the subsequent periods which in turn would explain the pattern of cumulative average residuals. Analogous arguments for reductions of security ratings would explain the opposite pattern of cumulative average residuals observed for them.

Because of the theoretical and empirical evidence, the proposed study will attempt to measure shifts in systematic risk upon the announcement of rating changes. The null hypothesis to be tested is that there are no shifts in systematic risk upon the announcement of rating changes. The alternative hypotheses are that a rating increase (reduction) will result in a decrease (increase) in beta on the announcement date.

Changes in price could also accompany the rating change announcement. A rating reduction could signal that the company will have a lower expected mean of cash flows to not only service the obligations of their debt and preferred shares, but also to contribute to the common shareholders. The opposite could be true of a rating

increase. Consequently, the announcmenmt of a rating reduction (increase) would lead to a one-time decrease (increase) in the price of the common equity.[3] This effect would be impounded in the market model residual on the announcement date. The null hypothesis to be tested is that there is no significant impact on the residuals of the announcement of a rating change. The alternative hypothesis is that a rating reduction (increase) will result in a negative (positive) residual on the announcement date.

The most recent and extensive published study of the effect of bond rating changes on daily common equity returns was performed by Holthausen and Leftwich (1986). They found that the announcements of downgrades had a significant effect as measured by the daily residuals of the market model while the announcements of upgrades had no significant effect.[4] After removing all rating changes with contemporaneous events, the effect of the downgrades was reduced but remained significant at a 1% level of significance.[5] Stickel (1986) examined the effect on the daily returns of a much smaller number of common equities of companies with preferred shares that had their ratings revised. The only difference in results from those of Leftwich and Holthausen was that upon the elimination of rating changes with contemporaneous events, the significance of the effects disappeared. These studies, substantiated by others by Pinches and Singleton (1978) and White and Lusztig (1980), illustrate the importance of handling other firm-specific contemporaneous events when measuring the impact of one type of information.

Instead of eliminating observations, this paper will examine the effects of these contemporaneous events directly and so distinguish the

impact of rating changes from them. Limiting a study to only rating changes with no contemporaneous events may bias the results. As Holthausen and Leftwich (1986) comment, the direction of this bias is uncertain as there are reasons both why the method would understate and overstate the effect. Furthermore, this study will be the first to test for a shift both in systematic risk as well as price. The statistical procedure is described in the next section. Section III presents the data while Section IV illustrates the results. Conclusions are drawn in the final section.

II. METHOD

Previous research on the capital market impact of rating changes has almost exclusively used examination of market model residuals as a method of analysis. Holthausen and Leftwich (1986) provide a recent example. Used by Schipper and Thompson (1983) in their event study, pooled cross-section time series analysis offers an alternative means of estimating the effects of rating changes. It improves upon previously employed methods in two ways. First, pooled cross-section time series analysis permits shifts in systematic risk to be examined as well as abnormal returns. Measurement of single period abnormal returns should reflect shifts in price. Second, the method allows the effect of multiple events across both time and securities to be measured. Thus the impact of the announcement of rating changes can be isolated from that of contemporaneous news.

In order to specify the correct pooled cross-section time series model, the effects of all contemporaneous information likely to have an impact should be incorporated. As an important determinant of the degree of systematic risk, announcements of increases and decreases in leverage should lead to changes in beta. It has also been argued by researchers such as Beaver, Kettler and Scholes (1970) that changes in dividend payout should be a signal of shifts in systematic risk. Since companies are reluctant to reduce dividends, increases in dividends are a signal that management expects earnings will be less sensitive to economic downturn. Consequently, announcements of increases in payout should be a signal of lower systematic risk and announcements of reductions in payout should have the opposite effect.

Announcements of changes in leverage and dividends paid per share should also result in one-period abnormal returns because they are signals of shifts in expected cash flows. A study by Masulis (1983) shows how announcements of management's action to increase leverage have a positive impact on price. Woolridge (1983) demonstrated that unexpected dividend increases (reductions) lead to positive (negative) abnormal returns while Joy, Litzenberger and McEnally (1977) showed that news of unexpected changes in earnings also results in adjustments of common stock prices. Furthermore, because research in this area has found asymmetric impacts to favourable/unfavourable news, separate variables will be used to measure each. Holthausen and Leftwich (1986) suggest several reasons for the asymmetry. As the loss function of the rating agencies may not be symmetric, downgrades may be issued on a more timely basis than upgrades. There is also evidence to suggest that management is reluctant to release unfavourable news. As Chambers and

Penman (1984) illustrate, unexpected positive earnings reports are on average early whereas unexpected negative earnings reports are late. Thus whereas the investment community would anticipate rating upgrades because of previously released favourable information, it would not expect a rating reduction because management would tend to withhold adverse news. A third rationale for the asymmetry is that investors have asymmetric utility functions with respect to equal but opposite changes in the company's condition. An unexpected one percent loss in earnings would affect expected utility more than a one percent increase in earnings.

There are announcements of company-specific information other than dividends, earnings per share and changes in leverage which should also cause abnormal returns. Depending on the expected impact on price, miscellaneous information was categorized as favourable, neutral and unfavourable. Because of the difficulty in classifying them objectively, most of the miscellaneous events were categorized as neutral.[5] However, a large number of items could still be classified as positive or negative where it was highly likely that the impact of an event on the common stock price was in a particular direction. For example, the announcement of a court ruling in favour of a company would at the very least have no negative effect on the common stock price.

The pooled cross-section time series model for this study is composed of a series of equations of the following form:

$$(1)\quad \ln(1+R_{jt}) = \delta_0 + \delta_1[\dot{a}_j + \delta_j \ln(1+R_{mt})]$$

$$+ \sum_{k=1}^{6} \delta_{1+k}\,[C_{kjt} \ln(1+R_{mt})] + \sum_{i=1}^{11} \delta_{7+i}\, D_{ijt}$$

$$+ \sum_{p=1}^{2} \delta_{18+p}\, F_{pjt} + U_{jt} \quad ; \quad j=1, \ldots N \quad t=1, \ldots T$$

where R_{jt} = daily rate of return on security j in period t.

$\dot{a}_j, \delta_j$ = regression coefficients estimated for security j over an interval prior to the test period using the market model.

R_{mt} = return on the Standard and Poor's 500 Composite Index in period t

D_{ijt} = residual dummy variables for announcement of event type i relating to security j.

i = 1 rating increase

i = 2 rating reduction

i = 3 earnings per share increase

i = 4 earnings per share decrease

i = 5 dividend increase

i = 6 dividend decrease

i = 7 increase in leverage

i = 8 reduction in leverage

i = 9 favourable information

i = 10 unfavourable information

i = 11 neutral information

C_{kjt} = beta shift dummy variables for announcement of event type k relating to security j[6]

k = 1 rating increase

k = 2 rating reduction

k = 3 increase in leverage

k = 4 decrease in leverage

F_{pjt} = alpha shift dummy variable for announcement of event type p relating to security j

p = 1 rating increase

p = 2 rating reduction

The coefficients on the beta shift dummy variables and residual dummy variables are used to measure shifts in beta and in price respectively.[7] A dummy residual variable is equal to one for the date for publication in the Wall Street Journal, one for day before and zero otherwise. Moody's and Standard and Poor's usually announce rating changes at 10:30 a.m. or 2:00 p.m. on the business day before publication in the Wall Street Journal. Occasionally announcements are made after the New York Stock Exchange closes. Thus the dates of new information must also include the day of publication.

As the precise timing of the issuance of other firm-specific information could also not be established, the other residual dummy variables were set equal to one for the day of and the day before publication in the Wall Street Journal Index. The use of these residual dummy variables assumes that the market has semi-strong form efficiency. Semi-strong form efficiency is

substantiated by the studies of Fama, Fisher, Jensen and Roll (1969), Waud (1970) and Scholes (1972) and White and Lusztig (1980). The model also assumes that the impact of each variable is homogenous across securities and over time.

The alpha shift variables for rating upgrades and downgrades was included to capture the impact of changes in the alpha coefficient of the market model. The variable took the value zero up to the day of publication and one thereafter. Because no impact is expected, coefficients of these variables significantly different from zero will weaken conclusions drawn from the model.

The pooled cross-section time series model employs the variable $[\hat{a}_j + \hat{b}_j \ln (1 + R_{mt})]$ which represents the return generated by the market model. For each rating change, $\hat{a}_j$ and $\hat{b}_j$ were estimated using the market model with returns on the 240 trading days from the 300th to 61st observation before the announcement date. Any observations prior to a previous rating change were eliminated and a minimum of 60 observations was required to estimate $\hat{a}_j + \hat{b}_j$.

In order to select thirty days as the number of daily observations before and after each rating change required to estimate the pooled cross-section time series model, several criteria were used. First, most of the contemporaneous events were concentrated in the month and a half before and after a rating change. In addition, a sufficient number of observations was needed to reduce estimation error.

In the absence of any company-specific information and measurement error, the value of the coefficient δ_1 should be one for all securities. An alternative formulation for the pooled cross-section time series model would be to have separate intercept and market

variables for each security. This alternative formulation would improve the percentage of variance explained but would sharply increase the number of coefficients to be estimated and thus reduce the degrees of freedom. This loss of efficiency because of the reduction in degrees of freedom outweighs the increased percentage of variance explained in choosing the model with more variables.

Weighted least squares was selected as the method to estimate the coefficients of the model. As Thiel (1971) discusses, the technique is employed where the variances of the residuals of the model across observations are different but there is no cross correlation. Previous research by Schwartz and Whitcomb (1977) indicates that residual variances across securities differ and that autocorrelation is present in market model residuals. However, the uncertainty of the source of autocorrelation has meant that alternative methods of estimation which assume autocorrelation such as Cochrane-Orcutt have not improved upon those that do not. Because the vast majority of rating changes in this study occurred at different dates, any contemporaneous correlation will have little impact.

In order to use weighted least squares, an estimation of the standard error of the market model residuals for each stock is required. These standard errors were estimated using the same observations needed to estimate $\hat{a}_j$ and $\hat{b}_j$ for each rating change. Each variable for a rating change was then divided by the estimate of the standard deviation of the residuals of the security's market model.

III. DATA

Rating changes by Moody's for the period January 1, 1970 through December, 1984 and by Standard and Poor's between January 1, 1970 and December 31, 1977 were selected on the basis of the following criteria[8]:

i) the rating change was published in the Wall Street Journal

ii) the daily returns of the firms were recorded by the Center for Research in Security Prices at the University of Chicago for a minimum of 300 days prior to the day of publication

iii) the firm had no rating changes announced in the Wall Street Journal in the period prior to the rating change over which the parameters of the market model were estimated

iv) the firm was not previously announced as being under review for a possible rating change.[9]

Since there were few rating changes prior to January 1, 1970, that day was chosen as the starting date. A chronological listing of the announcements of rating changes is presented in Appendix II.A, Table II.A1. Usually all rated securities of a company are affected by a rating change. Thus, although the majority of securities whose ratings were changed were bonds and preferred shares, ratings changes for commercial paper were included, as listed in Appendix II.A, Table II.A2, II.A3 and II.A4.

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The daily return on the market, R_{mt}, was obtained from the total return on the Standard and Poor's Index contained on the Daily Price Relative Tape of the Center for Research in Security Prices. The Wall Street Journal Index was examined for the thirty days before, day of and thirty days after each rating change and any firm-specific events identified were classified into the previously outlined categories. Because no models of the formation of expectations have been widely accepted, naive random-walk models were assumed. Consequently, the dividend per share expected next period is equal to that of this period; the earnings per share expected in this next quarter is equal to earnings per share of the same quarter last year. The current degree of corporate leverage is assumed to be the expectation before the announcement of new debt or equity. Any digressions from these expectations from announcements were considered new information and were modeled accordingly; otherwise the announcements were not incorporated.

IV RESULTS

The first line of Table II.1 illustrates the coefficients of the model after estimation by weighted least squares. The hypothesis that the announcement of rating downgrades and upgrades will not affect systematic risk is rejected. The coefficients of both beta shift variables for rating changes are significant but the rating increase coefficient is of the opposite sign to that expected. Because all the beta shift variables and the market factor variables are composed of

the same market returns, multicollinearity may present difficulties. In order to measure the impact of multicollinearity, a regression which constrains the value of the coefficient δ_1 to be equal to its theoretical value of one was estimated. The results of this constrained regression are shown in line two. The fact that the coefficients of the rating increase and rating reduction beta shift variables became insignificant is an indication of multicollinearity. Consequently, all subsequent analyses used constrained regressions.

Because the coefficient of the beta shift variable was insignificant, further analysis was performed to investigate whether the insignificance was a result of the estimation techniques employed rather than the underlying economics. The Pinches and Singleton method was replicated on the sample of rating changes for monthly data and similar patterns of cumulative residuals resulted. All betas estimated over the thirty-six months after the rating changes were regressed onto betas estimated over the months from forty-two to seven months prior to the rating announcement and a dummy variable set equal to one for a rating decrease and zero for rating increases. If rating decreases cause upward shifts in systematic risk while rating increases produce downward shifts, a significantly positive coefficient on the dummy variable is expected. Tables II.2 and II.3 show the coefficients of the dummy variables for samples of rating changes including and excluding leverage shifts. When all rating shifts were examined, the coefficient of the dummy variable was significantly positive at a ten percent level of significance. However, when the rating changes with leverage shifts were removed, the hypothesis could not be rejected.

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A regression, similar to that using monthly data, of 496 betas calculated from returns on days +60 to +240 onto betas calculated from returns on days -239 to -60 was performed (see Table II.4). The dummy variable was not significantly different from zero at a ten per cent level of significance. Excluding the rating changes with shifts in leverage did not alter the results. Consequently the daily and monthly results substantiate each other.

Both lines 1 and 2 of Table II.1 indicate the coefficient of the rating reduction residual dummy variable is negative and statistically significant at the one percent level.[10] The coefficient of the rating increase residual dummy variable is not significantly different from zero at even a ten percent level of significance. These asymmetric results are consistent with those of Holthausen and Leftwich (1986) and the arguments outlined earlier.

This asymmetry also appears in the coefficient of the other residual dummy variables which all have the correct expected sign and t-statistics significant at least at the ten percent level. The coefficient of the e.p.s. decrease variable has three times the absolute magnitude of that of the e.p.s. increase variable, while the coefficient of the increase in equity variable has almost three times the absolute magnitude of that of the increase in debt variable. The coefficient of the positive information variable has only one-sixth the absolute magnitude of that of the negative information variable. Only the absolute value of the coefficient of the dividend decrease variable is not substantially greater than that of the dividend increase variable. As expected, the coefficient of the neutral information variable is insignificant.

The coefficients of the alpha shift variable are not significantly different from zero at the ten percent level of significance on line 1 of Table II.1. Consequently, the changes in the market model after rating upgrades or downgrades did not include shifts in the intercept coefficient.

The method used to produce results for the first two lines of Table II.1 assumes that the amount of news is homogenous across all rating changes regardless of the number of grades the rating was changed. Holthausen and Leftwich (1986) provide evidence that the number of grades shifted is an important factor. Appendix II.A, Table II.A2, II.A3 and II.A4 outline the distribution of the shifts. Standard and Poor's uses pluses and minuses to make their ratings more precise within each category below AAA and CCC; Moody's began doing likewise with numerical subclassifications in May 1982. Consequently, a one-category change under the old Moody's rating system for this range of ratings was given three times the value of a Standard and Poor's and more recent Moody's change. As line three illustrates, when the residual dummy variables are weighted in this way, the magnitude of their coefficient falls.[11] The same weighting scheme is applied to the other regressions.

Because a high percentage of the rating shifts are accompanied by changes in leverage, multicollinearity may arise from including both the rating shift and leverage change variables. Approximately forty percent of the announcements of rating changes have news of changes in leverage in the surrounding sixty days. However, as line four shows, constraining the leverage change variables to be zero does not affect the coefficients of either the rating change beta shift or dummy residual variables.

Researchers such as Scholes and Williams (1977) have illustrated how non-synchronous data leads to autocorrelation and biased beta estimates. To evaluate the effect of non-synchronous data on the results of this study, rating changes with no other firm-specific contemporaneous information in the thirty days before, day of and thirty days following were eliminated. This method assumes that thin-trading and a lack of published announcements regarding the common shares are positively related. As the results of line five are virtually unchanged from line three, non-synchronous data has had little impact.[12]

To evaluate the stationarity of the pooled cross-section time series model, the rating changes were divided into two groups. The coefficients for these two groups are reported in lines six and seven. As the F-statistic calculated with the sum of squared errors of regressions reported in lines three, six and seven is 1.03 and the critical value of $F(18,\infty)$ at the five percent level is 1.60, one cannot reject the null hypothesis of stationarity of the model. Holthausen and Leftwich (1986) contend that the advent of new competition made the rating agencies provide more timely information subsequent to December 31, 1980. The rating changes before and after this date were examined separately. The coefficients of the dummy residual variables for rating changes for the period subsequent to December 1980 were higher in absolute value than those measured before. However, an F-test across the two samples could not reject the hypothesis of stationarity of the model.

V CONCLUSIONS

This paper uses a pooled cross-section time series model to measure the capital market impacts of security rating changes. This approach permits tests of significance of rating changes not only in one-time shifts in price but also in shifts in systematic risks. Furthermore, it removes the effects of confounding events on and around the dates of the rating changes.

The null hypothesis that the level of systematic risk was unchanged before and after the rating changes cannot be rejected from our examination of daily and monthly data. The null hypothesis that there are no one-time price effects for rating reductions can be rejected at a one percent confidence level, while for rating increases the null hypothesis cannot be rejected even at a ten percent confidence level. This asymmetric pattern which was similar to that of three of the four other pairs of positive/negative residual dummy variables supports the argument that companies are reluctant to release unfavourable information.

Table II.1

RESULTS OF WEIGHTED LEAST SQUARES REGRESSION ESTIMATIONS BASED ON 400 RATING CHANGES [1,2]

EQUATION	MARKET FACTOR	BETA SHIFT VARIABLES: RATING REDUCTION	RATING INCREASE	INCREASE IN DEBT	INCREASE IN EQUITY	RESIDUAL BUNDT VARIABLES: DIVIDEND INCREASE	DIVIDEND DECREASE	E P S INCREASE	E P S DECREASE	RATING REDUCTION	RATING INCREASE	INCREASE IN DEBT	INCREASE IN EQUITY	POSITIVE INFO	NEGATIVE INFO	NEUTRAL INFO	ALPHA SHIFT VARIABLES: RATING INCREASE	RATING DECREASE	CONSTANT	CASES	R^2
A BASIC EQUATION																					
1	0 893	0 070	0 079	0 005	-0 006	0 006	-0 007	0 004	-0 012	-0 002	-0 000	0 002	-0 005	0 001	-0 009	[redacted]	-0 0004	0 0002	-0 005		
	(62 13)	(2 63)	(2.14)	(0 14)	(0.11)	(3 24)	(1 68)	(4.07)	(11 15)	(2 64)	(0 01)	(1 67)	(2 76)	(1 73)	(10 78)	(0 20)	(1 53)	(0 86)	(0 51)	400	0 12
B MULTICOLLINEARITY																					
2	n a	0 002	-0.002	0 015	-0 005	C 006	-0 006	0 004	-0 012	-0 002	-0 000	0 002	-0 005	0 0015	-0 009	-0 000	-0 0004	0 0002	0 007		
		(0 08)	(0 06)	(0 40)	(0.09)	(3 24)	(1 65)	(4 02)	(11 09)	(2 66)	(12)	(1 62)	(2 74)	(1 81)	(10 75)	(0 20)	(1 32)	(0 98)	(0 70)	400	0 01
C METRIC FOR RATING CHANGE																					
3	n a	-0 014	-0 007	0 031	0 011	0 006	-0 006	0 004	-0 012	-0 001	0 000	0 002	-0 005	0 0015	-0 009	-0 0001	-0 0004	0 0002	-0 012		
		(1 02)	(0 63)	(0 84)	(0 21)	(3 22)	(1.65)	(4 00)	(11 10)	(2 62)	(0 21)	(1 65)	(2 75)	(1 80)	(10 77)	(0 25)	(0 90)	(1 76)	(1 35)	400	0 01
D PROXY FOR CHANGE IN CAPITAL STRUCTURE																					
4	n a	-0 008	-0 004	n a	n a	0 006	-0 006	0 004	-0 012	-0 001	0 000	n a	n a	0 0015	-0 009	-0 0001	-0 0001	0 0002	-0 012		
		(0 69)	(0.26)			(3 13)	(1 65)	(3 95)	(11 07)	(2 61)	(0 23)			(1 84)	(10 79)	(0.31)	(0 94)	(1 68)	(1 31)	400	0 01
E NON-SYNCHRONOUS DATA																					
5	n a	-0 010	-0 005	0 028	0 010	0 007	-0 006	0 004	-0 012	-0 001	0 0001	0 002	-0 005	0 002	-0 009	-0 000	-0 0001	0 0002	-0 013		
		(0 68)	(0 30)	(0 75)	(0 18)	(3 28)	(1 64)	(4 03)	(11 13)	(2 59)	(0 17)	(1 67)	(2 79)	(1 83)	(10 89)	(0 04)	(0 98)	(1 58)	(1 39)	372	0 01
F STATIONARITY																					
6	n a	-0 003	0 000	0 115	0 115	0 006	-0 0002	0 003	-0 013	-0 001	0 000	0 001	-0 003	0 002	-0 009	-0 001	0 0002	0 0	-0 013		
	(1970-1977)	(0 12)	(0 68)	(2 15)	(1 43)	(2 17)	(0.03)	(1 85)	(7 60)	(1 67)	(0 68)	(0 74)	(1 28)	(1 83)	(6 59)	(1 66)	(1 61)		(1 00)	179	0 01
7	n a	-0 015	-0 015	-0 011	-0 04	0 006	-0 010	0 006	-0 011	-0 001	-0 001	0 002	-0 0058	0 001	-0 009	0 005	-0 0003	0 0002	-0 011		
	(1978-1984)	(0 87)	(0 58)	(0 33)	(0 52)	(2 29)	(1 70)	(3 89)	(8 34)	(2 23)	(0 16)	(1 60)	(2 58)	(0 90)	(8 36)	(0 78)	(1 16)	(1 07)	(0 89)	221	0 01

[1] t-statistics are shown in parentheses below the regression coefficients. The abbreviation n a signifies not applicable.

[2] t = -30, -29, ..., 0, ..., +29, +30 days

[3] Includes announcement of new issue of preferred shares

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Table II.2

REGRESSION OF POST-RATING CHANGE BETAS ON PRE-RATING CHANGE BETAS

(Monthly Data)

Model: $(\text{Post } \beta) = \delta_0 + \delta_1 (\text{Pre } \beta) + \delta_2 C$

where C = 0 for rating increase
1 for rating reduction

Parameters:*

δ_0	δ_1	δ_2
0.555	0.438	0.100
(0.084)	(0.063)	(0.064)

Adjusted R^2 = 0.13

Number of rating increases	88
Number of rating decreases	236
Total	324

* standard errors in brackets

Thomas E. Copeland and J. Fred Weston, Financial Theory and Corporate Policy, Los Angeles, California: Addison-Wesley Publishing Company, Inc., (1983).

Paul Danos, Doris L. Holt and Eugene A. Imhoff, Jr., "Bond Raters' Use of Management Financial Forecasts: An Experiment in Expert Judgement", The Accounting Review, Vol. 59, (1984), pp. 547-573.

E.F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work", Journal of Finance, Vol 25, (May 1970), pp. 383-417

E.F. Fama, L. Fisher, M.C. Jensen and R. Roll, "The Adjustment of Stock Prices to New Information", International Economic Review, Vol. 10, (February 1969), pp. 1-21.

H. Russell Fraser, "Utility Bond and Commercial Paper Ratings", Public Utility Fortnightly, (September 27, 1973), pp. 42-45.

J. Glascock, "Announcement Effects of Bond Rating Changes on Common Stock Prices", Unpublished dissertation, North Texas State University, (1984).

Paul Grier and Steven Katz, "The Differential Effects of Bond Rating Changes Among Industrial and Public Utility Bonds by Maturity", Journal of Business, Vol. 49, (April 1976), p. 226-239.

Paul A. Griffin and Antonio Z. Sanvicente, "Common Stock Returns and Rating Changes: A Methodological Comparison", Journal of Finance, Vol. 37, (March 1982), pp. 103-119.

D.K. Guilkey and Peter Schmidt, "Estimation of Seemingly Unrelated Regressions with Vector Autoregressive Errors", Journal of the American Statistical Association, Vol. 68, (September 1973), pp. 642-647.

Robert A. Haugen, "Common Stock Quality Ratings and Risk", Financial Analysts Journal, Vol. 35 (March/April 1979), pp. 68-71.

George W. Hettenhouse and William L. Sartoris, "An Analysis of the Information Value of Bond-Rating Changes", Quarterly Review of Economics and Business, Vol. 16, (Summer 1976), pp. 65-78.

R. Higgins, Financial Management: Theory and Applications, Palo Alto: Science Research Associates (1977).

R.W. Holthausen and R.W. Leftwich, "Stock Price Effects of Bond Rating Changes", Journal of Financial Economics, Vol. 7, (September 1986), pp. 57-89.

