الجامعة الاسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
يونيۏرسيتي إسلام انتارابڠسا ملیسیا

PREDICTING A BOND RATING: A MULTIVARIATE ANALYSIS OF CORPORATE BONDS, A NEW LOOK AT MALAYSIAN CORPORATE BONDS

BY

AHMAD KEMO TOURAY

A RESEARCH PAPER SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN FINANCE

KULLIYYAH OF ECONOMICS AND MANAGEMENT SCIENCES

INTERNATIONAL ISLAMIC UNIVERSITY

MALAYSIA

JANUARY 2004

ABSTRACT

This study is primarily concerned with bond rating analysis. The objectives are to build and empirically test a multivariate statistical rating model, and to further test the ability of the model to predict the effect of the 1997 Asian financial crisis and its aftermath on rating changes in the Malaysian bond market. The study also tries to test the significance of a number of predictor variables as major determinants of corporate long-term bond rating. Initial results show that a Multiple Discriminant Model constructed from new ratings data incorporating six independent variables correctly classified 73.2 per cent of all cases of the original sample. First validation test results of this model on new rating data using Lachenbruch methods indicate that it correctly predicted the ratings of almost two-thirds of all the cases in the synthesized holdout sample. Second test results on already outstanding ratings show a decline in the predictive power of the model. This indicates that the 1997 crisis and its aftermath that triggered big rating changes in the bond market are not successfully captured by the model; apparently due to sample bias. The second model results show that a multinomial logistic regression model built using new ratings and incorporating only four predictor variables correctly predicted the ratings of 75 per cent of all cases in the original sample. This model also shows that, of all the multivariate combinations of predictor variables included in this study, a statistically significant model that best replicates RAM's ratings was obtained when variables relating to the interest coverage ratio, total assets of the firm, long-term leverage ratio along with bond's guarantee status variables were included. These variables are shown to be among the most significant determinants of corporate long-term debt quality ratings. The signs on all the coefficients of the independent variables are in accordance with our earlier expectations, except for the case of the long-term leverage ratio. These findings suggest that further research could improve the prediction rate as well as its accuracy.

ملخص البحث

يتعلق هذه الدّراسة بصورة أساسية بتحليل تقييّم السّند. ومن أهدا فها بناءواختبارنموذج تقييّم إحصائيّ, وذالك بطريقة تجريبيّة,ومن ثم إختبارقدرة النّموذج علي التّنبّؤبآثارالأزمات الماليّةالأسيويّة لعام1997 ومضاعفا تها على التغيرات في تقيّم السّند في سوق السّندات الماليزيّ. كما تحاول البحث أيضا الكشف عن أهمية تأثير عدد من العوامل المتغيرة المستقلة كفيا صل رئيسيّة في تقيم السّندالتجاريّ الطويل الأجل. وحسب النّتائج الأولية فإن النّموذج التميّزيّ المتعددة العوامل المتكوّنت من عيّنة من التّقييمات الجديدة والمحتوية على سّتة متغيّرات مستقلّة تمكّنت من تصنيف 73.2 بالمئة من كل الحالات للعيّنة الأصلية بصورة صحيحة.وتدل نتيجة اختبارالإجازة الأولى لهذا النّموذج على بيانات عيّنة تقييمات سندات جديدة محضّرة باستخدام طريقة لاتشينبرتش على أن النّموذج أجادت في التنبّؤ بتقييّمات حوالى ثلثي حالات هذه العيّنة بصورة صحيحة.غيرأنّ الإختبار الثاني لهذاالنّموذج على عيّنة من السّندات التي تغيّرت تقيّماتهاالأولىأظهرت تدهورا في قدرةالنّموذج التنبّؤي؛مما يدل على أنّ أزمة عام1997ومضاعفاتها التى أدت الىحدوث موجة تغييرات كبيرة في تقييمات السّندات في سوق السّندات لم تتم اكتشافها بنجاح من جانب النّموذج فيما يبدو بسبب تحيّز العيّنة. وتدل نتائج النموذج الثاني بأن نموذج تحليل الإنحدارالوجستيكي المتعددة العوامل المتكونة من عيّنة من السّندات الجديدة والمحتوية في بنيته على أربعة عوامل متغيرة فقط تنبّأت بطريقة سليمة بتقييمات حوالي 75 بالمئة من كلّ الحالات في العيّنة الأصلية. وبالإختبارتم الإثبات من خلال هذه النّموذج أنه: من بين كل الإتحادات المختلفة للمتغيرات المستقلة المتضمنة في هذه الدّراسة يتم الحصول على نّموذج ذات مغزى إحصائيّ والقادرة على إنتاج أفضل تكرارت مطابقة لتقييمات رام (RAM) فقط عندماتضم النّموذج متغيرات تتغلق بنسبة تغطية الفائدة, إجماليّ الأصل,تأثير نسبة القرو ض الطّويلة الأجل الى الرّأسمال, ووضع ضمانة الأداء للسّند. وتعتبر هذه المتغيّرات من أهم العوامل المتغيرة التي تحدد جودة تقييات السّندات التجاريّة الطويلةالأجل. والعلامات على كلّ المعاملات المتغيرة المستقلّة ظهرت وفقالتوقعنا السّبابق,باستثناء حالة معامل نسبةالقروض الطّويلة الأجل الى الرّأسمال. وهذه النتائج تدل على أنّه بالإمكان تحسين معدّل التنبّؤ ودقتة عن طريق القيام بالبحث الإضافي.
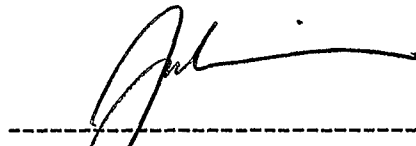
APPROVAL PAGE