Table II.4

REGRESSION OF POST-RATING CHANGE BETAS ON PRE-RATING CHANGE BETAS

(Daily Data)*

Model: $(\text{Post } \beta) = \sigma_0 + \sigma_1 (\text{Pre } \beta) + \sigma_2 C$

where C = 0 for rating increases
= 1 for rating decreases

Parameters: **

σ_0	σ_1	σ_2
0.361	0.589	-0.051
(0.044)	(0.037)	(0.037)

Adjusted R^2 = 0.34

Number of rating increases	164
Number of rating decreases	332
Total ***	496

---

* The results excluding all rating changes with contemporaneous leverage shifts are similar to those above.

** Standard errors in brackets.

*** The number of rating changes analyzed exceeds the number in the pooled cross-section time series analysis because rating changes with recent prior shifts were not excluded.

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NOTES

1 For summary of evidence, see Chapter 10, pp. 317-353, "Financial Theory and Corporate Policy", Thomas E. Copeland, J. Fred Weston.

2 If there is a negative correlation between the earnings of a company and the return of the market, then a negative relationship between earnings variability and a firm's systematic risk follows. Thus, lower earnings variability will lead to both a higher rating and a higher beta. However, because earnings of a company and of the market are most often positively correlated, this paper assumes that earnings variability and systematic risk are positively related.

3 This analysis assumes that a rating change will affect prices principally through a shift in the mean of the expected cash flows of the firm. The prices of the shares could also be affected by a change in the variability of the cash flows of the firm. Option pricing theory indicates that the increase in variability of the firm, ceteris paribus, raises the value of equity and reduces the value of debt. As higher variability of expected cash flows, ceteris paribus, is signalled by rating increases on debt, the positive impact on equity is opposite to that hypothesized. However, higher covariability of cash flows with the market usually accompanies higher variability of cash flows. Thus, the systematic risk of the common equity will rise. This higher systematic risk will require that investors discount expected cash flows at a higher rate and thus the price of the shares will be adversely affected. This negative impact should offset the positive reaction to increased variability of cash flows.

4 Although he did not control for the effect of contemporaneous events, Glascock (1984) found similar results with his analysis of daily market model residuals.

5 Most announcements of changes in corporate personnel were hypothesized to be routine and not incorporated in the model.

6 Beta shift variables for annquncements of changes in dividends per share were used as proxies for announcements of increases and decreases in payout. However, the coefficients of these variables were found to be insignificant and not included in the model reported in Table II.1.

7 The distribution of residuals of the market model using daily data tends to be fat-tailed rather than normal. Consequently, the measures of statistical significance of the coefficients must come under scrutiny. Yet evidence provided by Box and Anderson (1955), Hotelling (1961) and Kendall and Stuart (1973) indicates that tests of means are robust even when distributions are not normal. Simulations by MacBeth (1975) showed that this was true for samples as small as 30 observations and thus the tests of coefficients reported herein should be robust.

8 Rating changes by Standard and Poor's could not be obtained for the period after December 31, 1977.

9 The rating agencies began to publish lists of companies whose securities were under scrutiny for possible rating revision. Standard and Poor's first published "Creditweek" on November 9, 1981 and Moody's began to issue press releases titled "Corporate Watchlist" recently.

10 The equation was also estimated where the dummy variables for rating changes were non-zero for the days surrounding the day of and day before announcement in the Wall Street Journal. The residual dummy variable for the two days after the announcement was insignificantly different from zero. However, the residual dummy variable for the second and third days before the announcement of a rating decrease was significantly different from zero at a five percent level. One explanation would be a two-day delay in publication of a few rating changes announced by rating agencies such as those that Stickel (1986) reported. Another explanation could be that the market anticipated the rating change to some extent.

11 For rating changes affecting multiple securities of a company, the average magnitude of the changes were used as a metric.

12 Another test was performed to measure the effect of nonsynchronous data. The Center for Research in Security Prices records days of no trades as zeroes on the returns files. Although these are indistinguishable from days of zero returns, securities with a high percentage of zero returns are likely those with a lot of nonsynchronous trading. Thus, the regression was run on a smaller set of securities all of which had to have at least 75% of the observations in calculating both the market model parameters and the pooled cross-section model as non-zero entries. The regression results were similar to those in line 3. Note that all regressions in Table II.1 required that at least 50% of the observations in calculating the market model parameters neither be zero nor missing.

Appendix II.A

Table II.A1

DISTRIBUTION OF RATING CHANGES THROUGH TIME

Year	Increases	Decreases	Total
1970	0	2	2
1971	1	2	3
1972	1	6	7
1973	2	6	8
1974	0	7	7
1975	16	19	35
1976	26	33	59
1977	25	38	63
1978	14	11	25
1979	10	15	25
1980	4	24	28
1981	0	23	23
1982	7	81	88
1983	34	60	94
1984	42	37	79
TOTAL	182	364	546

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Table II.A2

DISTRIBUTION OF RATING CHANGES BY RATING FOR MOODY'S
(EXCEPT COMMERCIAL PAPER)

Old Rating	New Rating																			
	Aaa	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3	Ba1	Ba2	Ba3	B1	B2	B3	Caa	Ca	C
Aaa		27	2																
Aa1	10		4	2	42														
Aa2		2		5		2													
Aa3		1	2		14	7													
A1		22	1	6		11	5	36											
A2				1	9		18	5	1										
A3					1	8		17	16	5									
Baa1					40	3	9		18	4	20			1					
Baa2							9	5		9	3	1	1						
Baa3								8	6		8	9	2	1	1				
Ba1								17	4	6		5	5	29					
Ba2								1	2	5	2		10	5	2				
Ba3												1		4	1		1		
B1											15	2	2		4	8	13		
B2													4	1		2	3		
B3													2	2	6		10	1	
Caa														3	3			4	
Ca															1				
C																			

Note: Moody's expanded system of classification in May 1982 from one without numerical subdivisions.

Table II.A3

DISTRIBUTION OF RATING CHANGES
BY RATING FOR STANDARD AND POORS

Old Rating	New Rating																
	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B	CCC	CC	C
AAA		1	7														
AA+																	
AA	6	1		10	5	18											
AA-		1				2											
A+							1										
A			12		11		7	2	28	1							
A-						2		1	4								
BBB+						2	2										
BBB						10	1	3		3		18					
BBB-												1					
BB+									2								
BB									9				1	8			
BB-												1			6		1
CCC																	
CC																	
C																	1

Table II.A4

DISTRIBUTION OF RATING CHANGES
BY RATING FOR COMMERCIAL PAPER

(All by Moody's)

Old Rating	New Rating			
	P1	P2	P3	NOT PRIME
P1		28		
P2	5		12	
P3		1		2
NOT PRIME				

CHAPTER III

The Capital Market Impact of Recent Canadian Bank Failures

I. Introduction

The purpose of this chapter is to study how the announcement of difficulties at three Ontario trust companies in 1983 and two Alberta Schedule A chartered banks in 1985, as well as the news of the ensuing runs on deposits at other chartered banks, affected the price and systematic risk of common shares of non-distressed financial institutions [1] Studies of American bank failures by Pettway (1980) and Aharony and Swary (1983) indicate that a contagious reaction among common shareholders of non-distressed banks to news of such events occurs only where the announcements of distress reveal problems shared by other banks or by the whole banking system.[2] For example, the announcement of difficulties of the Franklin National Bank from foreign exchange losses affected other large money-centre banks with similar exposure to such losses. On the other hand, failures of U.S. banks resulting from managerial fraud did not affect other banks because they were considered by investors as firm-specific problems

In Canada during recent years, there has been considerable debate as to whether the problems of the failed Canadian financial institutions were isolated to them. The debate has taken on special significance because evidence of industry-wide problems has motivated the recommendation of new government regulation by the Dupré (1985) and Estey (1985) inquiries. The Dupré Report (1985) in analyzing the reasons for the "Trust Company" affair, cited the lack of regulation

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Thomas E. Copeland and J. Fred Weston, Financial Theory and Corporate Policy, Los Angeles, California: Addison-Wesley Publishing Company, Inc., (1983).

Paul Danos, Doris L. Holt and Eugene A. Imhoff, Jr., "Bond Raters' Use of Management Financial Forecasts: An Experiment in Expert Judgement", The Accounting Review, Vol. 59, (1984), pp. 547-573.

E.F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work", Journal of Finance, Vol. 25, (May 1970), pp. 383-417.

E.F. Fama, L. Fisher, M.C. Jensen and R. Roll, "The Adjustment of Stock Prices to New Information", International Economic Review, Vol. 10, (February 1969), pp. 1-21.

H. Russell Fraser, "Utility Bond and Commercial Paper Ratings", Public Utility Fortnightly, (September 27, 1973), pp. 42-45.

J. Glascock, "Announcement Effects of Bond Rating Changes on Common Stock Prices", Unpublished dissertation, North Texas State University, (1984).

Paul Grier and Steven Katz, "The Differential Effects of Bond Rating Changes Among Industrial and Public Utility Bonds by Maturity", Journal of Business, Vol. 49, (April 1976), p. 226-239.

Paul A. Griffin and Antonio Z. Sanvicente, "Common Stock Returns and Rating Changes: A Methodological Comparison", Journal of Finance, Vol. 37, (March 1982), pp. 103-119.

D.K. Guilkey and Peter Schmidt, "Estimation of Seemingly Unrelated Regressions with Vector Autoregressive Errors", Journal of the American Statistical Association, Vol. 68, (September 1973), pp. 642-647.

Robert A. Haugen, "Common Stock Quality Ratings and Risk", Financial Analysts Journal, Vol. 35 (March/April 1979), pp. 68-71.

George W. Hettenhouse and William L. Sartoris, "An Analysis of the Information Value of Bond-Rating Changes", Quarterly Review of Economics and Business, Vol. 16, (Summer 1976), pp. 65-78.

R. Higgins, Financial Management: Theory and Applications, Palo Alto: Science Research Associates (1977).

R.W. Holthausen and R.W. Leftwich, "Stock Price Effects of Bond Rating Changes", Journal of Financial Economics, Vol. 7, (September 1986), pp. 57-89.

37

H. Hotelling, "The Behavior of Some Standard Statistical Tests Under Non-Standard Conditions", Proceedings of the Fourth Berkeley Symposium, edited by Jerzy Neyman, Berkely, California: University of California Press (1961), pp. 319-359.

J.E. Jaffe, "Special Information and Insider Trading", Journal of Business, Vol. 47, (July 1974), pp. 410-428.

Maurice Joy, Robert H. Litzenberger and Richard W. McEnally, "The Adjustment of Stock Prices to Announcements of Unanticipated Changes in Quarterly Earnings", Journal of Accounting Research, Vol. 15, (Autumn 1977), pp. 207-225.

Steven Katz, "The Price Adjustment Process of Bonds to Rating Reclassifications: A Test of Bond Market Efficiency", Journal of Finance, Vol. 29, (May 1974), pp. 551-559.

Robert S. Kaplan, "The Information Content of Financial Accounting Numbers: A Survey of Empirical Evidence", Working Paper #10-75-76, Carnegie-Mellon University (September 1975).

Maurice G. Kendall and Alan Stuart, The Advanced Theory of Statistics, Vol. 2, 3rd ed., New York: Hafner Publishing Company (1973), Chapter 31.

James MacBeth, Tests of the Two Parameter Model of Capital Market Equilibrium, Unpublished Doctoral Dissertation, University of Chicago, (March 1975).

Ronald M. Marshall, "Interpreting the API", The Accounting Review, Vol. 50, (January 1975), pp. 99-111.

Ronald W. Masulis, "The Impact of Capital Structure Change on Firm Value: Some Estimates", Journal of Finance, Vol. 38, (March 1983), pp. 107-126.

Ronald W. Melicher and David F. Rush, "Systematic Risk, Financial Data and Bond Rating Relationships in a Regulated Industry Environment", Journal of Finance, Vol. 29, (May 1974), pp. 537-544.

S. Meyer, "The Stationarity Problem in the Use of the Market Model of Security Price Behavior", The Accounting Review, Vol. 48, (April 1973), pp. 318-322.

Moody's Bond Record, July 1976.

George E. Pinches and J. Clay Singleton, "The Adjustment of Stock Prices to Bond Rating Changes", Journal of Finance, Vol. 23 (March 1978), pp. 29-44).

George E. Pinches and Kent A. Mongo, "A Multivariate Analysis of Industrial Bond Ratings", Journal of Finance, Vol. 28, (March 1973), pp. 1-18.

Thomas F. Pogue and Robert M. Soldofsky, "What's in a Bond Rating?", Journal of Financial and Quantitative Analysis, Vol. 4, (June 1969), pp. 201-228.

Frank K. Reilly, Investment Analysis and Portfolio Management, Hinsdale, Illinois: The Dryden Press (1979).

Frank K. Reilly and Michael D. Joehnk, "The Association Between Market-Determined Risk Measures for Bonds and Bond Ratings", Journal of Finance, Vol. 31, (December 1976), pp. 1387-1403.

Irwin Ross, "Higher Stakes in the Bond Rating Game", Fortune, (April 1976), pp. 133-142.

M.S. Scholes, "The Market for Securities: Substitution versus Price Pressure and the Effects of Information on Share Price", Journal of Business, Vol. 45, (April 1972), pp. 179-211.

M. Scholes and J. Williams, Estimation Betas from Non-synchronous Data", Journal of Financial Economics, Vol. 5, (1977), pp. 309-327.

R.A. Schwartz and D.K. Whitcomb, "Evidence on the Presence and Causes of Serial Correlation in Market Model Residuals", Journal of Financial and Quantitative Analysis, Vol. 11, (June 1977), pp. 291-313.

Scott E. Stickel, "The Effect of Preferred Stock Rating Changes on Preferred and Common Stock Prices", forthcoming Journal of Accounting and Economics, 1986.

Henri Theil, Principles of Econometrics, Toronto: John Wiley and Sons, Inc. (1971).

James C. Van Horne, Financial Management Theory and Policy, Englewood Cliffs, N.J.: Prentice Hall, Inc. (1977).

Roger N. Waud, "Public Interpretation of Federal Reserve Discount Rate Changes: Evidence on the Announcement Effect", Econometrica, Vol. 38, (March 1970), pp. 231-250.

Mark I. Weinstein, "The Effect of Rating Change Announcement on Bond Price", Journal of Financial Economics, Vol. 5, (December 1977), pp. 329-350.

R.W. White and P.A. Lusztig, "The Price Effects of Rights Offerings", Journal of Financial and Quantitiative Analysis, Vol. 15, (March 1980), pp. 25-40.

39

J. Randall Woolridge, "Dividend Changes and Security Prices", Journal of Finance, Vol. 38, (December 1983), pp. 1607-1615.

A. Zellner, "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias", Journal of the American Statistical Association, Vol. 57, (June 1962), pp. 348-368.

of the banks had a higher level of exposure. One would expect that the contagious effects of increased systematic risk and lower price would differ between these two sets of banks.

Second, the bailout and subsequent runs at the CCB, the Northland Bank, Mercantile Bank, Continental Bank and the Bank of British Columbia drew attention to the exposure of banks of lower than average security ratings, especially those which relied heavily on wholesale deposits. Most wholesale deposits exceed the $60,000 insurance limit for deposits in trust companies and chartered banks in Canada. In times of increased uncertainty such as that following the CCB bailout, uninsured depositors tend to transfer funds from banks of lower ratings to financial institutions of higher ratings.[4] This "flight to quality" forces the affected institutions to rely on special liquidity assistance from stronger banks or Canada's central bank, the Bank of Canada. These banks are then placed in a vulnerable position where they could be forced to liquidate assets or be merged on terms unfavourable to the shareholders. Thus, expected bankruptcy costs would increase and the price of the shares of the lower rated banks would fall.

Table III.2 shows that the banks, at the time of the CCB bailout fell into ratings of two classes -- those with debentures rated below A and commercial paper rated below R1 low and those with more highly rated securities. The lower rated banks were the Bank of British Columbia, Canadian Commercial Bank, Continental Bank and Mercantile Bank. Furthermore, the CCB, Continental Bank, and the Mercantile Bank had only 15 percent or less of their liabilities in the form of the

to control self-dealing between trust companies and their personal and corporate owners as an industry-wide problem. The Estey Report (1986) contended weaknesses in the regulatory, accounting and auditing methods affecting all chartered banks led to the demise of the Canadian Commercial Bank (CCB) and Northland Bank. On the other hand, both trust company and banking industry representatives claim that the major causes of difficulties of the failed institutions were not widespread, thus these representatives conclude that many of the regulatory reforms recommended in these government reports are unwarranted.[3]

In order to test for a contagious reaction across financial institutions upon news of distress, a pooled cross-section time series model was employed. Pooled cross-section time series analysis offers more efficient parametric estimates than do the techniques used in earlier studies of bank failures.

The results from the analysis indicate that contagion effects were present in both the "Trust Company" affair and the Alberta banks crisis. The common share prices of other trust companies decreased when the involvement of three Ontario trust companies in a highly questionnable non-arms length transaction was revealed and later when their takeover by the Ontario government was announced. Upon announcement of the bailout of the CCB, the price of common shares of the non-distressed Schedule A chartered banks fell. At the same time, the systematic risk of banks with significant exposure to the oil and gas sector increased as the CCB bailout revealed the extent of difficulties in that sector. News of runs on deposits reduced the

common share prices of Canada's lower rated banks because these banks were prone to a "flight to quality" reaction among depositors.

The paper is divided into six sections. Section II develops competing hypotheses about the impact of announcements of distress on the prices and systematic risk of common shares of trust companies and banks. Section III describes the method of pooled cross-section time series. The time series data analyzed in our study are described in Section IV, while Section V reports the empirical results. Conclusions are presented in the final section.

II. News of Distress and Effect on Price and Systematic Risk

When difficulty at a bank or trust company is announced, the shareholders of other financial institutions will change their expectations if new information relevant to their securities has been revealed. The extent of the effect depends on how symptomatic the problems of the failed institution were of others. The difficulties could relate only to financial institutions with characteristics similar to those of the failed ones or could be so pervasive that the whole banking or trust company industry is affected. The following section reviews the "Trust Company" Affair and Alberta bank failures and develops hypotheses to be tested.

The "Trust Company" Affair

As the chronology in Appendix III.A illustrates, in late 1982 three Ontario trust companies were reported to be financing the purchase of 11,000 Toronto apartments at a price of $500 million by a series of numbered companies of undisclosed ownership. The security of the trust company financing was widely questionned because a few days earlier the apartments were purchased for $275 million by a

private company, Greymac Credit, whose ownership was closely connected to that of the trust companies. Greymac Credit resold the apartments to another related company, Kilderton Investments which in turn sold them to the numbered companies for a considerable profit. Because the mortgages provided by the trust companies appeared to exceed the legislated maximum percentage of 75% of the market value of real estate secured, the provincial government of Ontario took over the trust companies in January 1983.

The susceptibility of all trust companies to problems from self-dealing was highlighted by the announcements of the "Trust Company" affair. Common shareholders of most publicly traded trust companies in Canada were potentially subject to self-dealing from shareholders holding significant blocks of shares. Higher expectations of self-dealing would reduce expected cash flows because shareholders would expect greater misappropriation of firm assets and more difficulty in attracting deposits because of the unfavourable publicity. Based on this logic, the events are contagious; that is, upon announcement of these events, the price of the shares of the non-distressed trust companies would decrease. On the other hand, shareholders of the other trust companies may have viewed the "Trust Company" affair as an isolated event attributable to the suspect activities of a particular set of managers and controlling shareholders. Consequently, their expectations of the level of self-dealing among the other trust companies would be unchanged and no adverse reaction of the depositing public would be anticipated. Thus, the nul hypothesis is that the events are firm-specific and there is no information content with respect to the change in share prices of

the non-distressed trust companies in the announcement of the "Trust Company" affair.

The Alberta Bank Failures

In March 1985, the federal government, province of Alberta and the six largest Canadian chartered banks provided $225 million in financial aid to the Canadian Commercial Bank (CCB) headquartered in Edmonton, Alberta. Despite this assistance and the use of a massive line of credit from the Bank of Canada, the CCB and soon after another regional but smaller bank, the Northland Bank, experienced widely publicized runs on their deposits in the Spring and Summer of 1985. On September 1, 1985, the federal government closed these institutions but gave assurances that uninsured depositors would be compensated through special proposed legislation. In the ensuing months, as Appendix A chronicles, several smaller Schedule A banks experienced runs on deposits.

The bailout of the Canadian Commercial Bank (CCB) in March 1985 is argued to have had a ~~contagious effect~~ because it revealed new information about the extent of problems shared by other Schedule A chartered banks in Canada. First, the bailout showed how poor was the quality of loans to the oil and gas industry of Western Canada. If this information was new, expected cash flows of banks with portfolios of loans concentrated in these sectors would decrease and their common share prices would fall. Furthermore, systematic risk would increase because loans to these sectors would be perceived as more susceptible to economic downturn. The exposure of the banks to these areas is illustrated in Table III.1. The National Bank and the Bank of Nova Scotia had minimal exposure to the oil and gas industry while the rest

of the banks had a higher level of exposure. One would expect that the contagious effects of increased systematic risk and lower price would differ between these two sets of banks.

Second, the bailout and subsequent runs at the CCB, the Northland Bank, Mercantile Bank, Continental Bank and the Bank of British Columbia drew attention to the exposure of banks of lower than average security ratings, especially those which relied heavily on wholesale deposits. Most wholesale deposits exceed the $60,000 insurance limit for deposits in trust companies and chartered banks in Canada. In times of increased uncertainty such as that following the CCB bailout, uninsured depositors tend to transfer funds from banks of lower ratings to financial institutions of higher ratings.[4] This "flight to quality" forces the affected institutions to rely on special liquidity assistance from stronger banks or Canada's central bank, the Bank of Canada. These banks are then placed in a vulnerable position where they could be forced to liquidate assets or be merged on terms unfavourable to the shareholders. Thus, expected bankruptcy costs would increase and the price of the shares of the lower rated banks would fall.

Table III.2 shows that the banks, at the time of the CCB bailout fell into ratings of two classes -- those with debentures rated below A and commercial paper rated below R1 low and those with more highly rated securities. The lower rated banks were the Bank of British Columbia, Canadian Commercial Bank, Continental Bank and Mercantile Bank. Furthermore, the CCB, Continental Bank, and the Mercantile Bank had only 15 percent or less of their liabilities in the form of the

relatively stable deposits of individuals versus an average of 33 percent for the other Schedule A banks as at March 1985.

The wide divergence between what the financial statements and bond rating agencies reported on the condition of the CCB and its actual state of affairs drew the effectiveness of bank auditors, examiners and security rating agencies into serious question. Immediately after the CCB bailout was announced, a Canadian security rating agency, the Dominion Bond Rating Service lowered its ratings on CCB's debentures from BBB to CC and on CCB's commercial paper from R2 high to R2 middle. The downgrading suggests that the market was not aware of the problems of the CCB because of imperfections in the examination process; the revelation of the extent of the imperfections could lead investors to question the credibility of examinations of other banks. Investors could conclude that other banks were in worse condition than examinations revealed and decreases in price and increases in systematic risk would follow. This type of contagion would affect all bank shares equally.

It should be stressed that the presence of any of these types of contagion effects requires that new information be revealed by the events. As the publicly traded banks were widely studied by financial analysts over the period, there is merit to the argument that the information about industry-wide problems was already impounded in the common share prices and that no contagion effects will be observed.

If changes in the price of the non-failed bank stocks at the time of the CCB bailout in March 1985 and the collapse in September 1985 are identified, they will be examined for the three potential sources of contagion effects -- shared Western Canadian exposure, the "flight

to quality" and loss of confidence in the monitoring and regulatory system. In order to distinguish among the three different sources, the banks will be divided into three groups:

Group 1: Banks with low ratings and with heavy exposure to Western Canada. Exposure to Western Canada's problems will be measured by the percentage of a bank's assets in the oil and gas sector. The Bank of British Columbia, Continental Bank and Mercantile Bank belong to this group.

Group 2: Banks with high ratings and heavy exposure to Western Canada. Included in this group are the Bank of Montreal, Canadian Imperial Bank of Commerce, Royal Bank and Toronto-Dominion Bank.

Group 3: Banks with high ratings and minimal exposure to Western Canada. In this group are the Bank of Nova Scotia and National Bank.

If shared Western Canadian exposure was a major source of contagion, then the price effects on groups 2 and 3 would differ. If low security ratings contributed to contagion then the price effects on groups 1 and 2 would differ. If the loss of confidence in the monitoring and regulatory system was the cause of contagion, the price effects would be significantly different from zero and equal across all groups. If there were no contagion effects the price effect would not significantly differ from zero.