I certify that I have supervised and read this study and that in my opinion; it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality as a dissertation for the degree of Master of Science in Finance.
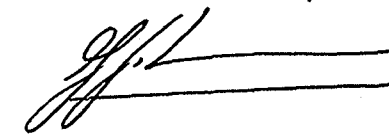
MOHD AZMI OMAR
Supervisor

This dissertation was submitted to the Department of Business Administration of Kulliyah of Economics and Management Sciences and is accepted as partial fulfillment of the requirements for the degree of Master of Science in Finance.

WAN JAMALIAH WAN JUSOH
Head, Department of
Business Administration

This dissertation was submitted to the Kulliyah of Economics and Managements Sciences and is accepted as partial fulfillment of the requirements for the degree of Master of Science in Finance.

MANSOR HJ. IBRAHIM
Dean, Kulliyah of Economics and
Managements Sciences

DECLARATION

I hereby declare that this dissertation is the results of my own investigation, except where otherwise stated. Other sources are acknowledged by footnotes, giving explicit references and a bibliography is appended.

Name: Ahmad Kemo Touray

Signature: ....Ahmad............   Date: ...29/01/2004............

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

DECLARATION OF COPYRIGHT AND AFFIRMATION OF FAIR USE OF UNPUBLISHED RESEARCH

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

AI	Artificial Intelligence
ANN	Artificial Neural Networks
CBR	Case Base Rules
CLDV	Categorical Limited Dependent Variables
CNN	Conventional Neural Networks
DDA	Descriptive Discriminant Analysis
EMH	Efficient Market Hypothesis
EPF	Employee Provident Fund
EPS	Expert System
FISD	Fixed Income Securities Database
HS	Holdout Sample
ID3	Induction Decision three
IDS	Intergraded Decision System
IPDS	Islamic Private Debt Securities
IMUR	Integrated Model Using Rough Set Analysis
KLSE	Kuala Lumpur Stock Exchange
KLSE-ris	Kuala Lumpur Stock Exchange (part of web address for downloadable online database of financial data of some listed companies)
LVQ	Learning Vector Quantization
LPM	Linear Probability Models
MARC	Malaysian Rating Corporation
MDA	Multiple Discriminant Analysis
MDA-C	Multiple Discriminant Analysis with Cross-Validation

MGS	Malaysian Government Securities
M-logit	Multinomial Logit Model
MLR	Multiple Linear Regression Models
NN	Neural Networks
OLS	Ordinary Least Square
OPP	Ordinal Pair wise Partitioning
PDA	Predictive Discriminant Analysis
PDS	Private Debt Securities
RAM	Rating Agency Malaysia
RBF	Radial basis Function
S&P	Standard and Poor
TS	Training Sample
VIF	Variance Inflation Factor

CHAPTER 1

1.0 INTRODUCTION

1.1 The Importance of Rating and the Role of Rating Agencies

The bond market in Malaysia now covers a variety of government and private debt securities[1]. Form the seventies up until the mid-eighties Malaysia's bond market was dominated by government and quasi-government debt securities. In the past the government had largely used these debt instruments as important sources of funds to finance many large infrastructure projects that are needed to spur economic growth. At the same time these securities were designed in such a way that they severed as an investments outlet for selected financial institutions in the country such as the Employee Provident Fund or EPF. Because these debt securities are either the government's own issues e.g. MGS or issue by government affiliated institutions such as the Khazanah and Danaharta bonds etc., they are relatively risk free. Investors need not be concerned much about default risk analysis of these instruments. On the other hand the corporate sector, besides using equity as a major source of funds, has been heavily reliant on borrowing money from the banking sector to supplement the financing of a significant part of their capital investment projects. The direct and indirect support provided by the central government through the central banking system to the banking sector, and often the governments' encouragement of the banking sector to make funds easily available to corporations, all give little incentive to either corporations or banks to be more prudent in their borrowing and lending