Ordering the Hypotheses

In testing the equality of these price effects across groups, hypotheses must be established and ordered in terms of increasing the number of banks for which the effects are set to be equal. That is,

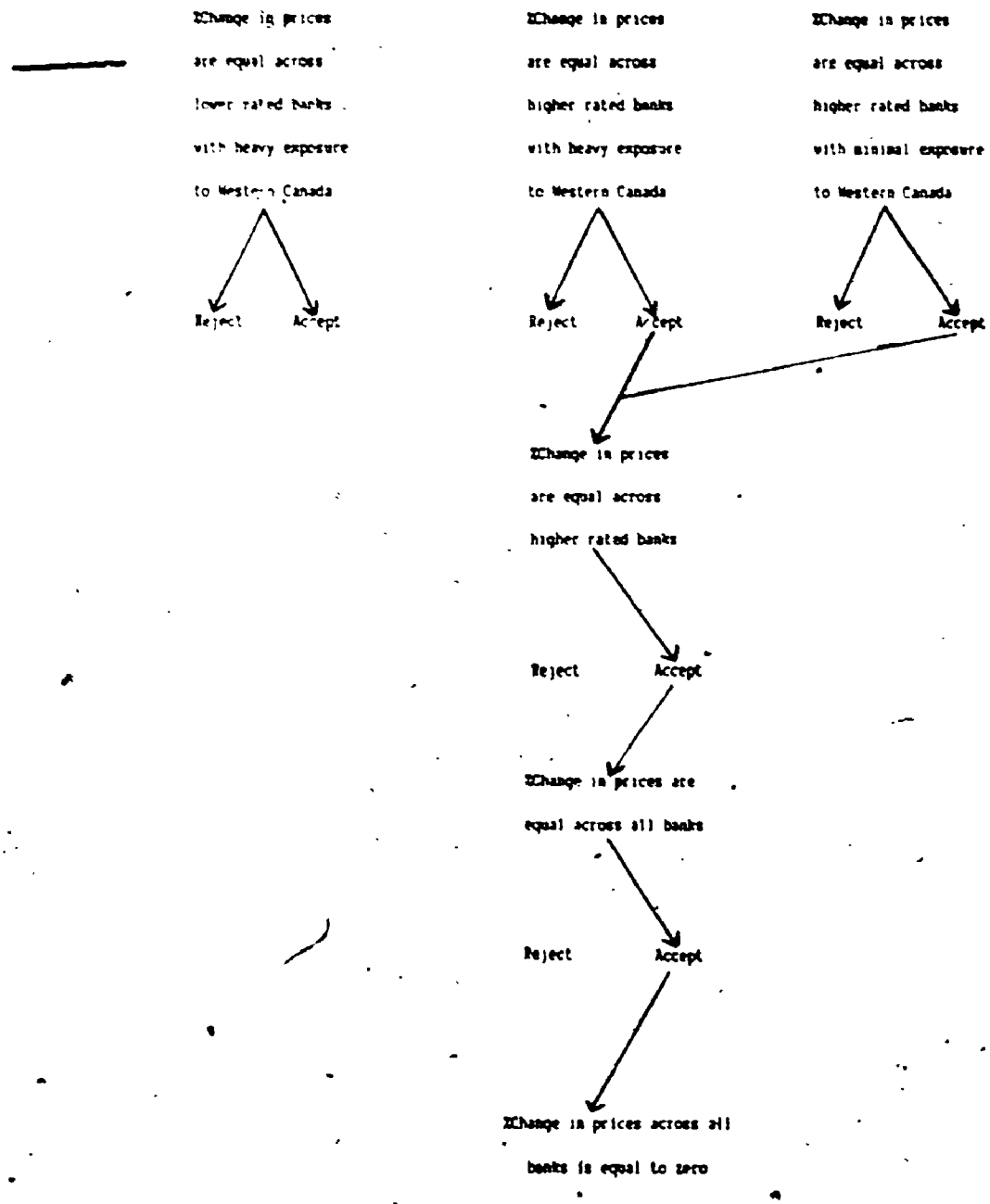
the first hypotheses is be that banks within group 2 all experienced the same percentage change and that banks within group 3 also had equal changes.[4] If neither of the hypotheses are rejected, then the next hypothesis will be that banks of group 2 had a percentage change equal to those of banks of group 3. Testing in order of increased restrictiveness of the equality of the coefficients allows successive test statistics to be independent (Harvey 1981, pp 184-185). Exhibit III.1 outlines the order of hypotheses which will be tested to examine the effect on common stock price of the non-failed banks at the time of the CCB bailout and its September 1, 1985 collapse.

EXHIBIT III.1

ORDER OF TESTING OF HYPOTHESES RESTRICTING EFFECT ON

STOCK PRICES FOR MARCH 26, 1985 ANNOUNCEMENT OF CCB BAILOUT

AND SEPTEMBER 3, 1985 ANNOUNCEMENT OF CCB COLLAPSE[1]



NOTE:

1 If the change in prices are not found to be equal, then the significance of their difference from zero should be tested.

Changes in systematic risk of the common shares of the non-failed banks at the time of the CCB bailout and collapse are hypothesized to arise from both the signal of greater exposure to Western Canada's problems and the loss of confidence in the regulatory and monitoring system. Consequently, the series of hypotheses needed to analyze the effect on systematic risk is be similar to that shown in Exhibit 1 for price except that banks are not segregated by security rating.

The initial announcement of a run on deposits at the CCB, Northland Bank, Mercantile Bank, Continental Bank and Bank of British Columbia were potentially signals of the "flight to quality" reaction of depositors. In order to test for contagion effects from these signals, the following hypotheses are examined for each announcement of distress:

1. The one-time percentage changes in the prices of the common shares of non-failed highly rated banks are equal.
2. The one-time percentage changes in the prices of the common shares of non-failed lower rated banks are equal.

If the first two hypotheses are not rejected then the hypothesis that the changes in the price of the shares of the high and low rated banks are equal will be tested. If either of the first two hypotheses are rejected, then for each common stock, the hypotheses that the percentage changes in price are not significantly different from zero will be tested.

III. METHOD

The hypotheses regarding one-period shifts in price and changes in systematic risk were tested by pooled cross-section time series models. The models explain common stock returns of non-distressed financial

institutions over the period surrounding the announcements of the "Trust Company" affair and Alberta bank failures by adding residual dummy and beta shift variables to the market model. Residual dummy variables detect one-period percentage shifts in price by identifying market model residuals significantly different from zero in a particular time period. Residual dummy variables have value one for the day of and day before the date of newspaper publication of the event and zero at other times. The time of the initial announcement is uncertain because the time of cut-off for newspaper publication differs from the closing time of the exchange. Shift variables measured changes in beta and have value zero for the days prior to the day before the announcement and one thereafter. To illustrate the model, consider a series of N, non-failed bank or trust company stocks over a T-day period during which there is announcement of distress in day t*:

$$r_{jt} = a_j + b_j r_{mt} + \alpha_j C_{jt} r_{mt} + \delta_j D_{jt} + e_{jt}; \quad j = 1,\ldots,N \quad t = 1,\ldots,T$$

where:

r_{jt} is the natural logarithm of one plus the total rate of return on the jth bank or trust company stock in day t

r_{mt} is the natural logarithm of one plus the total rate of return on the market in day t

a_j is the intercept coefficient of bank or trust company stock j

b_j is the beta of bank or trust company stock j

C_{jt} is the beta shift dummy variable for bank or trust company stock j announcement of distress

D_{jt} is the residual dummy variable for bank or trust company stock

j announcement of distress

α_j is the dummy variable coefficient to capture day t* shift in beta for bank or trust company stock j

δ_j is the dummy variable coefficient to capture day t* shift in price for bank or trust company stock j

The hypotheses outlined in the previous section were tested by evaluating the equality of dummy variable coefficients across common stocks of financial institutions in the order of increasing restrictiveness. For example:

1. H_o : The one-period percentage shifts in price with the news of the distress are not significantly different across the common stocks of the financial institutions,
   $\delta_1 = \delta_2 = \ldots = \delta_n$

2. H_o : The shifts in beta with the news of the distress are not significantly different across the common stocks of the financial institutions,
   $\alpha_1 = \alpha_2 = \ldots = \alpha_n$

3. H_o : The one-period percentage shifts in price with the news of the distress are not significantly different from zero,
   $\delta_1 = \delta_2 = \ldots = \delta_n = 0$

T-statistics were used to test linear restrictions on single coefficients, while the likelihood ratio test (LRT) examined the effects of multiple linear restrictions on the model.[5]

The pooled cross-section time series model employed an iterative Zellner method of estimation. The procedure first estimated a set of equations using ordinary least squares. The covariance matrix of residuals from these equations were then estimated and used to obtain a generalized least squares (GLS) estimator of the coefficients. These last two steps were interated until convergence was reached. It was noted that under the market model the ordinary least squares residuals of the bank stocks were significantly correlated, especially among the five largest chartered banks.[6] The significance of this contemporaneous correlation outweighed estimation error as a consideration in choosing GLS over ordinary least squares (OLS). The pooled cross-section time series method was also employed rather than separate OLS regressions because under the hypotheses tested, the suspected impacts were common across securities and thus the number of parameters to be estimated could be reduced.

IV. DATA

Daily individual common stock and market returns over the period January 3, 1984 to April 30, 1986 were obtained from the University of Western Ontario data base of Canadian securities to examine the effect of the March 1985 CCB bailout. The daily return on the market was calculated from the closing total return index of the Toronto Stock Exchange (T.S.E.) 300 Composite. The T.S.E. 300 Composite index is weighted by each listed company's value of outstanding shares which

are not part of control blocks of over 20 percent of outstanding shares. Of the twelve Schedule A chartered banks that remained after the CCB and Northland failed, only the three smallest banks were not included in the Canadian securities data base for the period under study.

In order to measure the extent of contagion from the "Trust Company" affair of January 1983, a similar model was extimated using data for the eight trust companies which were continuously listed over the period November 3, 1981 through March 2, 1984. Returns of securities for days when there were no trades were recorded as zero returns. However, all the chartered banks and most of the trust companies had very few days with no trades. In the case of three trust companies, there were a large percentage of days with no trades. The analysis was performed excluding these securities and no significant difference in results was noted.

V. RESULTS

Trust Company Affair

The results of Table III.3 indicate that the non-failed trust companies were affected by the announcements of the events of the "Trust Company" Affair.[7] The announcements of the questionable apartment sale and financing and of the provincial government takeover had adverse impacts on the share prices of the eight publicly traded trust companies examined.[8] This suggests that the common shareholders of the eight trust companies revised their expectations of future cash flows because of their susceptibility to self-dealing by major shareholders and to adverse depositor reactions to the publicity.

CCB and Northland Failures

From a review of the Canadian Business Periodical Index for the period January 1981 through April 1986, important announcements concerning the bailout of the CCB and subsequent runs on the deposits at it and the other Schedule A chartered banks released by the Canadian financial press were listed in Appendix A. A priori, the two most important items of news were the March 26, 1985 announcement that the CCB was being granted a $225 million rescue package by the six largest Canadian chartered banks, the Federal and Alberta governments and the Canada Deposit Insurance Corporation; and the September 1, 1985 announcement that the Bank of Canada would stop supporting the CCB and the Northland Bank. Other significant events were believed to be dates when major runs on deposits were first announced for the CCB, Northland, Mercantile, Continental and Bank of British Columbia.

The March 26, 1985 announcement of the bailout of the CCB appeared to be a major surprise to the capital markets. The total return on the bank's convertible preferred shares was -4.0% over the period October 1, 1984 to March 1, 1985 while the total return on the Mcleod, Young, Weir Bank and Utilities Straight Preferred Index 10 over the same time period was 8.0%. Over the period March 1, 1985 to March 22, 1985 the return on CCB shares was -2.0%. The shares closed trading at $19 5/8 on Friday, March 22, 1985 but fell to $5 1/4 on Wednesday, March 27, 1985 when trading resumed after being suspended for two days. Consequently, there may have been some anticipation by the equity market of difficulty for the CCB in the months' prior but this anticipation was dwarfed by the impact of news of the bailout. The Canadian Bond Rating Service suspended its rating of the CCB upon

news of the bailout while the Dominion bond Rating Service sharply lowered it's rating. This surprise is also subatantiated inthe Estey Report (p. 490) which claims that the earliest that news of the extent of CCB's difficulties was believed to have been "on the street" was the week prior to the bailout. Use of dummy residual variables in our model for the trading day(s) prior to the bailout did not detect any early contagion.

Table III.4 shows the model which remained after the series of increasing restrictions outlined in the earlier section were placed on the coefficients of bank stocks. Restrictions which could not be rejected at a 10% level of significance were placed on the model. Because the Mercantile Bank was merged with the National Bank on February 12, 1986, the effects on the Mercantile's stock were analyzed separately as shown in Table III.5.

Effect of March 26, 1985 Announcement of CCB Bailout

The CCB bailout was announced by the Federal Government on Monday, March 25, 1985 but was not reported by Canadian newspapers until the morning of Tuesday, March 26, 1985. The coefficients of the residual dummy variable with a value of one for Monday, March 25, 1985 and Tuesday, March 26, 1985 and zero otherwise were not significantly different from zero. However, as further details of the bailout were reported on the following Wednesday through Friday, it is likely that the full impact could only be measured over the whole week of the bailout. Because there were other reports published in a leading Canadian newspaper about banks on Friday, March 29, the residual variable was valued at one for the first four days of the week of the bailout and zero otherwise.[9,10] The coefficient on the four day

residual dummy variable as reported in Table III.4 is significantly negative at a 10% level of significance. Because the equality of the March 25-28 price drop both within and across groups could not be rejected, it is likely that the announcement of the CCB had an adverse impact on the confidence of investors in the whole banking system.

The hypothesis that the beta shift of highly rated bank stocks with heavy exposure to Western Canada was not significantly different from the beta shift of highly rated banks with low exposure was rejected. In addition, the beta shifts of high and low rated banks with high Western Canadian exposure were not significantly different. Consequently, it is likely that the upward shift in beta was attributable to the higher sensitivity to the exposure of banks with assets in Western Canada, especially in the oil and gas sector. The upward shift in beta is significantly positive at a significance level of 1%.

"Normal" Shifts in Beta

The test for a shift in beta of the oil intensive bank stocks incorporated in the pooled cross-section time series method assumes that in the absence of the bailout, these betas would have been constant. As Dodd and Leftwich (1980) contend in their study of beta shifts after changes in corporate charters, betas do shift for a host of reasons and the nul hypothesis should not be that the shift in beta was nil. Rather the nul hypothesis should be that the shift in beta was a "normal" one.

In order to identify "normal" shifts in the betas of the Canadian oil and gas intensive banks at the time of the CCB bailout, the pooled cross-section time series analysis was replicated on twenty sets of

eight American companies over the period January 3, 1984 to December 31, 1985.[11,12] Each group of companies belonged to a different industry randomly selected from classifications in Standard and Poor's Industrial Compustat. With the returns for each group of stocks, the total return on the Standard and Poor's 500 Index and dummy residual and beta shift variables similar to those employed in the Canadian model, twenty pooled cross-section time series models were developed. As in the Canadian model, equality was restricted across the coefficients of the beta shift variables of a randomly chosen six of the eight securities in each model.

Twenty percent of the industry groups had experienced shifts in these betas that were significantly positive at a ten percent level. These results suggest that the conclusion that shifts in beta of the Canadian oil and gas sensitive stocks were "normal" can still be rejected, but at a weaker level of significance than the test against a nul hypothesis of no change indicates.

Pooled cross-section time series models of six groups of eight common stocks of U.S. banks over the same time period revealed that there were similar increases in betas. Three of the six groups had coefficients of beta shifts significantly positive at least at a ten percent level. Review of the Wall Street Journal Index over the period of January through March 1985 indicated that U.S. banks had experienced revelations of weakening security of loans to oil and gas and gricultural producers similar to those of the Canadian banks upon news of the CCB bailout.

Effect of September Collapse of CCB and Northland Banks

On September 1, 1985, the CCB and Northland collapsed but the federal government simultaneously announced that it would introduce legislation to protect fully the uninsured depositors. This latter announcement likely offset the negative effect of the failure as the coefficient of the September 3, 1985 dummy residual variable was not significantly different both within and across the hypothesized groups.[13] Furthermore, it was not found to be significantly negative at a 10% level of significance and no shift in beta was identified. However, as Table 5 shows, the price of the shares of the Mercantile Bank had a significantly negative reaction to the collapse of the two banks

Initial Announcements of Runs on Deposits[14]

Five Schedule A banks experienced runs on their deposits, principally wholesale deposits over the year following the bailout of the CCB. Of the six highest rated banks, only the Bank of Nova Scotia and National Bank experienced a significantly negative residual on any of the five days. The National Bank's loss on October 9 1985, when the fact that the banks were assisting the Mercantile Bank was announced is likely related to its merger bid for the bank. The fall in the price of the Bank of Nova Scotia's shares in February, 1986 was likely tied to rumours that it was bidding for the troubled Bank of British Columbia. Consequently, Canada's highest rated banks appeared relatively immune to contagion effects resulting from announcements of runs on deposits at lower rated banks.

The price of the shares of all three of the lowest rated banks fell significantly at least once upon the news of runs on deposits at other banks. The price of common stock of the Bank of British

Columbia dropped on April 26 and October 9, 1985 and on February 24, 1986 when an announcement of its own financial difficulties and a run on deposits was broadcast to the public. The Continental Bank had a significantly negative reaction to the news of a run on deposits at the Mercantile Bank on October 9, 1985 and on November 1 when news of a run on its own deposits was revealed. News of the Northland Bank's run on deposits on July 11 caused a significant price drop for the Mercantile Bank's shares. Interestingly, the Mercantile was the only bank not to suffer a significant fall in prices upon news of a run on its deposits. The rumour of a takeover bid from the National Bank had likely offset the adverse effect of the news.

Sensitivity of Results

In order to evaluate the sensitivity of the results to the time period chosen for analysis, the model was tested for the period until the end of December 1985.[15] Because the Mercantile Bank's stock was traded until February 12, 1986, it was included in the model. While the significance of the coefficients of the residual dummy variables was mostly unchanged, the significance of the beta shift coefficient fell to a 10% significance level.

Because the market and the beta shift variables have equal values after the CCB bailout, they are highly correlated and thus multicollinearity may arise. To reduce the degree of correlation, the number of observations prior to the CCB bailout was increased. The sign, absolute value and significance of the coefficients were essentially unchanged.

The model was replicated using monthly data for the periods beginning January 1981 and ending April 1986 and December 1985. The

results substantiated those of the daily model in that the coefficient of the March 1985 residual dummy variable was significantly negative at a 1% significance level and the coefficient of the beta shift variable was significantly positive at a five percent significance level.

The pooled cross-section time series analysis was also performed using a three factor model.[16] The hypothesis that the average March dummy residual was equal to zero was rejected at a 1% significance level. The hypothesis that the first factor's beta shift was equal to zero could be rejected at a 10% level of significance. However, the other two factors were not found to be significantly different from zero.

IV. Conclusions

This paper has tested for the presence of contagion from two of the most sensational sets of failures in the recent history of the Canadian financial system. The prices of the common stocks of the non-failed trust companies fell upon news of details of the apartment resale and financing and the subsequent government takeover during the "Trust Company" affair.

The initial small but significantly negative one-time price fall upon the announcement of the CCB bailout across non-distressed bank stocks reflected a loss of confidence in the entire banking system. The upward shift in beta of the oil intensive bank stocks after the bailout suggests that investors became more sensitive to the exposure of the banks to Western Canada. The sensitivity of the lower rated banks to the threat of deposit runs was highlighted by the significant reduction in share values that they experienced upon news of runs at

other banks. In contrast, after the small initial shock of the CCB bailout, Canada's highest rated Schedule A banks remained relatively immune to the difficulties at other banks.

All of these results substantiate the Dupré and Estey Reports' underlying assumptions that the difficulties of the failed institutions were in part sympotomatic of problems of other trust companies and banks. Consequently, efforts to improve the regulatory, accounting and auditing framework surrounding financial institutions' are well grounded.

Table III.1

CANADA'S ELEVEN LARGEST SCHEDULE "A" CHARTERED BANKS

CONCENTRATION IN WESTERN CANADA AND CANADIAN OIL AND GAS SECTOR

	Percentage of Total Number of Canadian Branches in British Columbia, Alberta and Saskatchewan[a]	Percentage of Total Assets in Canadian Oil and Gas Industry[c]
Bank of British Columbia	100.0%	N.A.[d]
Bank of Montrea	30.6%	4.3%
Bank of Nova Scotia	27.8%	1.6%
Canadian Commercial Bank	44.4%	N.A.
Canadian Imperial Bank of Commerce	31.7%	5.1%
Continental Bank	32.8%	N.A.
Mercantile Bank	28.6%	N.A.
National Bank	1.9%	2.6%[e]
Northland Bank	72.7%	11.2%[f]
Royal Bank	32.2%	5.2%
Toronto Dominion Bank	29.2%	4.4%

Notes:

[a] As reported by the Canadian Bankers' Association as of December 31, 1984
[b] Per 1984 Annual Report
[c] Estimates by Burns Fry Limited publication "Chartered Banks" February 12, 1986
[d] Not available
[e] Includes mostly loans acquired through merger with Mercantile
[f] Estey Report, p. 568

Table III.2

Security Ratings of Schedule 'A' Chartered Banks[a] as of January 1985

	Debentures	Commercial Paper
Bank of British Columbia[b]	BBB low	R2 high
Bank of Montreal	AA.	R1 middle
Bank of Nova Scotia.	AA	R1 middle
Canadian Commercial Bank	BBB	R2 high
Canadian Imperial Bank of Commerce	AA low	R1 middle
Continental Bank	BBB high	R2 high
Mercantile Bank	BBB high	R2 high
National Bank	A	R1 low
Northland Bank	n.a.[c]	n.a.
Royal Bank	AA high	R1 middle
Toronto Dominion Bank	AA high	R1 middle

NOTES

[a] Ratings provided by the Dominion Bond Rating Service.

[b] On March 7, 1986 the Bank of British Columbia's debentures were downgraded to BB, a substandard rating.

[c] Not available

Table III.3

POOLED CROSS-SECTION DAILY TIME SERIES
NOVEMBER 3, 1981 TO MARCH 2, 1984
MARKET MODEL
RESTRICTIONS ACROSS TRUST COMPANIES

Coefficients[a]

	Trust Company	Alpha	Residual Dummy		Beta	Post Jan 8 1983 Beta Shift	R-Squared
			Nov. 20 1982	Jan. 8 1983			
(1)	Central Trust	0.001	-0 017	-0.015	0.23	0 04	0 01
		(0.75)	(2 23)	(2.05)	(1.45)	(0.42)	
(2)	Canada Trust	0.001	-0.017	-0.015	0.51	0 04	0 08
		(1.27)	(2.23)	(2.05)	(5.84)	(0.42)	
(3)	District Trust	-0.004	-0.017	-0.015	-0.28	0 04	0.00
		(0.71)	(2.23)	(2.05)	(0.42)	(0 42)	
(4)	First City Financial Corp. Ltd.	0.000	-0.017	-0 015	0 59	0.04	0.04
		(0.38)	(2.23)	(2 05)	(4 14)	(0 42)	
(5)	Fidelity Trust	-0.003	-0.017	-0.015	-0.95	0 04	0.00
		(1.17)	(2.23)	(2 05)	(0.32)	(0 42)	
(6)	National Trust	0.002	-0.017	-0.015	-0 95	0.04	0.00
		(0 20)	(2 23)	(2.05)	(0 79)	(0.42)	
(7)	Royal Trust Co.	0.001	-0.017	-0.015	0 45	0 004	0 07
		(1 79)	(2 23)	(2.05)	(5 66)	(0 42)	
(8)	Victoria & Grey Trust Co	0.001	-0.017	-0 015	0 47	0 04	0 03
		(1 25)	(2.23)	(2 05)	(3 52)	(0 42)	

Log of the Likelihood Function = 7726 38

Notes:

a t-statistics are enclosed in brackets

b The r-squareds of three of the securities are nil. This is likely to consequence of the high percentage of days on which there were no trades Excluding these these securities did not alter the results of the model

Table III.4 .

POOLED CROSS-SECTION MONTHLY TIME SERIES
JANUARY 4, 1984 TO APRIL 30, 1986
MARKET MODEL
RESTRICTIONS ACROSS BANKS[a]

Coefficients

Chartered Bank	Alpha	Residual Dummy						Post Mar. 25 Beta Shift		R-Squared
		March 25-28	Apr. 26	July 11	Sep. 3	Oct. 9	Nov. 1	Feb. 24		
(1) Higher Rated Banks High Exposure to Western Canada										
(a) Bank of Montreal	0.000	-0.005	0	0	0	0	0	0	0.94	0.25	0.32
	(0.35)	(1.63)							(12.82)	(2.86)	
(b) Canadian Imperial Bank of Commerce	0.000	-0.005	0	0	0	0	0	0	0.90	0.25	0.26
	(0.43)	(1.63)							(11.39)	(2.86)	
(c) Royal Bank	0.000	-0.005	0	0	0	0	0	0	0.93	0.25	0.34
	(0.83)	(1.63)							(13.11)	(2.86)	
(d) Toronto Dominion	0.000	-0.005	0	0	0	0	0	0	1.20	0.25	0.36
	(0.73)		0	0	0	0	0	0	(14.86)	(2.86)	
(2) Higher Rated Banks Low Exposure to Western Canada											
(a) Bank of Nova Scotia	-0.000	-0.005	0	0	0	0	0	-0.041	1.38	-0.10	0.29
	(0.62)	(1.63)						(3.45)	(12.92)	(0.77)	
(b) National Bank	0.001	-0.005	0	0	0	-0.013	0	0	1.18	-0.10	0.23
	(1.91)	(1.63)				(1.48)			(11.29)	(0.77)	
(3) Lower Rated Banks											
(a) Bank of British Columbia	-0.002	-0.005	-0.040	0	0	-0.025	0	-0.116	0.27	0.25	0.05
	(2.04)	(1.63)	(2.15)			(2.36)		(4.39)	(1.44)	(2.86)	
(b) Continental Bank	-0.008	-0.005	0	0	0	-0.025	-0.032	0.053	0.78	0.25	0.11
	(1.01)	(1.63)				(2.36)	(2.50)	(2.96)	(6.04)	(2.86)	

Log of likelihood function = 14046.7

Notes:

[a] t-statistics are enclosed in brackets

Table III.5

POOLED CROSS-SECTION DAILY TIME SERIES
JANUARY 4, 1984 TO DECEMBER 31, 1985
MARKET MODEL
FOR MERCANTILE BANK

Coefficients

Alpha	March 26-28	April 26	July 11	Sept. 23	Oct. 3	Oct. 9	Nov. 1	Beta	Post Mar. 25 Beta Shift	R-Squared
-0.002	-0.008	0.019	-0.033	-0.056	0.084	0.005	-0.023	0.29	0.29	0.08
(1.50)	(0.66)	(1.08)	(1.89)	(2.26)	(4.81)	(0.29)	(1.30)	(1.29)	(0.68)	

Log of the Likelihood Function = 1155.38

Notes

1 Chartered banks in Canada are classified as either Schedule A or "B" banks. No person or associated group can own more than 10 percent of the voting stock outstanding of a Schedule A bank. Schedule "B" banks can be more closely held and consequently none were found in the Canadian securities data base. The major component of Canadian chartered bank assets is commercial lending. Canadian trust companies focus on fiduciary activities and mortgages. Trust companies are limited by legislation from providing commercial loans above a small percentage of assets while chartered banks are not allowed to provide fiduciary services.

2 Aharony and Swary (1983) examined the significance of market model residuals for a portfolio of non-failed banks at and surrounding the time of several bank failures in the U.S. Only in the case of the Franklin National Bank, a large financial institution which failed because of foreign exchange exposure shared by other banks, were the residuals significant on the date of the failure.

Pettway (1976) estimated the market model for a portfolio of non-failed bank securities for the periods before and after the bank failures. Only in the case of the Franklin National Bank was there a shift in a parameter. The residual variance temporarily increased. The time series plot of residuals from our pooled cross-section time series model did not reveal any shift in their variance between the periods before and after the March, 1985 CCB bailout.

3 In December 1985, R. MacIntosh, President of the Canadian Bankers Association (CBA) claimed that the problems of the Canadian Commercial Bank and Northland Bank were a result of a lack of diversification and poor management not shared by the major Canadian banks in his speech titled "The Banking System Remains Sound" given in Winnipeg, Manitoba.

4 Any beneficial effects on higher rated financial institutions would not be measurable in the case of Canadian institutions because the higher rated banks are much larger than the lower rated banks.

5 The likelihood ratio test assumes $2\ln L_r - 2\ln L_{max} \sim \chi^2_m$ where $\ln L_r$ is the log of the likelihood function with m restrictions $\ln L_{max}$ is the log of the unrestricted likelihood function For a description of this test, see Harvey (1981)

6 Approximately 50% of the correlation coefficients of the residuals across securities were found to be positive at a significance level of 5% using a t-statistic:
where r is the correlation coefficient and T is the number of observations.

7 The distribution of residuals of the market model using daily data tends to be fat-tailed rather than normal. This is expecially true of the trust company securities in our study. S imulations by MacBeth (1975) showed that tests relying on t-statistics are robust even when distributions are not normal; thus the tests of coefficients reported herein should be robust.

8 The equality of the price effects and beta shifts across the non-failed trust companies could not be rejected.

9 If one includes all five days of the week of the bailout, the coefficient on the dummy residual variable is significantly negative at a 5% degree of significance.

10 Review of the Canadian Business Index and Wall Street Journal Index did not reveal any other news unfavourable to banks over the four days.

11 The individual common stock and Standard and Poor's 500 Index total returns were available only until the end of 1985.

12 American securities were used because there was an insufficient number of different industries in Canada with at least eight securities with complete data over the period of study.

13 The dummy residual variable for the September 1, 1985 announcement had a value of one on September 3, 1985, the first trading day after and zero otherwise. No leads or lags of price effects could be determined for this event across the eight bank stocks.

14 The dummy residual variables for April 26, July 11, October 9 and November 1 had values of one for the day that news of the run was published in the newspaper, one for the previous day and zero otherwise. Because the February 24, 1986 announcement was made on a broadcast after the stock market closed, only the following trading day was given a non-zero value.

15 Event studies have been criticized because they have not accounted for the impact of the January and small firm effects. The effect of abnormal January returns was not significant as the results of a pooled cross-section time series model was unchanged upon excluding January returns. The small firm effect was not deemed to be important in this study as tests of impacts across groups of securities mostly included both small and large banks.

16 The factor scores required for the Multi-factor Model developed by the regression method from factor loadings estimated during the sixty months prior to the period of pooled cross-section time series analysis. For an explanation of the regression method, see. Harmon, H. (1976).

APPENDIX III.A

BANK FAILURES AND SIGNIFICANT DATES*

A. "Trust Company" Affair

October 9, 1982	Greymac Credit purchased 11,000 Toronto apartments.
November 20, 1982	Greymac sold properties to Kilderton Investments Ltd. which in turn sold them for a considerable profit to a series of numbered companies of undisclosed ownership.
	It was believed that Seaway Trust, Kilderton, Crown Trust Co., and Greymac were involved in the provision of additional mortgage money.
January 8, 1983	Ontario Government takes over three trust firms.

B. Canadian Commercial Bank and Northland Bank

March 26, 1985	$225 Million rescue package granted by Federal Government, Alberta Government, CDIC and six largest Canadian chartered banks.
	CCB hurt by three years of recession in Western Canada and deterioration in U.S. energy sector.

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* Dates when information was first published in newspapers or periodicals according to Canadian Business Index.

April 26, 1985	Governor of Bank of Canada acknowledges that CCB is receiving considerable advances.**
July 11, 1985	Report that Northland was losing deposits.**
September 1, 1985	Bank of Canada stops providing support to Northland and CCB; both banks collapse and deposits frozen.
October 3, 1985	Mercantile Bank rumoured to be takeover target.
October 9, 1985	Banks are believed to be helping Mercantile.**
October 22, 1985	Merger bid from National Bank for Mercantile.
November 1, 1985	$2.9 billion standby line of credit to Continental Bank arranged by Bank of Canada and and a group of financial institutions to Continental Bank**

** First public announcement that this bank was experiencing a run on deposits.

February 24, 1986

The Canadian Broadcasting Corporation makes television broadcast that the Bank of British Columbia and unsuccessfully requested a federal and provincial assistance package worth $800 million. Borrowing from Bank of Canada acknowledged.**

References

1 Aharony, Joseph and Swary, Itzhak "Contagion Effects of Bank Failures: Evidence from Capital Markets". Journal of Business 56 (July, 1983), pp. 305-322.

2 Brown Stephen J., and Warner, Jerold B. "Measuring Security Price Performance", Journal of Financial Economics 8 (1980), 205-258.

3. Brown, Stephen J., and Weinstein, Mark I., "Derived Factors in Event Studies", Journal of Financial Economics 14 (1985), 491-495

4 Dodd, Peter and Leftwich, Richard "The Market for Corporate Charters: 'Unhealthy Competition' versus Federal Regulation", Journal of Business 53 (January 1980), pp 259-283.

5. Dupré, J., Stephen, Rendall, Dick A. and Alexander J. MacIntosh. "Ontario Task Force on Financial Institutions," December 1985.

6 Estey, Honourable Willard Z. "Report of the Inquiry into the Collapse of the CCB and Northland Bank", August 1986.

7 Fowler, David J., Rorke, Harvey C., and Jog Vijay M. "Heteroscedasticity, R^2 and Thin Trading on the Toronto Stock Exchange", Journal of Finance 34 (December, 1979), 1201-1210.

8. Gibbons, Michael R. "Multivariate Tests of Financial Models", Journal of Financial Economics 10 (1982), 3-27.

9. Harman, Harry Modern Factor Analysis. Chicago: University of Chicago Press, 1976.

10. Harvey, Andrew C. The Econometric Analysis of Time Series. Oxford: Phillip Allan Publishers Limited, 1981.

11 MacBeth, James, Tests of the Two Parameter Model of Capital Market Equilibrium, Unpublished Doctoral Dissertation, University Chicago, (March 1975).

12. Malatesta, Paul H., "Measuring Abnormal Performance: The Event Parameter Approach Using Joint Generalized Least Squares", Journal of Financial and Quantitative Analysis, Vol. 21, No. 1, (March 1986), 27-38.

13. Miller, James M. and Stover, Roger D., "Additional Evidence on the Capital Market Effect of Bank Failure", Financial Management, (Spring 1983), 37-41.

14. Pettway, Richard H., "Potential Insolvency, Market Efficiency, and Bank Regulation of Large Commercial Banks", Journal of Financial and Quantitative Analysis. Vol. 15, (March, 1980), 219-236.

15. Scholes, Myron S., and Williams, Joseph. "Estimating Betas from Nonsynchronous Data", Journal of Financial Economics 5 (December, 1977), 309-327.

16. Schipper, Katherine, and Thompson, Rex, "The Impact of Merger-Related Regulations on the Shareholders of Acquiring Firms", Journal of Accounting Research 21 (Spring, 1983), 184-221.

17. Smith, Brian F. "Four Essays on the Economics of Financial Distress", Unpublished dissertation, University of Western Ontario; March 1987.

18. White, Robert W. "Arbitrage Pricing Theory and the Profitability of Canadian Chartered Banks: A Pilot Study", School of Business Administration, University of Western Ontario, W.P. No. 83-05, February, 1983.

CHAPTER IV

Variable Rate Deposit Insurance Premiums

I. Introduction

Before deposit insurance was introduced into the Canadian banking system, depositors had to assess the future liquidity of the institutions in which they placed their savings. Because the role of financial analyst requires an inordinate amount of resources from the small individual depositor, legislation was enacted in Canada to guarantee deposits up to a specified level. For example, deposits in trust companies and banks in Canada are guaranteed to a maximum of $60,000 whereas members' non-equity shares and deposits in British Columbia credit unions are fully guaranteed.

Government sponsored corporations such as the Canada Deposit Insurance Corporation (CDIC) were established to administer the guarantee. Although these corporations have ultimate recourse to the government, they are required to maintain a pool of funds sufficient to cover administrative costs and in all but the most dire contingencies, to pay off depositors of failed financial institutions.

Because the reserves of the deposit insurance corporations are maintained through assessments of the financial institutions, a primary issue to be reviewed is how the deposit insurance premiums should be set? The amount of deposit insurance premiums paid by a given financial institution depends on the jurisdiction. Deposit insurance premiums for the Canadian chartered banks and trust companies are now calculated by a fixed percentage of the deposits they hold. On the other hand, British Columbia has legislated a

maximum level of premiums. However, as yet no jurisdiction charges different premiums to financial institutions on the basis of the riskiness of the assets they own.[1] A number of authors including Kreps and Wacht (1965, 1971), Meltzer (1967) and Scott and Mayer (1971) have cited the need for premiums variable with the riskiness of the assets held to control risk or at least to ensure "fairness" in the pricing of premiums. That is, if a financial institution lends money to oil wildcatters then, ceteris paribus, it will face higher deposit insurance premiums than if it finances NHA insured mortgages.

There are two ways in which government authorities now control the risk that financial institutions can incur in the absence of variable premiums. First, most jurisdictions closely restrict the type of assets in which a financial institution may invest. For example, the Credit Union Act of British Columbia dictates the type of bonds and mortgages that a credit union in the province can purchase. A second method is to set a minimum level of equity or permanent capital. As the shareholders are subordinated to the depositors in case of bankruptcy, the equity provides a cushion against losses to the deposit insurer. The main criticism of these methods is that they are not "efficient" in the sense that within a certain bound of activity, one bank could incur more risk than another and yet still pay the same deposit insurance premium; variable deposit insurance premiums have been proposed to remedy this inefficiency.

In the credit unions of British Columbia, the only "permanent" capital is the retained earnings. All the shares of the credit unions are members' shares which are fully redeemable upon demand and are completely insured by the provincial deposit insurance corporation,

the Credit Union Deposit Insurance Corporation (CUDIC). Furthermore, because the courts subordinate the members' shares to the common creditors in the case of bankruptcy, the CUDIC in fact bears a contingent liability on 100% of all liabilities and members' shares.

Merton (1977) has developed a theoretical model for setting variable rate premiums for deposit insurance. The model is applicable to the British Columbia credit union system because one of its main assumptions is that the deposit insurer has a 100% contingent liability. Merton based the model on his argument that there is a one-to-one correspondence between the seller of deposit insurance and the writer of a European put option; consequently deposit insurance premiums are equivalent to the price of a put and can be estimated via the Black-Scholes option pricing model. The purpose of this paper is to apply the model to the British Columbia credit union system and so bring the theoretical model one step closer to implementation. At the very least, it is probable that the models developed herein could be used as a tool by the deposit insurance corporations to evaluate their exposure over time and across credit unions.

Marcus and Shaked (1984) and Ronn and Verma (1986) applied the Merton model to large U.S. banks. Because these banks had publicly traded shares, a critical input of the model, the variance of the return on assets was calculated from the variance of the return on equity. However, as a large number of financial institutions are privately owned, the technique is not widely applicable. Furthermore, because legislation such as the Canadian Bank Act allows for more limited disclosure of financial information from banks than is required of non-financial institutions, it can be questioned whether

the investment community can properly assess the value of equity in a financial institution. This paper estimates the variance of asset returns directly and thus the method herein employed can be applied to all financial institutions and even to the system as a whole.

Two additional assumptions of the Merton model are also made less restrictive in order to better correspond to the present role of the deposit insurer. First, the model is extended to allow the deposit insurer to choose between stabilization and liquidation in the event of financial distress of a credit union rather than always assuming liquidation.[2] Second, a further adjustment of the model is made to evaluate the impact of allowing interim audits.

The paper proceeds as follows. Section II presents the theoretical basis for these extensions to the Merton model. Section III outlines the method employed to compute the premiums with the data described in Section IV. Results are provided in Section V which lead to the conclusions of Section VI.

II. The Theoretical Model

By specifying assumptions that placed the deposit insurer in the equivalent position of the writer of a European put option,[3] Merton used the Black-Scholes put option model to value deposit insurance. In Merton's model, a deposit insurance corporation only acts when an audit is conducted just as a writer of a European put option may only have the option exercised on the expiry date. At the time of the next audit, the deposit insurer will acquire and sell off the assets of the financial institution and pay off the depositors by the amount the deposits exceed the value of the assets. Consequently, the deposit

insurer will face an asymmetric payoff structure analogous to that of the writer of the put option at the expiry date. Then, the deposit insurer will have exposure equal to MAX [0, Amount of Deposits - Value of Assets]. This is similar to the put option writer's exposure of MAX [0, Exercise Price - Value of Stock] at the date of expiry.

By making corresponding assumptions about the amount of deposits and value of assets, the analogy is complete. Similar to the value of a stock that a put option is written on, the value of the assets of the financial institution is assumed to be determined by a logarithmic returns generating process. While the exercise price of a put option on a stock is usually fixed, the amount of deposits of a financial institution at the time of the next audit can be determined by an accumulation at a risk-free rate of interest in Merton's model. Analogous to the put option pricing formula, the value of deposit insurance is calculated as follows:

$$\text{Value of Insurance Premium} = -A\,[1 - N(h_1)] + L\,[1 - N(h_2)]\,e^{-rfT} \qquad (1)$$

where T = time to next audit

L = demand deposits at time of next audit

A = current market value of assets

rf = risk-free rate of interest

$N(h_1)$ = cumulative density function of h_1

where

$$h_1 = [\ln(A/L) + (rf + \tfrac{1}{2}\sigma^2)\,T] \,/\, \sigma\sqrt{T}$$

$N(h_2)$ = cumulative density function of h_2

where

$h_2 = h_1 - \sigma\sqrt{T}$

σ^2 = instantaneous variance of the return on assets

For the Merton model to be appropriate, it is important to ensure that the assumptions of the Black Scholes put option model are applicable to the British Columbia credit unions.

1. Limited Period of Deposit Insurance Coverage With Claims Settled at End of Period

To apply the Merton Model, the deposit insurer must first be placed in a time frame equivalent to that of the European put option writer. Instead of a prespecified expiration date when the terminal value of a European put option is determined, the deposit insurer usually faces the possibility of a claim upon the fund at any point in time in the future because of the unlimited life of the guarantee. The model presented herein will assume that the deposit insurance will only cover one period of time and that payoff can only occur at the end of the period of time.

The assumption of a limited time period may be appropriate if the deposit insurer only guarantees claims during a fixed term. In this case, if the financial institution does not pay its deposit insurance premiums, then it will face cancellation of its deposit insurance coverage for that time period. This is essentially how the CDIC operates but not how CUDIC does.

For CUDIC, the assumption of payoff only at the end of the period of time is supported by the fact that the annual audit of the financial statements usually occurs then. Furthermore, it is reasoned that most revelations of financial distress occur during the auditor's visit. However, there is an aspect of this assumption less certain.

Considerable time is often needed to perform an orderly liquidation which would be required to receive reasonable proceeds of disposition. Hence, even though the payoff occurs at the end of the planning period the fair market value of the assets is not realized until final disposition.

Because deposit insurance corporations can reduce their exposure by sooner identifying potentially bankrupt financial institutions, there is a strong incentive for them to monitor those units which are nearing financial distress. Appendix IV.A illustrates this point and provides a description of an extension to the Merton model which will allow for an interim audit. The extended model is similar to the valuation of a compound put option because only if the insured credit union is not liquidated at the interim audit is deposit insurance required for the period just preceding the final audit.

2. Resolution of Claims by Deposit Insurer

The Merton model assumes that at the end of the period the market value of the assets is compared to the book value of liabilities insured.[4] If the financial institution has assets with market value lower than the amount of liabilities insured, then the deposit insurer is assumed to pay out the difference. The amount paid out will thus either be nil or equal to the shortfall of liabilities less the market value of assets. The value of the insurance premium needed to cover the guarantee is thus identified at the end of the period, time T as:

$$\text{Claim} \quad \begin{cases} L-A & A<L \\ 0 & A \geq L \end{cases}$$

Value of insurance premiums at T = Maximum [0, L-A]

where L = book value of liabilities at T

A = market value of assets at T

This assumption is strict as it means that a liquidation occurs whenever there is an excess of deposits over the fair market value of assets.[5] However, deposit insurers often provide temporary loans to credit unions experiencing a fair market value deficiency.[6] As illustrated in Appendix IV.B, a temporary loan will be an appropriate alternative to liquidation only where there are "external" costs to liquidation such as loss of depositor confidence in the credit union system. An extension to the Merton model is developed in Appendix IV.B that allows the deposit insurer a choice between liquidation and providing a temporary loan.[7, 8]

3. Distribution of Bank Asset Returns

The assumption of lognormal distribution of bank asset returns was rejected by McCulloch (1978, 1981, 1984). McCulloch argued that the major component of bank asset returns was interest rate uncertainty and thus the distribution of returns would be that which he observed for interest-bearing securities -- symmetric Paretian stable. Because a Paretian stable distribution carries a much higher probability of events several standard deviations below the mean than does the lognormal distribution, the model that McCulloch developed estimated much higher premiums.

Marcus and Shaked (1984) contended that the bank assets' returns were lognormally distributed on the basis of two arguments. First, the kurtosis (fat-tails) of the distribution decreases as the trading interval increases from days to months (for example see Fama, 1976). This contradicts a prediction of the independent and identically

distributed stable Paretian model. In addition, the kurtosis of the returns can be explained by a lognormal distribution which has changing variances (for example see Westerfield, 1977). Unfortunately, as the process underlying changes in variance is not fully understood, tests evaluating the goodness-of-fit of models are dependent on tentative assumptions. Subject to the criticisms of McCulloch, the model will incorporate the assumption of asset returns being lognormally distributed.

4. Nature of Liabilities

It should first be stated that the deposit insurer is liable for the book value rather than the market value of liabilities upon payoff of depositors. Consequently, it is book rather than market value that is the parallel to the exercise price in the put option analogy to deposit insurance. Merton's model for deposit insurance assumed that insured liabilities were deposits whose book value increased at a non-stochastic rate. As the amount of deposits actually varies over time in most financial institutions, this assumption should be questioned. In Merton's model (1977), the insurance per dollar of liability is dependent solely on the ratio of the market value of assets to book value of liabilities, the instantaneous variance of the rate of return of the value of the assets, riskless rate of interest and time to maturity. It must be assumed that net additions of deposits will have no impact on any of these factors in order to make the assumption of no net deposit inflows or outflows robust.

Ronn and Verma (1986) assumed that insured liabilities increased at a stochastic riskless rate. Upon the further assumptions that there existed a riskless asset, D, with the same maturity as the period

of coverage, a constant instantaneous variance of return, σ^2_D, a constant instantaneous covariance between its returns and those of the bank assets of σ_{AD} and serial independence between its returns and those of the bank assets, a model of deposit insurance with stochastic riskless returns on deposits was developed and applied to a set of U.S. banks. The only difference from Merton's model (1977) was the replacement of σ_A^2 in (1) by $\sigma_A^2 + \sigma_D^2 - 2\sigma_{AD}$. The variance in the model's extensions developed in the appendices would similarly be changed.

Ronn and Verma (1986) did not find the premiums calculated under the assumption of stochastic risk-free rates substantially different from those using the Merton (1977) formulation. They attributed this result to the contention that interest rates risk was a small component of the total risk of the banks studied. However, the British Columbia credit unions over the period of study were highly affected by interest rate shifts. Thus, a stochastic increase in liabilities will be assumed in this analysis.

Furthermore, because most of the liabilities of B. C. credit unions are demand deposits or term deposits of less than a year, the assumption of increasing liabilities at the risk-free rate is also a reasonable approximation.[9] Members' non-equity shares earn dividends that vary with the interest paid on demand deposits. For credit unions with a significant proportion of liabilities which have a fixed rate and maturity in excess of a year, changes in the book value of liabilities would not be equal to the stochastic riskless rate of return. Consequently, a model similar to that of Fischer (1978) of a put option with uncertain exercise price would be employed.

The practical difficulty in employing such a model is that the expected return on an asset whose returns were perfectly correlated with changes in book value of the liabilities would have to be estimated.

5. Maintenance of Riskless Hedge

The Black-Scholes option model assumes that the shares can be continuously traded to maintain a riskless hedge. Clearly this assumption cannot technically be applied to financial institutions as the market for many of their assets such as commercial mortgages is not well enough established to be able to have continuous trading. However, as more frequently traded assets such as government bonds and GNMA bonds in the United States are proxies for their behaviour, a riskless hedge could still be maintained by trading in these assets.

III. METHOD

Premiums for Individual Credit Unions

The deposit insurance pricing formulae were applied to the individual credit unions of British Columbia. The Merton model requires only four inputs -- period of coverage, the current market value of assets, the current book value of liabilities and the instantaneous variance of the fair market value of the assets. The model's extensions to allow for interim audits and choice of stabilization require estimates of the time to the preliminary audit, period of stabilization and of the costs of liquidation.

Because the credit unions have their financial statements examined by auditors on an annual basis, the period of deposit insurance coverage was chosen as one year. In order to estimate the cost advantage of more frequent audits, six months was chosen as the

time to do the preliminary audit because credit unions now produce quarterly financial statements.

The market value of the assets and book value of liabilities of the credit unions were calculated with quarterly financial statements. The two primary assets of credit unions are loans secured by real estate mortgage and loans otherwise secured. The valuation of the former is described in Appendix IV.C while the latter is valued at gross book value less allowance for doubtful accounts. Loans otherwise secured are usually charged an interest rate that floats with the prime lending rate and hence do not bear significant interest rate risk. With figures provided by the Federal Reserve Bank of New York, fixed assets, property for resale, prepaid expenses and accounts receivable were changed from book to market value.[10] Because other assets are mainly short-term financial assets, they were valued at book value. The valuation of credit unions as portfolios of financial assets is based on the reports of deposit insurance administrators that credit unions experiencing financial distress have no goodwill.

A difficulty with using quarterly data to obtain estimates of book value is that audits are only done on an annual basis. Consequently, three of the four quarters' data each year must be assumed to accurately represent the financial condition of the credit union despite the absence of an auditor's examination.

As previously noted, all deposits and members' non-equity shares of the credit unions in British Columbia are guaranteed fully by the Credit Union Deposit Insurance Corporation (CUDIC), the provincial deposit insurer. Accrued interest is also provided an explicit guarantee while liabilities to common creditors will have to also be

met by CUDIC because of the judicial ruling that members' shares are subordinate to other liabilities. Thus the contingent liability faced by CUDIC is the market value of members' shares, deposits, accrued interest and other liabilities at the end of the period of coverage.[11,12,13]

On the assumption that the changes in assets and liabilities are solely attributable to their lognormal processes of accumulation, σ^2 $(=\sigma_A^2 + \sigma_D^2 - 2\sigma_{AD})$ can be estimated by measuring the variance of the natural logarithm of the following ratio:

$$\ln\left\{\frac{R_t}{R_{t-1}}\right\} \quad \text{where } Rt = \frac{\text{Assets}_t}{\text{Liabilities}_t}$$

Note that

$$\ln\left\{\frac{R_t}{R_{t-1}}\right\} = \ln\left\{\left\{\frac{\text{Assets}_t}{\text{Liabilities}_t}\right\}\left\{\frac{\text{Assets}_{t-1}}{\text{Liabilities}_{t-1}}\right\}\right\}$$

$$= \ln\left\{\left\{\frac{\text{Assets}_{t-1} * \exp(ra_t)}{\text{Liabilities}_{t-1} * \exp(rf_t)}\right\}\left\{\frac{\text{Assets}_{t-1}}{\text{Liabilities}_{t-1}}\right\}\right\}$$

$$= \ln \left(\exp(ra_t - rf_t)\right)$$

$$= ra_t - rf_t$$

Because the assets and liabilities increased according to a lognormal distribution and there is a constant covariance between

their returns, ra_t and rf_t are bivariate normally distributed. Consequently, the distribution of $ra_t - rf_t$ would be normal with variance $\sigma_A^2 + \sigma_D^2 - 2\sigma_{AD}$.[14]

The robustness of the measurement of this variance must be evaluated when there is an inflow (outflow) of deposits. This is an important concern because of the rapid growth of many of the British Columbia credit unions over the period of study. A simulation was used to conduct this evaluation. The following assumptions were made:

1. Asset returns and riskless rates of return on liabilities have lognormal distributions with constant mean, variance and covariance.
2. The variance of asset returns was calculated from the total monthly returns on holding a five-year term mortgage two years outstanding to maturity with amortization over fifteen years. The variance of returns was calculated from the monthly returns of ninety day treasury bills. The covariance between the assets and liabilities was calculated from both these series. The means of the returns were calculated from the expected one-month yields because actual returns on assets and liabilities were not representative of the ex ante means.[15]
3. Quarterly growth rates were obtained from the actual figures of 119 credit unions over the period of study. The growth rates were calculated as the natural logarithms of the ratio of this quarter's total assets over last quarter's. This estimation is only approximate as the increases due strictly to net inflow of deposits are not distinguished from the effects of accumulation of value of the original deposits and assets.