---

[1] See Norashikin Abdul Hamid's introductory book on the Malaysian bond market published by Rating Agency Malaysia Bhd 2000 titled: Guide to the Malaysian Bond Market For the latest instruments.

practices in the capital market. Such a central government-directed credit distribution system via the banking sector in the past had worked to delay the development of a vital PDS market that the capital market needed. Hakansson (1999) has argued that such policies, in fact, make the financial system more prone to frequent financial crises. In addition, this particular institutional environment setting of the capital market in Malaysia in the past made it also hard to envisage the importance of credit rating and the role of rating agencies in the capital market. This situation has changed markedly now due to the privatization programs initiated by the central government in the mid-eighties (Norashikin Abdul Hamid, 2000); and also due to the Asian financial crisis of the late nineties. Privatization means that private sector corporations will be the main drivers of economic growth instead of the central government. In doing so corporations would have to be less reliant on banking money but on their own reputation and creditworthiness to raise the needed funds (Jaffar Bin Hussein, 1989).The Asian financial crisis, on the other hand, has resulted in policies that try to minimize the exposure of the banking sector to the effect of corporate debt crisis. So as to facilitate the new settings of the capital market environment, therefore, a private debt securities market was developed and established. In this market, corporations are to raise the additional capital funds needed for their capital spending directly from investors. The ease of access to the funds and the cost of the funds will now be based on the reputation and creditworthiness of individual borrowers. Likewise, investors will need to deliberate more before putting their money into any new venture capital. To put it precisely, there is no risk free instrument in the PDS market as we have seen in the government debt market. The task now that confronts the investors is to find the tolerable risk-return securities that suit their individual and institutional needs and tests. This process can be difficult for the non specialist to carry out. Similarly,

government regulatory agencies also need to know which corporation should be allowed to raise funds in the PDS market and how much each individual corporation can raise. Regulators also most specify the criteria and qualities of debt securities that banks and other important financial institutions can invest their money into. This is necessary for a prudent market regulation. The above situation clearly indicates that there is an information gap or information imperfection between fund users and providers in the PDS market. In this case, some sort of credit information assessment and dissemination mechanism that serves the informational needs of all parties simultaneously in the PDS market is needed. The question that arises here is, who can best provide this information in the market? Mishkin (2001) discusses several competing views on who can best provide this service to the market. The general impression that can be drawn from his conclusions seems to suggest that an intermediate professional independent third-party is the best provider of this service for all the agents in the market including the government authorities. This conclusion goes well with the classical economic view that says that governments should only provide a particular good or service in the market if the good or service cannot be profitably produced by private agents (Basel committee on banking supervision, 2000). Based on the above argument, we are now able to see and recognize the importance of credit rating as well as the role of professional independent rating agencies in the capital market. Rating agencies, therefore, are the most suitable providers of quality credit rating information in the market. This is largely due to the several unique characteristics of the rating profession. On top of these, is the unrestricted access privilege to the insider information of corporations which rating agencies naturally enjoy. This point, to some extent, is what actually makes them different from other market analysts. Another major aspect which differentiates rating

agencies from others is in the credit information dissemination style they use. This is demonstrated by their ability to encapsulate the whole cluster of rigorous credit analyses and opinions into a few letters which are easy to understand by even the less sophisticated users in the market. With the development of the PDS market in Malaysia, the Malaysian government then moved further to allow the setting up of an independent debt rating agency. Rating Agency Malaysia Bhd or RAM was finally created in 1990 to meet the above need in the capital market.

For the rest of this introductory part, we next present a short history of RAM, its rating process and the rating methodology. Next we state the research problem followed by a statement of the main research objectives and the specific research questions. Then we discuss the significance of the study and its limitations and finally we show how the research is organized.