4. At the end of each period, the ratio of assets to liabilities was calculated as follows:

$$R_t = \frac{(\text{Assets}_{t-1} + \text{New Liabilities}_t) * \exp(ra_t)}{(\text{Liabilities}_{t-1} + \text{New Liabilities}_t) * \exp(rf_t)}$$

where Assets_{t-1} = market value of assets at beginning of quarter

Liabilities_{t-1} = book value of liabilities at beginning of quarter

New Liabilities = net additions (withdrawals) of liabilities in quarter

$= \text{Liabilities}_{t-1} (\exp(d_t) - 1)$

d_t = percentage change in liabilities through net additions in quarter

ra_t = percentage return on assets in quarter

rf_t = percentage riskless return on liabilities

5. The natural logarithm of the quarterly return of the assets per dollar of book value of liabilities was calculated from these ratios:

$$\text{natural log of the return} = \ln\left(\frac{R_t}{R_{t-1}}\right)$$

In order to correspond to the number of observations used to estimate the variance, the simulations involved calculation of thirty-two successive quarterly ratios, of the market values of assets to the book values of liabilities. The variances of the natural logarithms of the ratios were estimated first assuming no growth

(shrinkage) through incoming (outgoing) deposits and second assuming the actual growth (shrinkage) patterns of the 119 British Columbia credit unions studied. The results of the simulations indicated that the estimation of variance was relatively robust in the presence of additions (withdrawals) of deposits. An ordinary least squares regression was run with the series of variances incorporating stochastic net inflows regressed onto the other series. The estimated coefficient of the variable was 1.0373 which was not significantly different from its theoretical value of one at even a 20% significance level. The adjusted r-square of the regression was 0.872.

On this basis, the ratio of the market value of assets to the book value of liabilities was calculated for each credit union for the thirty-two quarters from January 1976 to December 1983. The variance of the natural log of one plus the percentage change in the ratio was calculated using all thirty-two quarterly figures. This estimate of quarterly variance was analyzed to arrive at an approximation of the variance of the return on assets for each dollar of liabilities for the period of deposit insurance coverage.[16] Using data over an eight year period to estimate the variance over the ninth is somewhat flawed because of the instability of the factors underlying the measure. For example, interest rates during the period 1979 through 1983 were significantly more volatile than during the the years before and after. However, as sufficient data is required to produce a statistically significant estimate of the variance, the eight year period is considered necessary despite the danger of stale data. Alternative methods of estimating this variance to be explored in

future research include use of the interest rate futures market to determine the volatility of proxies for the credit union's assets.

Because the external costs of liquidation could not be estimated, a range of costs was applied from 0.0% to 2.0% of the market value of assets. From simulations it was found that with external costs exceeding 2.0% of the market value of assets, almost no credit union would be liquidated thus making estimated costs above 2.0% unrealistic.

With these inputs, the Black-Scholes pricing model and its extensions, can be estimated by applying the formulae. However, as the model's extension for supervision does not have a closed form solution, numerical analysis will have to be employed. The integral will be approximated by Simpson's rule, as illustrated by Dorn and McCracken (1964).

Exposure of Canada Deposit Insurance Corporation (CDIC)

The Credit Union Deposit Insurance Corporation has a lender-of-last-resort facility with the CDIC. As CUDIC has substantial powers to draw financial resources from solvent credit unions to assist financially distressed units,[17] one would expect that the assistance of CDIC would only be required where the fair market value of the assets of the system fell below its liabilities' book value. Consequently, the exposure of the CDIC can be valued by using the Merton model with inputs as the aggregate market values of the assets and book values of liabilities and the variance of the log of one plus the return on the market value of assets per one dollar of aggregate liability.

IV. Data

The quarterly financial statement information for each of the credit unions in British Columbia was obtained from the Credit Union Deposit Insurance Corporation for the years 1976 through 1983. The quarterly financial statement information was comprised of 325 items which included balance sheet and income statement figures as well as miscellaneous data such as the amount of real estate mortgages issued each quarter. The data was screened for errors and found to be relatively free of them.

In order to reduce the estimation error of the variance, all credit unions with missing data were eliminated. This reduced the number of credit unions studied from 293 to 119. The majority of the credit unions which were not included were liquidated or merged before the end of 1983.

The mortgage interest rates needed to revalue the assets were obtained from the Bank of Canada Review.

V. Results

The deposit insurance pricing model was first applied to obtain estimates of the cost of annual coverage for the 119 British Columbia credit unions at the end of 1983. Neither external liquidation costs nor the deposit insurer's alternative of stabilization were assumed. Table IV.1 illustrates the results.

The most striking aspect of the Table is the wide difference in the cost of the guarantee across the credit unions. The premiums range from about nil to 7.0% of deposits and shares. The distribution of premiums is also highly skewed. Only 9 of the 119 credit unions

have premiums in excess of 1.0% of deposits and shares while 65 credit unions have premiums less than 0.1%. Consequently, the present system of pricing is clearly unfair.

The reported standard deviations of the natural logarithm of one plus the percentage return on the assets per dollar of liabilities are similar to the standard deviations of asset returns estimated for U.S. banks by Marcus and Shaked (1984) for the years 1979 and 1980 and by Konn and Verma (1986) for 1983.[18] These previous papers estimated standard deviations by using Merton's (1974) relationship of the standard deviation of the return on the assets of a company with riskless debt to that of its equity. Because the assets of both credit unions and banks are affected by similar macroeconomic factors, the closeness of the results implies that methods employed in this paper may be useful even in cases where there is publicly traded equity.[19]

The last two columns of Table IV.1 indicate the benefits of an interim audit in the absence of external liquidation costs. Aggregate annual premiums calculated at the end of the fourth quarter in 1983 would be reduced by about $2.44 million if there were a 6-month audit in addition to the final audits. This represents approximately 13% of the total premiums. Because the benefits of an interim audit vary across credit unions, the model could be used to allocate audit resources by the deposit insurer. As the results of Table IV.1 illustrate, an audit is especially beneficial for credit unions with little equity cushion and more volatile asset returns.

Liquidation Expenses/Stabilization

The premiums were recalculated using the pricing model extended to incorporate "external" liquidation expenses and choice of the deposit insurer to stabilize or liquidate a financially distressed credit union. The first two columns of Table IV.2 record the annual premiums assuming "external" liquidation expenses of 1% of assets but only a final audit and no choice of stabilization. The absolute increase of premiums is greater, ceteris paribus, as the ratio of the market value of assets to book value of liabilities falls. For example, the Credit Union B's premiums rose about 0.92% after incorporating a 1.0% "external" liquidation expense. The sharp increase reflected the fact that at a 0.93 asset to liability ratio, the credit union had a very high probability of being liquidated.

Column 5 of Table IV.2 illustrates the reduction in annual premiums that can be achieved through a semi-annual audit in the presence of liquidation costs. It was assumed that, at the time of the interim audit, a financially distressed credit union with market value of assets less than book value of liabilities would be liquidated. As in the case of no "external" liquidation costs, premium reductions were higher where the credit union had greater asset volatility, and its ratio of market value of assets to book value of liabilities was closer to one.

Because of the "external" liquidation costs imposed, the semi-annual audit actually increases CUDIC's exposure with many credit unions. For example, Credit Union RR would have its premiums increased by approximately $7,000 where a semi-annual audit occurred and the deposit insurer liquidated all financially distressed member institutions.

Column 6 of Table IV.2 lists the reductions in annual premiums that can be expected where the deposit insurer is allowed the choice of providing a temporary loan to the credit union rather than liquidating it at the time of the interim audit. At the end of the year, the credit union is liquidated if the market value of the assets falls short of the book value of liabilities. Savings from stabilization are greater, ceteris paribus, where the volatility of the asset returns is smaller. Furthermore, as predicted in Appendix IV.B, there does not appear to be a solvency level below which the savings from stabilization will disappear.

The most critical factor in determining whether a credit union should be liquidated or stabilized is clearly external liquidation costs. Confirming the analysis of Appendix IV.B, Table IV.3 shows the benefits to the deposit insurer of semi-annual audits and stabilization. At a 2% external liquidation cost, the annual savings from having semi-annual audits with a choice of stabilization is almost nil. Consequently, with a 2% external liquidation cost, almost no credit union will be liquidated at the interim audit.

In order to capture the benefits of stabilization where there is no limit to the period of stabilization, the model was altered to allow the deposit insurer the following alternatives at the end of one year.

- Liquidation
- Stabilization for one additional year
- Stabilization for two additional years

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- Stabilization for n additional years

Assuming the deposit insurer is motivated by a cost minimization principle, Table IV.4 shows the savings that can be achieved given an increasing number of years to allow stabilization. The additional savings diminish after a year, thus making the one-year alternative a reasonable proxy for an infinite period of stabilization.

As shown by Table IV.5, the exposure of CUDIC changed over the eight-year period studied. The volatility of the exposure would be further heightened if credit unions that had failed partway through, were added to the sample. From 1977 through 1982, the weighted mean of premiums was significantly above that of the arithmetic mean. This indicates that the larger credit unions imposed more risk on the deposit insurer than those smaller.

Even in the absence of external liquidation costs, the premiums required over the whole time period were much higher than those actually assessed the credit unions. The fixed rate premium charged the credit unions was only 0.07% of non-equity shares and deposits.[20]

There are several reasons for this discrepancy. First, since 1981 the British Columbia credit unions have had to build a statutory reserve account (SRA) which will eventually equal a minimum of 5.0% of its loans and investments. The minimum reserve level, which at the end of 1983 was 1.6 percent, is scheduled to increase 0.2 percent annually. Because the increases directly improve the position of the deposit insurer and would otherwise have been distributed to shareholders, these amounts can be viewed as similar to deposit insurance premiums. Assuming the reserve account will equal most of the excess of asset value over liabilities, by 1995, when a minimum 4.0% S.R.A.

is achieved, the weighted average of the premiums will be at most 0.15%.[21]

Another reason for the apparent underfunding of the deposit insurer is the fact that interest rate variance from 1979 through 1982 was historically high.[22] If the standard deviations of the credit unions' assets return were cut in half, the weighted average premium would be reduced to 0.23% as calculated at the end of the 1983.[23]

A critical test of the model is how well the actual record of financial distress corresponds to the premiums estimated for the credit unions. To evaluate the relationship of the amount of the estimated premiums with the actual loss experience over time, one would need a long series of observations to cover a representative sample of the distribution of the returns of financial assets. However, a study of how estimated premiums correspond to actual loss experience <u>across</u> credit unions can be performed.

At the end of June 1984, there were eighteen credit unions which were being stabilized. Six of these eighteen credit unions had the highest six premiums estimated as at the end of the fourth quarter of 1983. Twelve of the stabilized credit unions were among the highest twenty-two premiums estimated while only two of the stabilized institutions were in the bottom half of the premiums. It should be noted that stabilization may arise where a solvent credit union was experiencing a liquidity shortage. If one could distinguish the reason for each case of stabilization, it is likely the premiums' correspondence to actual distress would be even closer.

Table IV.7 illustrates two other measures which indicate a high degree of cross-sectional stability of estimated premiums. The

premiums calculated at the end of 1982 with information only up to that year-end corresponds closely to both the premiums calculated at the end of 1983 and the ratios of the market value of assets to book value of liabilities at the end of 1983. Excluding the seventeen credit unions with shares and deposits totalling less than one million dollars as of the fourth quarter of 1982, increases the correlations. This is likely the result of higher estimation error involved in the model's inputs for smaller credit unions.

Exposure of Canada Deposit Insurance Corporation (CDIC)

As the variance of the aggregate return on assets was lower than that of the mean of the individual credit unions, the exposure to the CDIC as lender-of-last-resort was lower than the weighted average premium.[24] Even after incorporating liquidation costs, the exposure to the CDIC was negligible at the end of the fourth quarter of 1976, 1982 and 1983 as Table IV.6 indicates. However, the risk became significant during the years 1979 through 1982 when interest rates escalated. If the British Columbia credit unions can reach a 4.0% S.R.A. level, then the CDIC will have almost nil exposure from the British Columbia system.

VI. Conclusion

The paper has further developed and applied Merton's deposit insurance pricing model. The results for both the basic model and its extension indicate that the present method of fixed-rate pricing is unfair as the actual exposure to the deposit insurer varies widely across credit unions. Furthermore, the required premiums change significantly over time to reflect varying financial conditions. In

order to apply the model without exascerbating the problems of distressed institutions, it is likely that deposit insurance administrators could give these institutions the alternatives to higher deposit insurance premiums of reducing leverage or lowering the volatility of the returns of assets per dollar of liabilities.

The models presented here not only provide an estimate of the deposit insurance premiums but also provide a guide as to whether the deposit insurer should conduct an interim audit and whether a credit union should be provided a temporary loan rather than liquidated. Interim audits would be most justified where liquidation costs are negligible, asset volatility is high and the credit union has little or no equity. Stabilization is a favorable alternative to liquidation where "external" liquidation expenses are significant and asset volatility is low.

The analysis suggests that variable rate premiums can be determined where there is no publicly traded equity. Future research should be directed to obtaining more current estimates of the variance of the asset return per dollar of liabilities that reflects current asset/liability composition and present volatility of macroeconomic factors. Options on interest rate futures offer a means of estimating variance of interest rates over the period of deposit insurance coverage. Furthermore, in order to apply the model to institutions which are more sensitive to credit risk such as Canada's chartered banks, the issue of how to determine the market value of loans such as those for commercial real estate and sovereign debtors will need to be resolved. Another issue to be explored is how "external" liquidation

costs differ across individual credit unions and over different policy regimes.

Table IV.1

BRITISH COLUMBIA CREDIT UNIONS -- 4TH QUARTER 1981

	CREDIT UNION NAME (DISGUISED)	PREMIUM % OF DEPOSITS AND SHARES	PREMIUM $ VALUE	STD. DEV.	ASSET/LIAB	SEMI. AUDIT SAVING % OF DEP.	SEMI. AUDIT SAVING $ VAL
1	A	7.025158	868535.37	0.045732	0.930857	0.085208	10534.41
2	B	6.629455	269458.81	0.030014	0.933818	0.010489	426.34
3	C	4.513630	1644348.00	0.024769	0.955167	0.025846	9415.90
4	D	4.019146	584185.56	0.023181	0.960173	0.030127	4378.96
5	E	2.691813	460537.50	0.025326	0.975199	0.113423	19405.29
6	F	2.194927	258550.44	0.030220	0.983534	0.186088	21920.10
7	G	2.045277	8895.26	0.018123	0.980864	0.074906	325.78
8	H	1.822227	2374.22	0.012708	0.982228	0.032114	41.84
9	I	1.786560	90256.31	0.026144	0.987391	0.164441	8307.49
10	J	0.985907	175920.44	0.024880	1.000134	0.144889	25853.23
11	K	0.929983	3168390.00	0.026837	1.002976	0.145595	496033.87
12	L	0.916399	692026.31	0.023907	1.000763	0.137007	103461.69
13	M	0.829214	29493.12	0.023742	1.002486	0.129388	4602.03
14	N	0.784926	470042.31	0.023793	1.003527	0.125271	75016.87
15	O	0.669171	29669.97	0.023319	1.005859	0.111651	4950.42
16	P	0.639079	10365.76	0.035904	1.020787	0.113123	1834.84
17	Q	0.558667	257157.75	0.026932	1.012832	0.098371	45280.73
18	R	0.500641	397947.06	0.025998	1.013648	0.088506	70351.12
19	S	0.457185	38578.68	0.021205	1.009928	0.080236	6770.57
20	T	0.454282	5670419.00	0.033762	1.025384	0.079015	986279.94
21	U	0.399935	562576.69	0.024285	1.015152	0.070689	99436.12
22	V	0.357462	6255.23	0.021929	1.013801	0.063159	1105.22
23	W	0.341515	1360.75	0.020172	1.022819	0.058579	233.41
24	X	0.329896	51453.78	0.026998	1.021746	0.056657	8837.02
25	Y	0.310291	507.91	0.027788	1.023845	0.052495	85.93
26	Z	0.275938	425.72	0.021134	1.016133	0.047847	73.82
27	AA	0.267269	8405.74	0.023534	1.019906	0.045368	1426.83
28	BB	0.263635	379289.62	0.022693	1.018887	0.044928	64637.67
29	CC	0.257792	1085690.00	0.025362	1.023079	0.042826	180360.75
30	DD	0.229710	64783.08	0.021673	1.019160	0.038500	10857.80
31	EE	0.223030	24789.05	0.018345	1.014742	0.038296	4256.44
32	FF	0.208866	984.24	0.020901	1.019158	0.034587	162.99
33	GG	0.208045	20170.78	0.024992	1.025488	0.032951	3194.73
34	HH	0.191482	196.95	0.029795	1.034594	0.028044	28.84
35	II	0.188524	20810.18	0.024000	1.025205	0.029392	3244.45
36	JJ	0.181335	11659..19	0.022835	1.023826	0.028163	18236.25
37	KK	0.177885	29122.[illegible]	0.023125	1.024528	0.027572	4514.07
38	LL	0.176784	21623.11	0.023681	1.025505	0.027162	3322.26
39	MM	0.167854	101576.25	0.022616	1.024406	0.025750	15582.53
40	NN	0.167076	7552.35	0.025014	1.028429	0.024801	1121.07

Table IV 1

BRITISH COLUMBIA CREDIT UNIONS -- 4TH QUARTER 1983

	CREDIT UNION NAME (DISGUISED)	PREMIUM % OF DEPOSITS AND SHARES	PREMIUM $ VALUE	STD. DEV.	ASSET/LIAB	SEMI. AUDIT SAVING % OF DEP.	SEMI. AUDIT SAVING $ VAL
41	OO	0.164203	79490.25	0.024346	1.027551	0.024453	11837.73
42	PP	0.154309	56978.71	0.021029	1.022792	0.023598	8713.62
43	QQ	0.147879	7224.96	0.020482	1.022362	0.022507	1099.65
44	RR	0.144734	70529.25	0.012883	1.010895	0.024541	11958.66
45	SS	0.140143	27361.90	0.023754	1.028481	0.019961	3897.22
46	TT	0.129101	138911.62	0.025061	1.031792	0.017500	18830.30
47	UU	0.128818	50401.64	0.020743	1.024268	0.018684	7310.39
48	VV	0.120254	13461.08	0.025486	1.033448	0.015758	1761.26
49	WW	0.135188	31791.38	0.024035	1.031319	0.015192	4192.86
50	XX	0.111685	13850.32	0.020960	1.026143	0.015346	1903.10
51	YY	0.104573	52221.47	0.021516	1.027827	0.013876	6929.23
52	ZZ	0.103115	16589.41	0.023401	1.031433	0.013154	2116.33
53	AAA	0.101528	36545.27	0.016098	1.018635	0.014815	5332.78
54	BBB	0.101392	6427.42	0.026188	1.036896	0.012245	776.22
55	CCC	0.099575	76420.56	0.023969	1.032894	0.012397	9514.19
56	DDD	0.093914	5652.50	0.022330	1.030467	0.011757	707.65
57	EEE	0.087322	10030.91	0.023574	1.033625	0.010354	1189.38
58	FFF	0.086925	24094.28	0.023030	1.032627	0.010393	2880.80
59	GGG	0.079052	18385.05	0.024785	1.037125	0.008762	2037.81
60	HHH	0.077319	5600.71	0.023466	1.034752	0.008702	630.37
61	III	0.077203	2051.55	0.017330	1.023061	0.009908	263.30
62	JJJ	0.070537	474.70	0.035361	1.061071	0.006175	41.55
63	KKK	0.056802	2875.75	0.027690	1.047099	0.005062	256.30
64	LLL	0.055547	5245.47	0.029268	1.050858	0.004749	448.46
65	MMM	0.054291	2484.73	0.025989	1.043919	0.004888	223.72
66	NNN	0.046919	44996.76	0.024634	1.042691	0.004022	3857.10
67	OOO	0.044823	1032.84	0.016076	1.024754	0.004686	107.97
68	PPP	0.041004	17379.17	0.018760	1.031097	0.003790	1606.51
69	QQQ	0.040929	887.73	0.020416	1.034665	0.003616	78.42
70	RRR	0.036853	23282.91	0.025603	1.043322	0.002714	1714.67
71	SSS	0.035621	8023.12	0.022311	1.040121	0.002783	626.84
72	TTT	0.030371	7305.78	0.020959	1.038481	0.002250	541.31
73	UUU	0.028201	638.47	0.024622	1.047771	0.001824	41.29
74	VVV	0.026134	4430.08	0.023261	1.045242	0.001672	283.48
75	WWW	0.025383	33700.77	0.022532	1.043762	0.001627	2160.76
76	XXX	0.022927	2261.11	0.023216	1.046402	0.001359	132.84
77	YYY	0.021821	52.45	0.017235	1.032461	0.001501	3.61
78	ZZZ	0.020[illegible]3	86283.25	0.021749	1.043025	0.001167	4955.37
79	AAAA	0.017743	755.53	0.019160	1.038556	0.001015	43.22
80	BBBB	0.017235	3728.90	0.022993	1.048380	0.000865	187.16

Table IV.1

BRITISH COLUMBIA CREDIT UNIONS -- 4TH QUARTER 1981

	CREDIT UNION NAME (DISGUISED)	PREMIUM % OF DEPOSITS AND SHARES	PREMIUM $ VALUE	STD. DEV.	ASSET/LIAB	SEMI. AUDIT SAVING % OF DEP.	SEMI. AUDIT SAVING $ VAL
81	CCCC	0.016638	11539.31	0.024393	1.052303	0.000787	545.80
82	DDDD	0.014897	1736.95	0.018323	1.037764	0.000788	91.89
83	EEEE	0.011154	1040.97	0.021968	1.049402	0.000439	40.93
84	FFFF	0.010718	187.93	0.018486	1.040479	0.000460	8.06
85	GGGG	0.010637	2643.91	0.019269	1.042587	0.000442	109.85
86	HHHH	0.010543	1006.28	0.020653	1.046325	0.000416	39.74
87	IIII	0.009284	3506.31	0.017252	1.038193	0.000380	143.54
88	JJJJ	0.007954	7.27	0.021129	1.049772	0.000258	0.24
89	KKKK	0.007911	1883.55	0.015146	1.033606	0.000318	75.77
90	LLLL	0.007752	3.95	0.028043	1.069797	0.000204	0.10
91	MMMM	0.007634	136.20	0.026664	1.065906	0.000206	3.67
92	NNNN	0.007032	160.11	0.012292	1.026768	0.000300	6.84
93	OOOO	0.005412	5898.55	0.021910	1.054933	0.000133	144.76
94	PPPP	0.004556	72.33	0.020790	1.052902	0.000103	1.64
95	QQQQ	0.004554	354.87	0.017718	1.043921	0.000115	8.97
96	RRRR	0.004035	873.98	0.022640	1.059360	0.000080	17.24
97	SSSS	0.003280	382.29	0.021093	1.056146	0.000059	6.89
98	TTTT	0.003017	202.38	0.022367	1.060705	0.000049	3.31
99	UUUU	0.002002	544.53	0.024252	1.069899	0.000023	6.18
100	VVVV	0.001988	50.83	0.011579	1.010021	0.000039	0.99
101	WWWW	0.001820	495.96	0.024791	1.072447	0.000020	5.56
102	XXXX	0.001687	223.33	0.022690	1.065997	0.000018	2.44
103	YYYY	0.001453	927.48	0.019972	1.057976	0.000016	10.00
104	ZZZZ	0.001301	127.99	0.020051	1.058930	0.000013	1.27
105	AAAAA	0.001051	319.71	0.022169	1.067532	0.000008	2.52
106	BBBBB	0.000756	7.05	0.017910	1.054809	0.000005	0.05
107	CCCCC	0.000750	23.54	0.016999	1.051713	0.000006	0.18
108	DDDDD	0.000748	11.09	0.019922	1.061874	0.000005	0.07
109	EEEEE	0.000717	18.54	0.019722	1.061424	0.000005	0.12
110	FFFFF	0.000673	107.08	0.020759	1.065468	0.000004	0.62
111	GGGGG	0.000534	9.84	0.018726	1.059566	0.000003	0.05
112	HHHHH	0.000333	4.20	0.028938	1.101417	0.000000	0.00
113	IIIII	0.000253	0.54	0.012474	1.040473	0.000001	0.00
114	JJJJJ	0.000172	6.63	0.020254	1.071547	0.000000	-0.01
115	KKKKK	0.000132	0.68	0.013678	1.047260	0.000000	0.00
116	LLLLL	0.000094	0.07	0.021349	1.079359	0.000001	0.00
117	MMMMM	0.000027	0.04	0.006793	1.024731	0.000000	0.00
118	NNNNN	0.000003	0.05	0.009815	1.041537	0.000000	0.00
119	OOOOO	0.000000	0.00	0.014724	1.084103	0.000000	0.00

Table IV 2

BRITISH COLUMBIA CREDIT UNIONS 4TH QUARTER 1983

LIQUIDATION COSTS AND CHOICE OF STABILIZATION INCORPORATED INTO MODEL

EXTERNAL LIQUIDATION COSTS ASSUMED TO BE 1% OF ASSETS

	CREDIT UNION NAME (DISGUISED)	PREMIUM % OF DEPOSITS AND SHARES	$ VALUE	STD. DEV. ASSET/LIAB		AUD. SAV. % OF DEP.	STAB SAV. % OF DEP.
1	A	7.899944	976561.50	0.045737	0.930857	0.036365	0.000024
2	B	7.552338	306970.06	0.030014	0.933818	0.300077	0.001047
3	C	5.437351	1980867.00	0.324769	0.955167	0.302920	0.004233
4	D	4.940150	718055.50	0.321131	.960173	0.015001	0.006051
5	E	3.507277	600053.75	0.325326	0.975199	0.006629	0.006052
6	F	2.806773	340046.25	0.330220	0.993534	0.396699	0.001102
7	G	2.803694	12561.63	0.318123	0.980866	0.024527	0.024559
8	H	2.725829	3551.54	0.012738	0.992228	0.031953	0.031958
9	I	2.459631	124259.12	0.326144	0.987321	0.023116	0.003515
10	J	1.478858	263980.31	0.024480	1.000114	0.019611	0.002695
11	L	1.399271	1056671.00	0.023907	1.000763	0.013997	0.003299
12	K	1.381927	4708136.00	0.026837	1.002976	0.029741	0.001022
13	M	1.281993	45663.50	0.023742	1.002486	0.013042	0.003043
14	N	1.222951	732354.19	0.023793	1.003527	0.013214	0.002751
15	O	1.069078	47156.90	0.023313	1.005859	0.010463	0.002629
16	P	0.922104	14956.39	0.035906	1.020787	0.047603	0.000013
17	Q	0.875855	403161.19	0.026932	1.012832	0.022158	0.000385
18	R	0.801215	636865.50	0.025998	1.013648	0.017682	0.000487
19	S	0.783819	66141.05	0.021205	1.009528	0.001273	0.003612
20	T	0.683787	8535125.00	0.033762	1.025396	0.010797	0.000015
21	U	0.667826	939411.06	0.024245	1.015152	0.010476	0.000729
22	V	0.623458	10909.90	0.021929	1.013801	0.003632	0.001802
23	W	0.553549	2205.75	0.020172	1.022839	0.015918	0.000081
24	X	0.543307	84741.87	0.026998	1.021746	0.013605	0.000135
25	Y	0.509284	833.64	0.327788	1.023845	0.013826	0.000080
26	Z	0.500799	772.64	0.021134	1.016133	0.001378	0.001722
27	AA	0.469057	14752.09	0.023534	1.019906	0.005929	0.000511
28	BB	0.469051	674020.62	0.022693	1.018087	0.004407	0.000755
29	CC	0.442757	1864672.00	0.025362	1.023079	0.008364	0.000190
30	EE	0.435944	48458.33	0.018345	1.016742	-0.004438	0.004542
31	DD	0.420376	118723.81	0.021673	1.019160	0.012239	0.000984
32	FF	0.391515	1844.93	0.020901	1.019158	0.000865	0.001226
33	GG	0.365939	35479.27	0.024992	1.025488	0.006173	0.000151
34	HH	0.345233	168232.50	0.012883	1.010895	-0.014322	0.014325
35	II	0.339273	37450.53	0.024000	1.025205	0.004536	0.000210
36	JJ	0.333436	214389.31	0.022835	1.023826	0.003175	0.000361
37	KK	0.326137	53394.21	0.023125	1.024528	0.013400	0.000299
38	LL	0.325699	39322.41	0.023681	1.025905	0.009929	0.000220
39	MM	0.319537	328.66	0.029795	1.034594	0.009010	0.000010
40	NN	0.311908	198749.94	0.022616	1.024606	0.002696	0.000351

Table IV.2

BRITISH COLUMBIA CREDIT UNIONS 4TH QUARTER 1983

LIQUIDATION COSTS AND CHOICE OF STABILIZATION INCORPORATED INTO MODEL

EXTERNAL LIQUIDATION COSTS ASSUMED TO BE 1% OF ASSETS

	CREDIT UNION NAME (DISGUISED)	PREMIUM % OF DEPOSITS AND SHARES	$ VALUE	STD. DEV. ASSET/LIAB		AUD. SAV. % OF DEP.	BIAS SAV. % OF DEP.
41	NN	0.299301	13529.28	0.025014	1.028429	0.004758	0.000096
42	OO	0.297491	144014.44	0.024346	1.027531	0.004149	0.000134
43	PP	0.297079	109696.69	0.024029	1.027192	0.000891	0.000692
44	QQ	0.296808	14110.36	0.024087	1.027262	0.000281	0.000854
45	SS	0.259663	50697.45	0.023754	1.026891	0.003020	0.000136
46	UU	0.253509	99189.62	0.020763	1.024259	0.000520	0.000590
47	TT	0.235986	253319.56	0.025061	1.031792	0.003454	0.000056
48	AAA	0.227982	82027.25	0.016099	1.019635	0.003728	0.003731
49	XX	0.221653	27487.76	0.020950	1.026163	0.000623	0.000411
50	VV	0.219542	24549.97	0.025496	1.033568	0.003338	0.000010
51	WW	0.215899	59584.53	0.024035	1.031319	0.002696	0.000040
52	YY	0.205492	103115.06	0.021516	1.027827	0.000228	0.000270
53	ZZ	0.197035	31699.52	0.023432	1.031633	0.001851	0.000092
54	CCC	0.188933	145038.00	0.023982	1.032536	0.002834	0.000063
55	BBB	0.185657	11769.12	0.026198	1.036996	0.002882	0.000019
56	DDD	0.184262	11090.36	0.022330	1.030667	0.001209	0.000142
57	III	0.172051	45711.99	0.017339	1.023061	0.001542	0.001544
58	FFF	0.169443	66966.91	0.023030	1.032627	0.001366	0.000093
59	EEE	0.165540	19360.72	0.023574	1.033625	0.001770	0.000061
60	HHH	0.150407	10931.15	0.023656	1.034752	0.001299	0.000052
61	GGG	0.151613	35032.64	0.024795	1.037125	0.001708	0.000026
62	JJJ	0.118419	796.93	0.015361	1.026071	0.002701	0.000093
63	LLL	0.108912	2509.59	0.016025	1.026756	0.001127	0.001128
64	KKK	0.105495	5160.75	0.027630	1.047033	0.001431	0.000005
65	MMM	0.104159	4767.02	0.025989	1.043919	0.001153	0.000008
66	LLL	0.101439	9579.18	0.022268	1.038958	0.001529	0.000003
67	PPP	0.092387	39369.29	0.018760	1.031037	0.000217	0.000255
68	NNN	0.092874	89069.81	0.024694	1.042691	0.000792	0.000011
69	QQQ	0.089082	1932.17	0.020416	1.036665	0.000106	0.000096
70	SSS	0.075152	16927.01	0.022311	1.040121	0.000316	0.000025
71	RRR	0.072962	66096.34	0.025603	1.047322	0.000618	0.000005
72	TTT	0.066706	16046.36	0.020959	1.038641	0.000130	0.000041
73	UUU	0.057769	1307.89	0.024622	1.047771	0.000363	0.000005
74	VVV	0.055209	9358.57	0.023261	1.045242	0.000255	0.000009
75	WWW	0.054528	72396.56	0.022532	1.043762	0.000204	0.000012
76	YYY	0.054124	130.09	0.017235	1.032461	0.000215	0.000216
77	XXX	0.049960	4776.16	0.023236	1.046432	0.000208	0.000007
78	ZZZ	0.045045	191236.69	0.021749	1.043825	0.000112	0.000013
79	AAAA	0.042273	1800.05	0.019160	1.038556	0.000226	0.000047
80	BBBB	0.037570	8128.44	0.022993	1.048190	0.000121	0.000005

Table IV 2

BRITISH COLUMBIA CREDIT UNIONS 4TH QUARTER 1981

LIQUIDATION COSTS AND CHOICE OF STABILIZATION INCORPORATED INTO MODEL

EXTERNAL LIQUIDATION COSTS ASSUMED TO BE 1% OF ASSETS

	CREDIT UNION NAME (DISGUISED)	PREMIUM % OF DEPOSITS AND SHARES	$ VALUE	STD. DEV.	ASSET/LIAB	AUD. SAV. $ OF DEP.	STAB SAV. $ OF DEP.
81	DDUD	0.036758	4285.94	0.018321	1.037764	0.000356	0.000059
82	CCCC	0.035334	24506.15	0.024591	1.052303	0.000154	0.000002
83	FFFF	0.026899	471.65	0.019996	1.040479	0.000026	0.000010
84	GGGG	0.026121	6497.92	0.019269	1.042587	0.000006	0.000010
85	EEEE	0.025521	2381.71	0.021968	1.042432	0.000049	0.000004
86	HHHH	0.024980	2384.19	0.020653	1.046325	0.000023	0.000007
87	IIII	0.024422	9223.73	0.017252	1.038193	0.000050	0.000051
88	NNNN	0.023025	524.27	0.012292	1.026768	-0.000176	0.000177
89	KKKK	0.022652	5393.41	0.015156	1.033606	-0.000091	0.000092
90	JJJJ	0.018934	17.30	0.021129	1.049772	0.000021	0.000003
91	MMMM	0.018205	289.12	0.026664	1.065906	0.000057	0.000000
92	LLLL	0.016054	8.17	0.028053	1.069797	0.0000064	0.000000
93	OOOO	0.012911	14071.29	0.021910	1.054933	0.000016	0.000001
94	BBBB	0.012338	960.80	0.017718	1.043921	0.000010	0.000011
95	PPPP	0.011291	7179.11	0.020790	1.052902	0.000008	0.000001
96	RRRR	0.009605	2080.60	0.022660	1.059160	0.000013	0.000000
97	SSSS	0.009198	955.56	0.021093	1.056146	0.000006	0.000001
98	VVVV	0.007375	189.56	0.011579	1.030021	0.000025	0.000025
99	TTTT	0.007335	492.04	0.022367	1.060705	0.000008	0.000000
100	UUUU	0.004791	1292.42	0.024252	1.069899	0.000006	0.000000
101	WWWW	0.004287	1169.42	0.024731	1.072447	0.000005	0.000000
102	XXXX	0.004183	553.88	0.022690	1.065997	0.000003	0.000000
103	YYYY	0.003901	2489.86	0.019972	1.057976	0.000001	0.000001
104	ZZZZ	0.003503	344.63	0.020051	1.058930	0.000001	0.000001
105	AAAAA	0.002699	820.80	0.022169	1.067532	0.000001	0.000000
106	CCCCC	0.002293	71.91	0.016999	1.051713	0.000000	0.000001
107	BBBBB	0.002236	20.95	0.017910	1.054809	0.000000	0.000001
108	DDDDD	0.002074	30.76	0.019922	1.061874	0.000000	0.000000
109	EEEEE	0.002004	51.84	0.019722	1.061424	0.000000	0.000000
110	FFFFF	0.001932	291.32	0.020759	1.065468	0.000000	0.000000
111	GGGGG	0.001562	28.78	0.018726	1.059566	0.000000	0.000001
112	IIIII	0.001001	2.13	0.012474	1.040473	0.000001	0.000001
113	HHHHH	0.000774	9.76	0.028939	1.101417	-0.000001	0.000000
114	KKKKK	0.000508	2.60	0.013678	1.047260	0.000001	0.000000
115	JJJJJ	0.000506	19.44	0.020756	1.071547	0.000001	0.000000
116	LLLLL	0.000274	0.22	0.021369	1.079359	0.000001	0.000000
117	MMMMM	0.000190	0.28	0.006791	1.026731	0.000000	0.000000
118	NNNNN	0.000071	0.29	0.009815	1.041537	0.000000	0.000000
119	OOOOO	0.000000	0.00	0.014724	1.064103	0.000000	0.000000

Table IV.3

Aggregate Reductions (Increases) in Annual Premiums
of British Columbia Credit Unions
Calculated as at the Fourth Quarter, 1983
through Semi-Annual Audit and Choice of Stabilization

External Liquidation Costs (As a % of assets)	Savings from Semi-Annual Audit ($000's)	Savings from Choice of Stabilization ($000's)	Combined Savings ($000's)
0.0%	2,438	0	2,438
1.0%	615	27	642
2.0%	(1,209)	1,210	1

Table IV.4

Aggregate Reductions (Increases) in Annual Premiums
of British Columbia Credit Unions
Calculated as at the Fourth Quarter, 1983
through Choice of Stabilization

Number of Years in Future Stabilization Allowed	Savings From Choice of Stabilization* ($000's)
1	$658.7
1, 2	$665.1
1, 2, 3	$665.3

* Assumes "external" liquidation costs equal to 2.0% of market value of assets.

Table IV.5

MEANS OF PREMIUMS[1]
FOURTH QUARTER 1976
THROUGH FOURTH QUARTER 1983

Year	No liquidation costs		With liquidation costs[2] Choice of stabilization	
	Weighted Mean	Arithmetic Mean	Weighted Mean	Arithmetic Mean
1976	0.313	0.352	0.499	0.533
1977	0.504	0.383	0.766	0.584
1978	1.087	0.757	1.546	1.112
1979	1.825	1.191	2.451	1.672
1980	1.801	1.195	2.419	1.671
1981	1.638	1.164	2.204	1.604
1982	0.353	0.274	0.525	0.401
1983	0.373	0.408	0.547	0.561

[1] as percentage of book value of liabilities

[2] 1.0 % of market value of assets

Table IV.6

Exposure of CDIC[1]
Fourth Quarter, 1976
Through Fourth Quarter, 1983

Year	No liquidation costs	With liquidation costs [2]
1976	0.001	0.004
1977	0.035	0.108
1978	0.414	0.896
1979	1.277	2.132
1980	1.247	2.095
1981	0.980	1.754
1982	0.003	0.010
1983	0.002	0.009

[1] as percentage of aggregate book value of liabilities

[2] 1.0 % of market value of aggregate assets

TABLE IV.7

Cross Sectional Stability
of Premiums Across
Time

	All Credit Unions[1]		Excluding Smallest Credit Unions[2]	
	Pearson	Spearman Rank	Pearson	Spearman Rank
Correlation of annual Premium Calculated at end of 1982 with Premium Calculated at end of 1983	0.846	0.831	0.873	0.855
Correlation of Annual Premium Calculated at end of 1982 with Ratio of Market Value of Assets to Book Value of Liabilities at end of 1983	-0.750	-0.703	-0.801	-0.752

[1] 119 British Columbia credit unions with continuous quarterly financial statement information from first quarter 1976 through fourth quarter 1983

[2] excludes seventeen credit unions with shares and deposits totalling less than $1 million as of fourth quarter 1982

Notes

1 The Federal Deposit Insurance Corporation intended to implement a program on December 31, 1986 to evaluate the riskiness of each member financial institution and decide whether or not to provide a rebate of deposit insurance premiums.

2 Ronn and Shaked (17) extended the Merton model by assuming the deposit insurer would provide a loan to distressed financial institutions with asset value below 100% of the level of deposits but above a prespecified percentage, P. With asset value below P, the financial institution would be liquidated. As contended in Appendix IV.B, the choice between liquidation and stabilization should incorporate the policy of selecting a course of action that minimizes the direct costs to the deposit insurance fund as well as the costs of externalities.

3 The seller of a European put option has the obligation to purchase the underlying security at a prespecified exercise price at the expiration date if called upon by the buyer of the option to do so. The writer of a put option thus faces an asymmetric payoff structure. He will lose only if the stock price at the time of expiry is below the prespecified expiration price; the amount of his loss will either be zero or the difference in the stock price at the expiration date and the exercise price.

4 The auditors of a financial institution do not attest that the financial statements report the fair market value of assets. They only attest that the credit union's financial statements fairly represent its financial conditions according to generally accepted accounting principles (GAAP). For example, GAAP does not require that mortgages be revalued according to current interest rates. However, with the information that the auditors attest to, the deposit insurance administrators can revalue the mortgages and other assets in order to determine the fair market value of the unit's assets.

5 We also assume that where the market value of the assets exceeds the book value of the liabilities, the deposit insurer will not liquidate the credit union. If the credit union experiences a liquidity shortage, then a temporary loan will be granted by the deposit insurer.

6 Deposit insurance administrators often seek to merge credit unions experiencing financial difficulty with a stronger partner. However, because credit unions experiencing financial distress usually have almost no goodwill, the payoff to the merger partner is similar to that involved in liquidation. Thus mergers are treated as liquidations in our model.

7 Because a credit union may experience a fair market value deficiency but still have adequate liquidity, the deposit insurer often does not need to provide a loan. In addition, because our model assumes that depositors are paid off when the deposit

insurance corporation provides a loan, the exposure of the corporation is no different from that which arises when no loan is provided. The corporation has just exchanged its exposure through insured deposits with that of a direct loan.

8 The extended model assumes that the costs of liquidation are proportionate to the dollar value of the assets. This has been confirmed by consultations with deposit insurance administrators. The model also assumes that any expenditures made to stabilize a distressed credit union will be offset directly by increases in the value of the credit union's assets from better management of the credit union's assets thus leaving the insurer's exposure unchanged. However, if these stabilization costs were not deemed to add value then the model could be extended by a method analogous to that of the liquidation costs.

9 Note that the riskless rate of interest is usually measured by the yield on short-term government treasury bills. Assuming a competitive financial market for short-term deposits, any short-fall in the interest paid on demand deposits from that on short-term treasury bills is compensated by the value of banking services provided. However, if the market for short-term deposits is not purely competitive then the actual rate on short-term deposits plus the value of banking services would be used as in Marcus and Shaked (1984).

10 The reductions from book to market value are calculated as follows:

4% of non-mortgage investments plus
50% of net book value of fixed assets and property held for resale plus
100.0% of prepaid expenses plus
20% of accounts receivable

Although quarterly adjustments to reflect varying economic conditions are required for practical application of the model, deposit insurance administrators confirmed that these figures were reasonable adjustments for conditions of the early 1980's recession in Western Canada.

11 Because it was assumed the liabilities of each credit union will increase at the risk-free rate of interest, the risk-free rate is cancelled out of the pricing formulae. If one assumes that liabilities increased differently from the risk-free input of the model then the rate on deposits would be adjusted accordingly. A rate on deposits higher than the risk-free rate of interest would cause premiums to increase while a rate lower would have the opposite effect. In this way, the effect of an asset/liability mismatch would be incorporated in the model.

12 Dividends are usually paid once a year by credit unions. In order to reflect the fact that a liability to pay out dividends accrues over a full year, the amount of dividends in a given

quarter was added back to the four previous quarters as a liability. The full amount was added to the previous quarter's liabilities, three quarters of the amount paid was added to the liabilities two quarters back, one-half was added to the liabilities three quarters back, and one quarter was added to the liabilities four quarters back.

13 Valuation of deferred taxes is a problem because of the uncertainty in the timing of the reversal of income and expense items for financial reporting and income tax purposes. However, as the presence of the deferred taxes on the balance sheet indicates there is a reasonable probability that the items will be reversed, it is treated like other liabilities in our model. A further extension of our model would be to estimate the timing of the reversals and discount the expected tax payments by the risk-free rate.

14 Evaluate M(t), the moment generating function of the difference of two variables, X and Y with a bivariate normal distribution. X and Y are distributed $N(\mu_1,\sigma_1^2)$ and $N(\mu_2,\sigma_2^2)$ repectively with covariance σ_{12}.

$$M(t) = E\,(\exp\,(t\,(X-Y))$$

$$= E\,(\exp\,(tX - tY)$$

$$= M_{\star}\,(t,-t)$$ where $M_{\star}$ is the moment generating function of a bivariate normal distribution (Hogg and Craig, 1978, p. 119)

$$= \exp\left[t\,(\mu_1 - \mu_2) + \frac{t^2}{2}(\sigma_1^2 - 2\sigma_{12} + \sigma_2^2)\right]$$

Thus X-Y is distributed

$$N(\mu_1 - \mu_2,\ \sigma_1^2 - 2\sigma_{12} + \sigma_2^2)$$

15 The actual mean of the return on the mortgage portfolio was less than that of the treasury bills over the period of study.

16 Because the natural logarithms of one plus the quarterly return on the assets are assumed to be independent and identical draws from a normal distribution, the annual variance is four times that of the quarterly variance.

17 The Credit Unions Act of British Columbia limits the levying powers of CUDIC. The maximum level of assessments and mandatory purchases of CUDIC debentures are each set at 0.2% of deposits and non-equity shares.

18 The arithmetic means of the standard deviations of the log of one plus the return on assets per dollar of liability were calculated for the British Columbia credit unions over the period 1976 through 1983. As illustrated below, these approximate the

standard deviations of returns on assets calculated in previous papers.

Distribution of Standard Deviations

	British Columbia	Marcus & Shaked (1984)		Ronn & Verma (1986)	
	1976-1983	1979	1980	Quarter I 1983	Quarter IV 1983
Mean	0.022	0.022	0.022	0.018	0.016
Standard Deviation	(0.005)	(0.006)	(0.008)	(0.008)	(0.006

19 As noted earlier, a major disadvantage of using accounting data is the fact that the number of observations available to calculate standard deviations is limited to the number of reporting intervals. Because of the need to reduce estimation error, all thirty-one quarterly changes in the natural logarithm of the ratio of the market value of assets to the book value of liabilities to calculate the standard deviations were used. Because of the much greater time period over which our estimates were made, the standard deviations reported herein are likely more susceptible to stale data error than those reported in papers employing market data.

To test the stability of standard deviations across time, estimates of these parameters were compared on the basis of credit union data before first quarter 1980 (15 quarterly changes) and data after and including first quarter 1980 (16 quarterly changes). The Pearson and Spearman correlations between the two sets of estimates were insignificant at the 5% significance level.

In order to obtain more recent estimates of the standard deviations for financial institutions not publicly traded, one could obtain estimates of the variances and covariances of the returns of publicly traded assets proxying those of the institutions. By also incorporating an estimate of the variance of net deposit inflows, a simulation could be used to determine the standard deviation of the return on the market value of assets per dollar of book value of liabilities.

20 When one includes investment income on the deposit insurance fund less administrative costs apart from the financial assistance to credit unions, the percentage increases to 0.09% of deposits and non-equity shares.

21 These calculations assume "external" liquidation costs of 1%.

22 Ronn and Verma (17) found the impact of interest rate risk was only a minor component of the risk of 43 large U S. banks studied. The difference from our results is attributable to the higher degree of asset / liability term and interest rate mismatching of the British Columbia credit unions The British Columbia credit unions during the years studied were funding fixed rate mortgages of terms on average three years with short-term deposits The U S banks had a much higher proportion of assets in commercial loans with floating interest rates

23 These calculations assume "external" liquidation costs of 1%

24 This method of valuing the exposure of the CDIC to the British Columbia Credit Union System makes the assumption that it can liquidate the system if it enters into default Given the weakness of this assumption, an appropriate alternative would be a permanent guarantee of insurance in which case the cost would increase

Appendix IV A

Valuation of Deposit Insurance

Where Intermediary Audit

The cost of deposit insurance will be reduced where there is an interim as well as a final audit. With an interim audit, the deposit insurer can sooner identify and liquidate a credit union in a deficit position and so reduce its exposure.

The price of deposit insurance with an interim audit is equal to the sum of the value of the insurance for the period prior to the interim audit and the value of the insurance for the subsequent period. At an interim audit, the deposit insurer will liquidate the credit union if the market value of liabilities exceeds the market value of assets. The cost of coverage for the period up to the interim audit can be calculated using the previously outlined model. If the market value of assets exceeds the book value of the liabilities, then the deposit insurer will guarantee deposits over the time period between the interim audit and the final audit.

The cost of this second period's guarantee is thus dependent on the likelihood that the market value of the credit union's assets will exceed the liabilities as at the interim audit. These conditions are similar to those of the compound call option model developed by Geske (1979).

By invoking the risk neutrality arguments of Cox-Ross (1975), Geske contended that the current value of a compound call option is:

$$C = e^{-rf(t_{\star}-t)} E\,[C'_{t\star}]$$

liabilities. According to discussions with credit union officials, a premium for goodwill is rarely paid by a merger partner.

The lending of funds to a distressed credit union may be a less expensive alternative to liquidation or merger. However, it should first be noted that this will require an assumption that liquidation or forced merger will bear external liquidation costs additional to the shortfall in asset value. The lending of funds to a distressed credit union usually involves considerable administrative costs. From discussions with deposit insurance officials, the costs of administering stabilization and liquidation are approximately equal and are ignored for purposes of this comparison. Consider the case of a credit union that has fallen into financial distress; the deposit insurer can either liquidate the credit union now or else provide a temporary loan and insure it for another time period. Assuming that the loan provided by the deposit insurer is used to pay off existing liabilities of the credit union, the ratio of the market value of assets to book value of liabilities is unchanged. In the absence of externalities the two choices would be valued as:

(1) Liquidation = $L - A$

(2) Stabilization = $-[AN(-h) - LN(\sigma\sqrt{T} - h)]$

for one Period where

$$h = \ln(A/L)/\sigma\sqrt{T} + \tfrac{1}{2}\sigma\sqrt{T}$$

L = current amount of demand deposits

Similar to the solution of Geske (1979) for compound call valuation, the value of the put can be determined if we know the conditional distribution of the value of the firm's assets at the time of the intermediary audit given the firm's assets have a current value of A, $F(A_{t\star}/A)$. In addition, the value of the call $C_{t\star}$ at time $t_\star$ can be obtained by the Black-Scholes option pricing model.

$$P = e^{-rf(t_\star - t)} \int_{L_{t_\star}}^{\infty} AN_1 (k+\sigma_A \sqrt{T-t_\star})\, F(A_{t\star}/A)\, dA$$

$$- \int_{L_{t_\star}}^{\infty} Le^{-rf(T-t_\star)} N_1 (k)\, F(A_{t\star}/A)\, dA$$

$$- \int_{L_{t_\star}}^{\infty} A_{t\star}\, F(A_{t\star}/A)\, dA + \int_{L_{t_\star}}^{\infty} Le^{-rf(T-t_\star)}\, F(A_{t\star}/A)\, dA$$

$$\text{where } k = \frac{\ln(A/L) + (rf - \frac{1}{2}\sigma_A^2)(T-t_\star)}{\sigma_A \sqrt{T-t_\star}}$$

σ_A^2 = instantaneous variance of return on assets

L = amount of demand deposit at time, T

$L_{t\star}$ = amount of demand deposits at time, $t_\star$

Using Geske's evaluation of the first two integrals and that of Jarrow and Rudd (1983) of the last two, the current price of the deposit insurance coverage for the second time period can be rewritten as:

$$P = AN_2\left(h+\sigma_A\sqrt{t_\star-t},\ k+\sigma_A\sqrt{T-t};\ \sqrt{(t_\star-t)/(T-t)}\right)$$

$$- Le^{-rf(T-t)}N_2\left(h,\ k;\ \sqrt{(t_\star-t)/(T-t)}\right)$$

$$- AN_1(h_\star) + Le^{-rf(T-t)}N_1\left(h_\star-\sigma_A\sqrt{t_\star-t}\right)$$

where $$h = \frac{\ln(A/L_{t\star}) + (rf - \frac{1}{2}\sigma_A^2)(t_\star-t)}{\sigma_A\sqrt{t_\star-t}}$$

$$k = \frac{\ln(A/L) + (rf - \frac{1}{2}\sigma_A^2)(T-t)}{\sigma_A\sqrt{T-t}}$$

$$h_\star = \frac{\ln(A/L_{t\star}) + (rf + \frac{1}{2}\sigma_A^2)(t_\star-t)}{\sigma_A\sqrt{t_\star-t}}$$

$N_2(\ )$ = bivariate cumulative normal distribution function

Appendix IV.B

Valuation of Choice

of Stabilization/Liquidation

Deposit insurers usually have three choices when a financial institution has encountered financial distress. The financial institution can be liquidated, merged or be given an emergency loan. The Merton model assumes that the financial institution will be liquidated. However, most of the governing statutes require that in order to guarantee deposits, the deposit insurer should choose the least costly course of action except in cases where the choice would deprive a community of the services of a financial institution. Because of this type of exception our deposit insurance model will incorporate the goal of minimizing costs not only to the deposit insurance fund but also those of externalities. There are three categories of costs involved in the liquidation of a distressed credit union by a deposit insurer. First, there is the shortfall in asset value below book value of liabilities. Second, there are administrative costs involved in managing an assistance program. Last, there are "external" costs such as loss of confidence in the credit union system, loss of employment of management and staff and disruption of customer banking relationships.

The cost of a forced merger would likely be similar to that of a liquidation as the merger partner usually demands payment equal to the shortfall in market value of assets from the book value of

liabilities. According to discussions with credit union officials, a premium for goodwill is rarely paid by a merger partner.

The lending of funds to a distressed credit union may be a less expensive alternative to liquidation or merger. However, it should first be noted that this will require an assumption that liquidation or forced merger will bear external liquidation costs additional to the shortfall in asset value. The lending of funds to a distressed credit union usually involves considerable administrative costs. From discussions with deposit insurance officials, the costs of administering stabilization and liquidation are approximately equal and are ignored for purposes of this comparison. Consider the case of a credit union that has fallen into financial distress; the deposit insurer can either liquidate the credit union now or else provide a temporary loan and insure it for another time period. Assuming that the loan provided by the deposit insurer is used to pay off existing liabilities of the credit union, the ratio of the market value of assets to book value of liabilities is unchanged. In the absence of externalities the two choices would be valued as:

(1) Liquidation = $L - A$

(2) Stabilization = $-[AN(-h) - LN(\sigma\sqrt{T} - h)]$

for one Period where

$$h = \ln(A/L)/\sigma\sqrt{T} + \tfrac{1}{2}\sigma\sqrt{T}$$

L = current amount of demand deposits

Additional cost of stabilization over liquidation:

$= LN(\sigma\sqrt{T} - h) - AN(-h) - L + A$

$= L(N(\sigma\sqrt{T} - h) - 1) - A(N(-h) - 1)$

$= L(-N(h - \sigma\sqrt{T})) - A(-N(h))$

$= AN(h) - LN(h - \sigma\sqrt{T})$

= price of call with asset value A and exercise price L at end of T time period.

≥ 0 as call has limited liability.

Thus the cost of providing a temporary loan never falls below the cost of liquidation in the absence of "external" liquidation costs. In reality, liquidation often involves "externalities". From discussions with deposit insurance administrators, the "external" cost of liquidation is best modeled as a percentage, x, of assets.

Thus the relevant costs are equal to:

(1) Liquidation = $L - A + xA$

(2) Supervision for = $-[AN(-h) - LN(\sigma\sqrt{T} - h)] + xAN(-h)$*

for one Period where

$h = (\ln(A/L) + \sigma^2 T/2) / \sigma\sqrt{T}$

L = current amount of demand deposits

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*Expected value of "external" cost of liquidation:

$= e^{-rfT} E(xA | A < Le^{rfT})$

$= e^{-rfT} [E(xA) - E(xA | A \geq Le^{rfT})]$

$= e^{-rfT} [xA\, e^{rfT} - xAe^{rfT} N(h)]$

$= xA(1-N(h))$

$= xAN(-h)$

Additional cost ($\overline{AC}$) of stabilization over liquidation:

$$\begin{aligned} AC &= AN(h) - LN(h - \sigma\sqrt{T}) + xAN(-h) - xA \\ &= AN(h) - LN(h - \sigma\sqrt{T}) - xA(1-N(-h)) \\ &= AN(h) - LN(h - \sigma\sqrt{T}) - xAN(h) \\ &\gtrless 0 \quad \text{for } 0 < x < 1 \end{aligned}$$

Thus, the choice between stabilization and liquidation depends on the amount of liquidation costs and the asset value at the time of the preliminary audit, the standard deviation of the asset return and the time to the end of the stabilization period.

As the liquidation expenses increase as a proportion of total asset value, the relative cost of stabilization decreases:

$$\frac{\partial AC}{\partial x} = - AN(h) < 0$$

However, for a given liquidation cost, the direction of the change in the additional cost of stabilization is uncertain as the ratio of asset value to book value of liabilities increases.[1]

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[1]Furthermore, for a given liquidation cost, the direction of the change in the additional cost of stabilization is uncertain as the standard deviation of the return on assets increases.

$$\frac{\partial AC}{\partial \sigma} = A\sqrt{T}N'(h)\left[1 - x\left\{\frac{-\ln}{\sigma^2 T}(A/L) + \frac{1}{2}\right\}\right]$$

$$\gtrless 0$$

where $N'(h) = \frac{1}{\sqrt{2\pi}} e^{-h^2/2}$

By setting L=1, we evaluate:

$$\frac{\partial AC}{\partial A} = N(h) - xN(h) - x\,AN'(h) / A\,\sigma\sqrt{T}$$

$$= (1-x)\,N(h) - x\,N'(h) / \sigma\sqrt{T}$$

$$\gtrless 0 \quad \forall \quad 0 < x < 1$$

$$\text{and } N'(h) = \frac{1}{\sqrt{2\pi}} e^{-h^2/2}$$

Thus, in order to calculate the premium for insuring the deposits of a credit union over two periods where there's a choice of stabilizing or liquidating the unit at the end of period one, a closed form solution cannot be employed. By the risk neutrality arguments of Cox and Ross, the value of the deposit insurance is equal to the expected value of the cost at the end of the preliminary audit given the choice of either insurance or stabilization discounted at the riskless rate of return:[2]

$$\text{Premium} = e^{-rfT_1}\ E\ \{\min < L-A + xA,$$

$$-[AN(-h) - LN(\sigma\sqrt{T_2} - h)] + xAN(-h)>\}$$

$$\text{where}\quad h = [(\ln(A/L) + \sigma^2 T_2/2) / \sigma\sqrt{T_2}]$$

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[2]Administrative costs, ad, equal for both stabilization and liquidation could be incorporated as follows:

$$\text{Premium} = e^{-rfT_1}\ E\ \{\min < L - A + xA,\ -[AN(-h) - LN(\sigma\sqrt{T_2} - h)] + xAN(-h)> + ad\}$$

$$\text{where } h = [\ln(A/L) + \sigma^2 T_2/2) / \sigma\sqrt{T_2}]$$

T_1 = length of time to first audit

T_2 = length of time from first to second audit

$$= e^{-rT_1} \int_{-\infty}^{L} \min < L - A' + xA', - [A'N(-h) - LN(\sigma\sqrt{T_2} - h)] + xA'N(-h) > \frac{e^{-v^2/2}}{\sqrt{2\pi}}\, dv \quad (1)$$

where $A' = Ae^{(rT_1 + \sigma\sqrt{T_1}\, v)3}$

This integral can be solved by numerical analysis. In this paper, Simpson's Rule was employed because of its computational ease and relatively small approximation error.[4]

In order to compute the benefits of a preliminary audit when there is an opportunity for stabilization and "external" liquidation costs are present, the compound put model was recalculated. The value of the deposit insurance incorporating "external" liquidation costs when there is only one audit and no opportunity for an intermediate period of stabilization is equal to:

$$- [AN(-h) - LN(\sigma\sqrt{T} - h)] + xAN(-h)$$

where $h = [\ln(A/L) + \sigma^2 T/2] / \sigma\sqrt{T}$

The price for insurance where there is a preliminary audit with the opportunity for stabilization is a combination of model

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[3] Jarrow and Rudd, page 94

[4] Dorn and McCracken

(B.1) providing coverage in cases where the asset value falls below the liability value at the interim audit and a recomputed compound put model from Appendix IV.A, P*, providing coverage in cases where the asset value was above or equal to the liability value at interim audit:

$$P^* = A(1-x)\, N_2\left(h+\sigma_A\sqrt{t_*-t},\ k+\sigma_A\sqrt{T-t};\ \sqrt{(t_*-t)/(T-t)}\right)$$

$$- Le^{-rf(T-t)}\, N_2\left(h,\ k;\ \sqrt{(t_*-t)/(T-t)}\right)$$

$$- (1-x)\, AN_1(h_*) + Le^{-rf(T-t)}\, N_1\left(h_*-\sigma_A\sqrt{t_*-t}\right)$$

where terms are equivalent to those of the previously outlined compound put model in Appendix IV.A.

Appendix IV.C

Market Value of Assets

Real Estate Mortgages

Although the quarterly financial statements were not audited, it was assumed that both quarterly and annual allowances for doubtful accounts were reasonable estimates of the proportion of the book value of mortgages that would not be repaid. The allowance for doubtful accounts was split on the basis of the proportion of book value between real estate and other mortgages.

After this adjustment for the allowance for bad debt, the mortgages were revalued by discounting all their expected monthly payments and final payments of principal outstanding by the current mortgage rate. No provision was made for early repayment as there were usually significant penalties on such action by borrowers. All mortgage balances were treated as having three year terms. This assumption was supported by the following ratios of the average of three previous year-end balances of real estate mortgages over principal repaid during the year:

1978	1979	1980	1981	1982	1983
1.86	2.33	2.56	3.16	2.49	3.19

The next step in the valuation of real estate mortgages as at the end of a quarter was to calculate the amount of mortgages outstanding at that date which were issued in each of the prior thirty-six months.

These amounts were estimated as follows for the outstanding balance at the end of month T.

Three year term real estate mortgages issued in month, t, outstanding at end of month T	=	Mortgages issued in month, t	X	Principal Outstanding Adjustment Factor

where the Principal Outstanding Adjustment Factor is equal to the proportion of the original principal of the mortgages at the time of issue, t, remaining at month T. The mortgages were assumed to be issued with equal amounts of five, ten, fifteen, twenty and twenty-five year amortizations.

With these balances and their corresponding number of months outstanding, amortization period and the mortgage interest rate,[6] future mortgage payments were estimated. These future cash flows were then discounted by the current month's mortgage rates to arrive at the market value of the mortgages.

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[5]The sum of the outstanding mortagages estimated to have been issued over the prior thirty-six months was compared against the actual amount outstanding. An adjustment was made to the estimates on this basis.

[6]The five year conventional mortgage rate from the Bank of Canada Review was used because no series of three-year rates was available.

REFERENCES

F Black, and M. Scholes, "The Pricing of Options and Corporate Liabilities," Journal of Political Economy, Vol. 81 (May/June 1972), 637-54.

J C Cox and S. A. Ross, "The Valuation of Options for Alternative Stochastic Processes," Journal of Financial Economics, Vol 3, (January 1976), 145-66.

W S. Dorn and D D McCracken, Numerical Methods and Fortran Programming, New York: Wiley, (1964).

E. F Fama, Foundations of Finance: Portfolio Decisions and Securities Prices, New York: Basic Books, (1976).

S Fischer, "Call Option Pricing When the Exercise Price is Uncertain, and the Valuation of Index Bonds," Journal of Finance, Vol. 33, (March 1978), 169-76.

R .Geske, "The Valuation of Compound Options," Journal of Financial Economics, Vol. 7, (March 1979), 63-81.

R. V. Hogg and Allen T. Craig, Introduction to Mathematical Statistics, New York: MacMillan Publishing Co., Inc., (1978).

R. A. Jarrow and A. Rudd, Option Pricing, Homewood, Illinois: Richard D. Irwin, Inc., (1983).

C Kreps and R. Wacht, "A Graduated Deposit Insurance Plan," Review of Economics and Statistics, Vol. 47 (1965), 114-6.

_____, "A More Constructive Role for Deposit Insurance," Journal of Finance, Vol. 26 (May 1971), 605-13.

A. J Marcus and I. Shaked, "The Valuation of FDIC Deposit Insurance Using Option-pricing Estimates," Journal of Money, Credit and Banking, Vol. 16, (November 1984), Part 1, 446-460.

T. A. Marsh and E. R. Rosenfield, "Stochastic Processes for Interest Rates and Equilibrium Bond Prices," Journal of Finance, Vol. 38, (May 1983), 635-646.

J H. McCulloch, "Continuous Time Processes With Stable Increments," Journal of Business, Vol, 51, (1978), 601-619.

_____, "Interest Rate Risk and Capital Adequacy for Traditional Banks and Financial Intermediaries," in "Risk and Capital Adequacy in Commercial Banks," edited by Sherman J. Maisel. Chicago: University of Chicago Press,(1981).

_____, "Interest-Risk Sensitive Deposit Insurance Premia," Working Paper #84-3, (April 1984), 1-30.

A. H. Meltzer, "Major Issues in the Regulation of Financial Institutions," Journal of Political Economy, Vol. 75 (August 1967), 482-501.

R. C. Merton, "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates," Journal of Finance, Vol. 29 (May 1974), 449-70.

_____, "An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees," Journal of Banking and Finance, Vol. 1 (1977), 3-11.

_____, "On the Cost of Deposit Insurance When There Are Surveillance Costs," Journal of Business, Vol. 51, (July 1978), 439-452.

Y. E. Orgler, "Capital Adequacy and Recoveries from Failed Banks," The Journal of Finance, Vol 30 (December 1975), 1366-1373.

E. Ronn and A. Verma, "Pricing Risk-Adjusted Deposit Insurance: An Option-Based Model," Journal of Finance, Vol. 41, (September 1986) 871-895.

K. E. Scott and T. Mayer, "Risk and Regulation in Banking: Some Proposals for Federal Deposit Insurance Reform," Stanford Law Review, Vol. 23 (May 1971), 857-1207.

H. R. Stoll, "The Relationship Between Put and Call Option Prices," The Journal of Finance, Vol. 24 (December 1969), 802-824.

E. S. Schwartz and M. J. Brennan, "The Pricing of Equity-Linked Life Insurance Policies with an Asset Value Guarantee," Journal of Financial Economics, Vol. 2 (1976), 195-213.

R. Westerfield, "The Distribution of Common Stock Price Changes: An Application of Transaction Time and Subordinate Stochastic Models," Journal of Financial and Quantitative Analysis, Vol. 12 (December 1977), 743-765.

CHAPTER V

Early Warning System Predicting Both Financial Distress and Type of Financial Assistance Required

I. Introduction

Deposit insurance corporations have a primary objective of insuring deposits up to levels specified by legislation. Legislation usually mandates that they accomplish this goal in a way least costly to the deposit insurance funds they administer. A secondary objective, which appears to have been adopted by several deposit insurance corporations in Canada and the United States, is to contribute to the stability of the financial system.[1] Contributing stability to the financial system is a general rubric that incorporates a whole spectrum of lesser objectives.

At one extreme is the Funds of Quebec Federation which has a legislated objective of providing assistance for the benefit of the member "caisses populaires".[2] At the other extreme, would be a deposit insurer that considers stability in the financial system as an objective only because its liquidation of a distressed financial institution may lead to other failures which, in turn, would trigger increased draws on the insurance fund. In between, most deposit insurance corporations consider the effect of failure on the businesses financed by and the depositors of the distressed financial institution. Especially of concern to the provincial credit unions' deposit insurers are remote communities where the member institution is the only provider of banking services.

The last few years have seen an increasing weight placed on the goal of stabilization rather than pure insurance. For example, the Canada Deposit Insurance Corporation's March, 1985 bailout of the Canadian Commercial Bank was based partly on a goal of maintaining regional banks. The large numbers of savings and loan institutions in the United States receiving loans from the Federal Savings and Loan Insurance Corporation in the early 1980's, reflected the relative importance of protecting the stability of the financial system.

If a financial institution encounters financial distress, there are four types of assistance a deposit insurance corporation can provide: liquidation, merger, loan and supervision. Supervision of a member institution usually involves deposit insurance administrators closely monitoring operations and holding authority over major decisions. A deposit insurer whose sole function is pure insurance would mostly choose liquidation or merger as a means of settling claims. Loans and supervision are the main tools of a deposit insurance system aiming to preserve distressed members as going concerns. The first two types of assistance carry costs and require management skills different from those of the last two forms. Consequently, in order to estimate the amount of funds necessary to fulfil the claims on the deposit insurer, the likelihood of each type of assistance is a necessary calculation.

Previous papers have presented models to predict the likelihood of financial distress based on a series of accounting measures.[3,4] This paper will develop an early warning model to predict not only the likelihood of incurring financial distress but also the type of financial assistance required. The model will be based on data from

the Ontario Credit Union system over the period 1979 through 1985. Because a large number of credit unions were provided a variety of forms of assistance over the period, analysis of the system should be of relevance to all deposit insurance corporations that conduct both pure insurance activities and stabilization.

The next section of this paper develops a framework for the model as well as relevant variables to be incorporated in it. Section Three discusses the method of estimation while the fourth section reviews the data. Section Five presents the results while the sixth section provides conclusions.

II. THEORY

1. Types of Distress

Previous models predicting financial distress of financial institutions have not distinguished the distress by the type of assistance provided. For example, Altman (1977), Martin (1977), and Sinkey (1978) lump together problem banks receiving different forms of assistance. The hypothesis to be tested in this paper is that financial institutions likely to receive one form of assistance are not significantly different from financial institutions likely to receive another.

It is seldom that a credit union receiving a loan from a deposit insurance corporation not be under or subsequently placed under supervision. Consequently these two categories were collapsed into one and are referred to as supervision.

A strong a priori case can be made for combining liquidation and merger groups. In both instances the primary cause of the dissolution

is that the credit union is no longer economically viable on its own and the deposit insurance corporation has no special intent to make it so. A liquidation usually occurs when a suitable merger partner cannot be found. Thus, it is not expected that the hypothesis that the characteristics of credit unions which are liquidated are the same as those of credit unions which are merged will be rejected. On the other hand, it is expected that credit unions which make a supervision claim are significantly different from those that make a liquidation/merger claim.

There are no precise guidelines by which OSDIC chooses one remedy to financial distress over another. From discussions with provincial deposit insurance administrators, supervision is chosen over liquidation/merger for the following economic reasons. Supervision is often applied where the problems leading to the financial distress of the credit union appear temporary. For example, the deposit insurance corporation would provide a loan to a solvent credit union experiencing a liquidity shortage. Another example would be a credit union experiencing an unusual amount of non-performing loans because of circumstances likely to reverse themselves such as a strike at a local employer.

Supervision will be applied also to the cases where the largest financial institutions have fallen into distress. As commented by Mayer (1975) and Ho and Saunders (1980), deposit insurance corporations will be reluctant to publicize the financial difficulty of a large financial institution because of the adverse reaction of depositors of other banks. With a fear of contagion effects there is an incentive to discretely provide a loan to a troubled member institution, especially a large one, rather than

conduct a liquidation and pay off depositors. Consequently, it is expected that size will distinguish the two types of claims.

2. Variables

The Merton (1977) deposit insurance pricing model relates the exposure of a deposit insurance corporation from a particular financial institution to three variables--variance of the return on assets, ratio of market value of assets to the level of deposits and time to the next audit. As the last variable is not usually different among credit unions, the first two variables should be sufficient to compare exposure across credit unions. However, because both of these variables are difficult to measure, a series of proxy variables using readily available financial statement figures are employed as predictors of financial distress. These variables are listed in Exhibit V.1.

The volatility of asset returns is mainly a result of sensitivity to default risk and interest rate risk. Default risk will be measured by the expected loan delinquency rate as represented by the allowance for doubtful accounts as a proportion of total loans and applicable investments.[5] Increases in default risk will lead to a higher probability of encountering financial distress.

Interest rate risk is the result of changes in interest rates occurring when a credit union does not have the term and fixed rate conditions of its liabilities and assets matched. Because most of the liabilities have a term less than one year, most of the interest rate risk will arise from holding a high proportion of long term fixed rate assets. However, as the length of the term of the assets, especially

investments, was not available for our study, there was no method by which to measure interest rate risk by examining asset composition. Another proxy for interest rate risk, standard deviation of the ratio of net interest income to total revenue, is listed in Exhibit V.1. The measure is most appropriate for financial institutions whose previous volatility of interest rate margin is reflective of current conditions. However, the information was again unavailable at the time of this study.

The ratio of the balance sheet measures of net worth to total assets is a proxy for the excess of the market value of assets over the level of deposits. This excess provides a cushion to absorb reduction in asset values caused by default and interest rate risks. The higher the capital cushion, the lower the likelihood of distress.

A series of other measures should help predict the probability of financial distress. First, operating efficiency is likely to increase the value of the credit union. Operating efficiency is measured by the ratio of net operating expenses to total assets. Numerous situations can give rise to inefficiencies. For example, the credit union may simply be too small to be competitive, it may have too many branches, or it may simply be poorly administered. Because of the variety of causes, a financially distressed credit union with low operating efficiency may have its problems redressed through supervision, liquidation or merger.

Earnings, as measured by the ratio of net income (before tax and dividends) to total revenue incorporates the effects of all the measures previously listed. The higher the net income to total revenue, the lower the probability of financial distress.

Exhibit V.1

EXPECTED IMPACT OF EXPLANATORY VARIABLES
ON LIKELIHOOD OF FINANCIAL DISTRESS

	Variable	Definition	The Likelihood of Supervision Increases when the Variable	The Likelihood of Liquidation/ Merger Increases when the Variable
1.)	Default Risk (DFRK)	Allowance for Doubtful Accounts / Total Loans	Increases	Increases
2.)	Operational Efficiency (OPEX)	Operating Expenses / Total Assets	Increases	Increases
3.)	Capital Adequacy (NWTA)	Net Worth / Total Assets	Decreases	Decreases
4.)	Earning Power (NITR)	Net Revenue / Total Revenue	Decreases	Decreases
5.)	Liquidity (LQ)	Total Investments Less Required Reserves / Total Assets	Decreases	Increases
6.)	Financial Risk (FINR)	Accounts Payable & Short Term Borrowing / Total Assets.	Increases	Decreases
7.)	Economic Prospects (GRTA)	Natural Log of the Ratio of the Current to Prior Year End s Total Assets	Increases	Decreases
8.)	Size (TA)	Natural Log of the Year End Total Assets	Increases	Decreases

The variables listed above are all predictors of financial distress but are unlikely to discriminate between forecast situations where supervision will be applied as opposed to liquidation or merger. Liquidity, financial risk, total assets and economic prospects should not only predict financial distress but also distinguish whether the assistance will be stabilization or liquidation and merger.

Liquidity is measured by the sum of cash and investments less required reserves. An excessive amount of liquidity implies that a credit union is unable to acquire "high yielding" loans. Consequently, its long-term economic prospects are likely poor and thus the deposit insurer will probably liquidate or merge a distressed unit with excessive liquidity. If a credit union has a shortage of liquidity, then it is likely a result of a default on payments from the assets or improper matching of asset and liability cash flows. Because the credit union's problem will likely reverse itself, the deposit insurer often provides temporary assistance through a loan. It is expected that excess liquidity will be resolved by liquidation/merger while a deficiency in liquidity will be remedied through supervision.

Financial risk is measured by the extent to which "hot money" is used. It is defined as the ratio of loans payable plus accounts payable to total assets. The premise is that credit unions do not borrow to create financial leverage but borrow to cover shortfalls. It is another indicator of a liquidity shortage and thus would likely be resolved through supervision.

Asset size should be a predictor of financial distress for two reasons. First, asset size is a proxy for the age of the credit union. A new credit union is more likely to encounter financial distress than a well established institution because of lesser managerial and operational experience. As Murray and White (1983) illustrated, larger credit unions also have advantages of economies of scope and scale.

As earlier stated, deposit insurance corporations are less willing to liquidate large credit unions than smaller units. Consequently, greater total assets will be associated with supervision.

Regional economic prospects of a credit union are measured by growth in total assets. The current annual growth rate is assumed to be a good estimate of the future growth prospects. In the short run, rapid growth can create management, planning and cost problems. These all suggest that in the short run, high growth will often result in supervision. As the problems are viewed as temporary, the deposit insurer remedies the problem through supervision. In the long run, high growth reflects a credit union's viability because of the need to achieve economies of scope and scale. A high growth rate is expected to result in a lower probability of liquidation/merger.

III. METHOD

Previous models to predict financial distress of firms have employed any one of, or combination of, three techniques: discriminant analyses, logit and probit. The arguments supporting the use of each statistical technique in construction of an early warning system for financial distress are described in detail by D. Martin

(1977). For reasons similar to Martin's, this paper will choose the logit model over discriminant analysis. First, the goal of an early warning system should be to provide some means of identifying the likelihood of a financial institution encountering distress. The logit model satisfies this goal by providing estimates of the probability of an event occurring. Discriminant analysis estimates dichotomous relationships such as whether a credit union belongs to a group that will encounter financial distress or one that does not. These different goals are reflected by the results of Martin (1977) which substantiated earlier work done by Jones (1975). Martin found that the discriminant estimates of the likelihood of a failure were far worse than those obtained by the logit model. On the other hand, the logit model and discriminant analysis were equally able to classify financial institutions as being failures or non-failures. The resulting Type I and Type II errors were comparable.

A secondary reason why the logit model is preferred to discriminant analysis is that its assumptions are less restrictive. Unlike the logit model, discriminant analysis requires that the independent variables be distributed multivariate normal.[6]

The logit model was also chosen over the probit model. Both models share similar assumptions and produce almost identical results but the logit model is computationally easier. Both models are estimated by maximum likelihood by trying to maximize the likelihood functions of:

$$\ln (Y,B) = \prod_{i=1}^{N} P_i^{Y_i} (1-P_i)^{1-Y_i} \qquad (1)$$

where $Y = Y_1, \ldots, Y_N$ are the actual outcomes of a sample of N observations where

$Y_i = \begin{cases} 0 & \text{non-event} \\ 1 & \text{event} \end{cases}$

$B = (b_0, b_1, \ldots b_M)$ a vector of coefficients and P_i's are probabilities determined by the coefficients and a set of independent variables.

The difference between the probit and logit model arises in the functional form of P_i. The functional form of the logit model is the logistic function:

$$P_i = \text{Prob}\ (Y_i=1) = \frac{1}{1 + e^{-W_i}}, \quad i = 1, \ldots, N, \qquad (2)$$

Where $W_i = b_o + \sum_{j=1}^{M} b_j x_{ij}$ is a linear combination of the independent variables $x_{i1}, x_{i2}, \ldots, x_{iM}$ and a set of coefficients $B = (b_0, b_1 \ldots, b_M)$ to be estimated.

The probit model has the functional form of a cumulative normal distribution:

$$P_i = \text{Prob}\ (Y_i=1) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{W_i} e^{\frac{-v^2}{2}}\, dv \qquad (3)$$

where W_i is the same as above but with a different set of B to be estimated.

As logistic function (2) is a close approximation of (3), the estimated coefficients, B, as well as the estimated probabilities are similar. From both (2) and (3), it can be seen that changes in the independent variables x_{ij}'s will have an impact on W_i which in turn will affect the probability P_i. The higher the W_i, the higher the probability of an event. Furthermore, the change in probability will be lower when the credit union moves toward extreme values of W_i. This behaviour mirrors the impact of changes of variables on a credit union's likelihood of facing distress. For example, a one percent increase in capital will have its greatest impact when a credit union has approximately nil equity rather than a large deficiency or positive amount.

Because credit unions can make more than one type of claim in a given year, the logit model employed will involve a simultaneous estimation of two or more equations. Because of earlier stated arguments, coefficients of the equation for supervision are likely to differ from those of merger/liquidation. Zellner and Lee (1965) developed a model to obtain joint estimates of two or more equations in which the errors terms were correlated across equations. Analogous to the method of seemingly unrelated regressions for ordinary least squares, the joint estimation technique should improve the efficiency of the coefficients estimated. Nerlove and Press (1973) developed an algorithm to obtain maximum likelihood estimates; the model assumes that there are no interaction effects of order higher than two of the independent explanatory variables, bivariate interaction effects are constant and the main effects are linear functions of independent

variables. As maximum likelihood estimates, they are asymptotically both unbiased and normally distributed.[7]

In order to further improve the efficiency of the model's coefficients, observations will be grouped across both time and credit unions. The assumption of stationarity over the period 1979 through 1985 will be analyzed by comparing the results of subperiods.

An important issue addressed by Meyer and Pifer (1970) and Sinkey (1975) in their work on building models to identify problem banks was that of incorporating costs of misclassification. The model presented herein assumes that the Type I and Type II errors of classifying a credit union as likely to be liquidated are not only equal to each other but also to those of classifying a credit union as likely to be supervised. Practical application of the joint estimation technique will need to incorporate differences in these misclassification costs.

IV. DATA

The data required to estimate the coefficients of the early warning model was obtained from Ontario Share and Deposit Insurance Corporation (OSDIC). For the years 1979 through 1985, data on all credit unions in Ontario was obtained. Because all credit unions which operated without supervision for some part of a given year were included, biases described by Zmijewski (1984) were avoided.[8] Claims in each calendar year for each credit union were identified as supervision, liquidation or merger. Two claims such as liquidation and supervision could occur in any one year. Table V.1 lists the types of assistance provided by OSDIC.

V. RESULTS

Three dichotomous logit models were estimated using financial ratios from each of the years 1980 through 1984 to predict financial distress for each of the corresponding subsequent years 1981 through 1985. The first model estimates the likelihood of encountering financial distress without reference to the type of assistance provided by OSDIC. The second model estimates the probability of being liquidated or merged while the third model estimates the probability of being placed under supervision.[9] Table V.2 illustrates the results.

In comparing the three models, the similarities should first be noted. The variables for operational efficiency and financial risk were not found to be significant at even a 10% significance level and were eliminated from the models. The variables capital adequacy and earning power were of the expected sign and significant at least at a 10% level in all three models. Default risk was not found to be of significance in predicting the likelihood of a financial institution being placed under supervision. However, its coefficient was positive and significant at least at a 10% significance level for the models, predicting financial distress and predicting liquidation or merger.

Liquidity was not found to be significant as a predictor of financial distress but it was a significant variable when each type of claim was predicted separately. As expected, liquidity bears a negative relationship with the likelihood of supervision and a positive relationship with the probability of liquidation or merger.

The variable economic prospects had a significant negative coefficient in all three models. This confirms the expectation that higher growth reduces the probability of merger and liquidation but rejects the expectation that higher growth increases the unconditional likelihood of being placed under supervision.

The significant negative coefficient on the size variable in models one and two confirms the expectation that the likelihood of distress and liquidation or merger increases with smaller size. The coefficient of the size variable for supervision is found to be insignificant thus implying no relationship between size and the unconditional likelihood of being placed under supervision.

Table V.3 provides more insight into the differences between models two and three. Using only the 238 Ontario credit unions that encountered financial distress during the years 1981 through 1985, a dichotomous logit model was estimated which predicted the likelihood of being liquidated or merged as opposed to being placed under supervision. With the exception of the variable, financial risk, which was insignificant, the variables illustrated in Exhibit V.1 which were expected to distinguish the two categories of claims, do so at significance levels below 5%. Size is especially significant indicating that larger credit unions in financial distress get placed under supervision while smaller ones get liquidated or merged. This bias favouring larger credit unions may arise from the greater cost of externalities such as widespread bad publicity towards the credit union movement associated with failures of larger financial institutions (see Mayer 1975).

Because a credit union may be placed under supervision and subsequently liquidated or merged in the same year, a simultaneous estimation of two dichotomous dependent variables was employed. Table V.4 outlines the results of the estimation. The model is equivalent to models two and three of Table V.2 except that the bivariate interation term is not constrained to equal zero. The bivariate interaction term is significantly different from zero at a 1% level by both the t-statistic and the likelihood ratio test. Consequently, the model's unrestricted form provides a better explanation of the relationship of the independent variables to the likelihood and type of financial distress.

The model of the simultaneous equations was tested for stationarity across both time and across credit unions. Models were estimated over the period 1981 to 1982 and the period 1983 through 1985. By comparing the sums of the logs of the likelihood functions of these two models to the log of the likelihood function for the model for the whole period, stationarity across time was rejected.[10] Furthermore by splitting the observations in 1981 in half, stationarity across credit unions was analyzed and rejected.[11] The model's nonstationarity could be the result of a variety of factors. Unmeasurable but likely significant exogenous variables such as interest rate risk have not been included in the model. This could induce nonstationarity across credit unions. Second, economic conditions changed differently across each of the years 1981 through 1985. Consequently, credit unions with poor net worth at the beginning of 1981 would likely have encountered financial distress in 1981 while credit unions with the same net worth at the beginning of

1983 would have had a higher prospect of surviving. If one could predict the economic conditions in the coming year, nonstationarity across time could be handled by estimating the model over similar time periods. One would still have to ensure that the deposit insurer's criteria for choosing the type of financial assistance was unchanged.

The predictive accuracy of the model was tested by comparing the classifications predicted by a model based on prior years' information against the actual classification in the current year.[12] A credit union could be classified as (1) not financially distressed, (2) supervised but not liquidated or merged, (3) liquidated or merged but not supervised, and (4) supervised and merged or liquidated. The coefficients estimated from prior years' information were used to calculate the probabilities of belonging to each of the four classifications in a current year.[13]

Each year, an average of 5.3% of the credit unions encountered financial distress over the period 1981 through 1983.[14] Consequently, if a credit union had a probability of encountering financial distress below 5.3%, it was classified as not financially distressed. If a credit union had a probability of encountering financial distress in excess of 5.3%, it was considered a higher than average risk.[15] It was then classified as belonging to which of groups (2), (3) and (4) had the highest probability. Table V.5 illustrates the results.

The model was able to predict 83.3% of credit unions actually placed under supervision as being either in group (2) or in group (4).[16] It was also able to correctly classify 68.3% of the credit

unions actually merged or liquidated as being in group (3) or in group (4).[17] A majority of credit unions not financially distressed were also correctly classified.

VI. CONCLUSIONS

A model has been developed which should be a valuable monitoring tool of deposit insurance corporations. Presently, these corporations use early-warning systems to identify member financial institutions which are likely to encounter financial distress. The model presented in this paper also predicts the type of financial assistance likely to be provided. Thus, better estimates can be made of required financial and human resources of the deposit insurance corporation.

The paper also provides insight into the criteria that underlie the choice between supervision and liquidation or merger of a distressed financial institution. The significance of size as a predictor of the type of assistance provided illustrates the importance of incorporating the cost of externalities in the decision.

TABLE V.1

Types of Financial Assistance
Provided by OSDIC
to Ontario Credit Unions[1]

Category	Year					
	1981	1982	1983	1984	1985	Total
Financial Distress:						
(1) Liquidation	4	3	0	2	0	9
(2) Merger	25	33	22	18	34	132
(3) Supervision	26	20	7	9	10	72
(4) Supervision/ Liquidation	4	3	2	0	0	9
(5) Supervision/ Merger	13	1	1	0	1	16
	72	60	32	29	45	238
No Financial Distress:	925	877	850	825	780	4257
	997	937	882	854	825	4495

[1] Does not include credit unions placed under supervision in a previous year.

TABLE V.2

Dichotomous Logit
Models of Financial Distress[1]

	(1) Distess=1 Other=0	(2) Liquidation or Merger=1 Other=0	(3) Supervision=1 Other=0
Constant	1.95 (2.26)	3.97 (4.02)	-1.96 (1.57)
Default Risk	3.08 (1.59)	2.54 (1.35)	-0.48 (0.11)
Capital Adequacy	-5.46 (2.24)	-2.58 (1.23)	-8.93 (2.07)
Earning Power	-2.48 (8.00)	-1.45 (4.35)	-3.98 (7.74)
Liquidity	0.61 (1.16)	1.34 (2.48)	-2.22 (2.08)
Economic Prospects	-1.11 (4.16)	-0.99 (3.53)	-1.07 (2.45)
Size	-0.29 (5.56)	-0.52 7.96	-0.01 (0.16)
Operational Efficiency	-1.17 (0.37)	-0.04 (0.01)	-4.87 (1.02)
Financial Risk	1.36 (1.04)	1.00 (0.72)	-0.07 (0.04)
Likelihood Ratio Test	166.6(8 D.F.)	156.3(8 D.F.)	155.0(8 D.F.)
Chow			
R-square[2]	0.90	0.92	0.90

1. asymptotic t-statistics are enclosed in brackets
2. see Chow (1983)

TABLE V.3

Dichotomous Logit[1,2]
Supervision = 0
Liquidation/Merger =1

Variable	
(1) Constant	12.60 (6.39)
(2) Financial Risk	1.06 (0.26)
(3) Economic Prospects	-2.33 (1.93)
(4) Size	-0.91 (6.48)
(5) Liquidity	4.69 (2.22)
Likelihood Ratio Test	118.43 (4 D.F.)
Chow R-squared	0.76

[1] t-statistics are enclosed in brackets
[2] conditional on financial distress

TABLE V.4

Simultaneous Estimation
of 2 Dichotomous Dependent
Variables[1]

	(1) Liquidation or Merger=1 Other=0	(2) Supervision=1 Other=0
Constant	2.50	-1.57
	(5.46)	(2.84)
Default Risk	1.41	-1.57
	(1.53)	(0.72)
Capital Adequacy	-0.60	-4.44
	(0.58)	(1.98)
Earning Power	-0.48	-1.74
	(3.15)	(7.30)
Liquidity	0.71	-1.26
	(2.66)	(2.40)
Economic Prospects	-0.45	-0.30
	(3.21)	(2.10)
Size	-0.27	0.06
	(8.27)	(1.72)
Bivariate Interaction	0.65	
	(8.39)	
Log of Likelihood Function	-996.3	
Log of Likelihood Function where Bivariate Interaction[2]=0	-1023.7	
Likelihood Ratio Test	54.8 with 1 D.F.	

[1] asympototic t-statistics are enclosed in brackets

[2] sum of logs of likelihood function for models (2) and (3), Table 2 with first six variables only.

Table V.5

Predicted Versus Actual
Condition of Credit Union
Over Years 1982 Through 1985

		ACTUAL				
		(1) Not Financially Distressed	(2) Supervised Not Liquidated/Merged	(3) Liquidated/Merged Not Supervised	(4) Supervised Liquidated/Merged	TOTAL
PREDICTED	(1) Not Financially Distressed	1979	3	29	0	2011
	(2) Supervised Not Liquidated/ Merged	518	37	7	2	564
	(3) Liquidated/Merged Not Supervised	762	2	58	4	826
	(4) Supervised Liquidated/Merged	73	4	18	2	97
	TOTAL	3332	46	112	8	

Percentages of actual classifications correctly predicted:
59.4% of credit unions not financially distressed.
80.4% of credit unions supervised but not merged or liquidated.
51.9% of credit unions merged or liquidated but not supervised.
25.0%[1] of credit unions merged or liquidated, and supervised.

[1] Note that all credit unions which were merged or liquidated, and supervised were predicted as being financially distressed.

NOTES

1 The August 1986 "Report of the Inquiry into the Collapse of the CCB and Northland Bank" recommended that the Canada Deposit Insurance Corporation (CDIC) "should have regard to a wide range of factors including the national interest in the stability of the banking system as well as the likelihood of loss itself" (p.278) when deciding upon a course of action to handle a financially distressed member institution.

2 A "caisse populaire" is a financial institution similar to a credit union.

3 See for example Sinkey (1975), Martin (1977).

4 Ho and Saunders (1980) criticize early-warning models of bank distress such as the one presented in this paper because these models assume that the path towards distress is continuous. They contend that the trend towards failures is discontinuous especially for large banks with risky portfolios of assets funded mostly by deposits not covered by deposit insurance. Because most credit unions in Ontario do not have a high percentage of deposits above the $60,000 level guaranteed by the Ontario Share and Deposit Insurance Corporation and are limited in the degree of riskiness of assets they can hold, the assumption of a continuous path toward distress is reasonable.

5 The allowance for doubtful accounts is determined by management and at year end, the auditors attest to the reasonableness of this figure. OSDIC calculates its own estimate of expected loan delinquency by summary of the following percentages:

10% of loans three to six months in arrears
25% of loans six to twelve months in arrears
50% of loans twelve to eighteen months in arrears
75% of loans eighteen to twenty-four months in arrears

Replication of the model with this measure of default risk were not substantially different from those reported.

6 Linear discriminant analysis makes the further assumption that the independent variables of the two groups have equal covariance matrices. Quadratic discriminant analysis as noted by Altman (1977) does not requires this assumption.

7 Per Martin (1977), Monte Carlo simulations of maximum likelihood estimates of single equation logit models indicate that for large sample sizes (over 300

observations) the amount of bias is small for both the coefficients themselves and their estimated variance.

8 Zmijewski (1984) identified two biases that have plagued research into estimation of financial distress models. The first type of bias results from "oversampling" distressed firms while the second results from excluding firms with incomplete data.

9 Given the previously outlined reasons and the fact that there were only eighteen credit unions which were liquidated, the liquidated credit unions were classified with merged credit unions for estimation purposes.

10

Estimation Period of Model	Log of Likelihood Function
(1) 1981 - 1982	-512.7
(2) 1983 - 1985	-439.2
	-951.9
(3) 1981 - 1985	-996.3

Likelihood Ratio Test = 88.8 $> \chi^2_{15}$ or 30.2

11

Observations used to estimate models	Log of Likelihood Function
(1) 498 credit unions in 1981	-161.9
(2) 499 credit unions in 1981	- 94.4
	-256.3
(3) 977 credit unions in 1981	-278.4

Likelihood Ratio Test = 44.27 $> \chi^2$ 15 or 30.2

12

Period of Estimation of Simultaneous Equation Coefficients Used to Make Prediction	Period When Classification Predicted
1979 - 1981	1982
1979 - 1982	1983
1979 - 1983	1984
1979 - 1984	1985

13 As described by Nerlove and Press (1973), especially pages 33-34, the probabilities of a double dichotomy can be estimated by treating it as an estimation of the probabilities of four separate classifications which sum to one:

$$P_j = \frac{e^{z_j}}{\sum_{k=1}^{4} e^{z_k}}, \quad j = 1, \ldots 4$$

where P_j = probability of belonging to group j

$$Z_1 = a_1 + a_2 + B$$
$$Z_2 = a_1 - a_2 - B$$
$$Z_3 = -a_1 + a_2 - B$$
$$Z_4 = -a_1 - a_2 + B$$

and $a_1 = b_{10} + b_{11}x_1 + b_{12}x_2 \cdots b_{1M}x_M$

$a_2 = b_{20} + b_{21}x_1 + b_{22}x_2 + \ldots + b_{2M}x_M$

where M is the number of exogenous variables X_i

B = bivariate interaction term

14 238/4495 = 5.3%

15 A classification method of identifying all credit unions as belonging to the group with the highest historic probability was not used because most deposit insurance corporations want to bias the results in favour of obtaining higher percentages of actual supervisions and liquidations/mergers correctly predicted at the expense of lower percentages of not financially distressed credit unions correctly predicted.

16 Both Predicted as (2) or (4) and Actually in (2) or (4)
Actually in (2) or (4)

$$= \frac{37 + 2 + 4 + 2}{46 + 8} = 83.3\%$$

17 Both Predicted as (3) or (4) and Actually in (3) or (4)
Actually in (3) or (4)

$$= \frac{58 + 2 + 4 + 18}{120}$$

$$= 68.3\%$$

REFERENCES

Altman, Edward I. "Predicting Performance in the Savings and Loan Association Industry," Journal of Monetary Economics, 3, (1977), pp. 443-466.

Dambolena, Ismael G. and Khoury, Sarkis J. "Ratio Stability and Corporate Failure," Journal of Finance, 35, (September, 1980), pp. 1017-1026.

Eisenbeis, Robert A. "Pitfalls in the Application of Discriminant Analysis in Business, Finance, and Economics," Journal of Finance, 32, (June 1977), pp. 875-900.

Estey, Hon. Willard Z. Report of the Inquiry into the Collapse of the CCB and Northland Bank, (August 1986).

Final Report of the Working Committee on the Canada Deposit Insurance Corporation" (April 24, 1985).

Ghera, David and Sokoler, Meir. "An Alternative Approach to the Problem of Classification--The Case of Bank Failures in Israel," Journal of Bank Research, 12,(Winter, 1982) pp. 228-238.

Hayes, David, G. "Discussion: Should Large Banks be Allowed to Fail?" Journal of Financial and Quantitative Analysis, 10, (November, 1975), pp. 617-618.

Ho, Thomas and Saunders, Anthony. "A Catastrophe Model of Bank Failure," Journal of Finance, 35, (December, 1980), pp. 1189-1206.

Jones, R.M. "Probability Estimation Using a Multinomial Logistic Function," Journal of Statistics and Computer Simulation, 3, (1975), pp.315-329.

Judge, Griffith, Hill and Lee. The Theory and Practice of Econometrics," Wiley, Chapter 14, pp. 583-621.

Lee, Lung-Fei. "Specification Error in Multinomial Logit Models," Journal of Econometrics, 20, (1982), pp. 197-209.

Linnen, Beth M. "New Corporation will Dispose of The FSLIC's Problem Assets," Savings Institutions, 106, (November, 1985), pp. 68-71.

Martin, Daniel. "Early Warning of Bank Failure. A logit regression approach," Journal of Banking and Finance, 1, (November, 1977), pp. 249-276.

Mayer, Thomas. "Should Large Banks be Allowed to Fail?" Journal of Financial and Quantitative Analysis, (November, 1975), 10, pp. 603-610.

McFadden, Daniel. "Quantal Choice Analysis: A Survey," Annals of

Economic and Social Measurement, 5/4, (1976),pp. 363-390.

McFadden, Daniel. "A Comment on Discrimant Analysis 'Versus' Logit Analysis," Annals of Economic and Social Measurement, 5/4, (1976), pp. 511-523.

Meyer, Paul A. and Pifer, Howard W. "Prediction of Bank Failures," Journal of Finance, 25, (September, 1970), pp. 853-868.

Murray, John D. and White, Robert W. "Economies of Scale and Economies of Scope in Multi-Product Financial Institutions: A Study of British Columbia Credit Unions," Journal of Finance, 38, (June, 1983), pp. 887-902.

Nerlove, Marc, and Press, James S., Univariate and Multivariate Log-linear and Logistic Models, Rand Co. (December, 1973).

Pettway, Richard H. and Sinkey, Joseph F. "Establishing On-Site Bank Examination Priorities: An Early-Warning System Using Accounting and Market Information," Journal of Finance, 35, (March, 1980) pp. 137-150.

Santomero, Anthony M., and Vinso, Joseph D. "Estimating The Probability of Failures for Commercial Banks and The Banking System," Journal of Banking and Finance, 1, (October, 1977), pp. 185-205.

Sharpe, William F. "Bank Capital Adequacy, Deposit Insurance and Security Values," Journal of Financial and Quantitative Analysis, 13, (November, 1978), pp. 701-718.

Sinkey, Joseph F., Jr. "A Multivariate Statistical Analysis of the Characteristics of Problem Banks," Journal of Finance 30, (March, 1975) pp. 21-36

Sinkey, Joseph F., Jr. "Identifying 'Problem' Banks," Journal of Money, Credit and Banking, 10, (May, 1978), pp. 184-193.

Williams, Monci, Jo. "Uncle Sam Enters the S & L Business," Fortune, 112, (November 25, 1985), pp. 67-79.

Zellner, A., and Lee, T.H. "Joint Estimation of Relationships Involving Discrete Random Variables," Econometrics, 33, (April, 1965), pp. 382-394.

Zmijewski, Mark E. "Methodological Issues Related to the Estimation of Financial Distress Prediction Models," Journal of Accounting Research, 22, Supplement (1984), pp. 59-82.