1.2 Background and Institutional Environment[2]

Rating agency Malaysia Bhd was established in 1990 as an independent corporation to be responsible for rating all private debt securities issues. In addition to PDS rating, RAM also rates a wide array of securities and entities such as Banks, Financial institutions and Claim paying abilities. The original shareholders of RAM, at the inception, consist of 33 commercial banks, five merchant banks, ten finance companies and others including the Asian Development Bank and IBCA limited (UK). None of the shareholders hold majority shares individually. This is to ensure

---

[2] All the information in this section and the next section was taken from Rating Agency Malaysia Bhd's various publications and from its website.

4

that it is independent and to give the management complete control over the entity's business operations.

1.3 Rating Process and Methodology

RAM's rating process begins with the reception of a rating request and related information from a borrowing corporation. Next, a team of analysts is formed to analyze the information after which the analysts will visit the company premises for further talks. After that the analysts will prepare a comprehensive report and submit it to the Rating Committee. The committee will then rate the issue/company and send the results to the company. This enables them to hear the company's view on it. Based on the acceptance of the company, the rating would finally be made public and a regular periodic appraisal of the outstanding issues is maintained. See **Appendix**1.0 for a diagram of the rating process. The methodology which RAM employs in its rating process covers four major analysis areas: Industry, General Business Environment, Financial Analysis and Management Evaluation. The industry analysis involves the analysis of industry specific risk, and the nature of competition in it. The business environment analysis involves the study of the nature of the operations, cost structure, market shares, business strategies and the competitive position. The financial analysis process involves the assessment of the quality of the asset, its productivity, the cash flow nature and pattern, the trends in interest coverage as well as the leverage ratio. RAM also conducts careful analysis of other off balance sheet financing activities. The management evaluation consists of the appraisal of the key managerial capabilities, functions and qualities and looks into the past records and future scenarios. RAM uses a rating scale composed of 8 main rating classes starting

from AAA to D. The AAA represents the highest quality category while **D** represents the lowest debt quality rating of all rating categories or entities in default already. RAM also applies subscripts 1, 2, 3 in each category from the AA to the C category. These subscripts indicate the rankings of the entities within a rating class. For example, the subscript number 1 indicates the highest position within a rating class while number 2 indicates the second highest in the ranking and so on. **See Appendix 1.1** for an explanation and definition of the various rating classes. According to the data we received from the agency, since its inception up to March, 2003 RAM has rated a cumulative total of 700 PDS amounting to a total RM value of 192,322 million. These ratings consist of 11 industry groups. See Exhibits 1 & 2 in Appendix 1.2 for the distribution of all long-term PDS bonds rated by RAM from 1991 to March 2003 categorized by the industry group, number of issues, and the ringgit value of the issues.

1.4 Problem Statement

Credit rating information is extensively used by all major participants in the capital market. Most corporate bonds are issued to the public only after receiving an acceptable rating grade. At the same time, most institutional investors are restricted to holding only certain grades of corporate debt securities in their portfolios. The influence of ratings in the securities market has been enormous due to the fact that it affects both the access to and the cost of the funds, as well as the ability of thrift institutions to make investments. These ratings are essentially a prediction of the future probability of default/payment on debt obligations by a borrower. Although all major rating agencies insist that their ratings are not a product of number games

(Moody investors, 2002), by observing closely the rating process of these agencies it is clear that it involves both quantitative and qualitative assessments of the borrowing entity's condition and the special provisions and enhancements attached to a particular security issue. The above assertion has opened up a possibility of modeling and predicting credit ratings of companies that have sufficient information available in the public domain. Following the same line of arguments in the past and in the present, we found that a series of attempts have been made to analyze and predict the ratings that agencies give to corporations. This is done by means of modeling the publicly available financial and non financial information using various statistical and non statistical methods[3]. Such research studies are as useful as the ratings themselves for the securities market for several reasons. First, since ratings are highly regarded in the market, their accuracy is crucial. Because rating research studies by and large use publicly available information about corporation, (which supposed to be accurate, representative and timely) the success or failure of rating research models in verifying or predicting bond quality ratings as given by the agencies could have implications for all users of rating information including the agencies themselves. For example, if a rating model is to test known key quantitative and qualitative factors of a creditor but fails to explain its credit quality standing as assigned by the agency, then this could be the result of incorrect modeling but it could also be because of inaccurate information provided by the entity to the public or incorrect rating by the agency or it could even be a result of the insufficient disclosure of vital market information. In any of the above cases, there would be a policy review with regard to corporate disclosure or the

---

[3] See the book entitled: Application of classification Techniques in Business, Banking and Finance Volume 3 by Altman et al (1981). This book provides a detailed account of the statistical methods used in bond rating prediction. The other methods also widely used now to predict bond ratings are in the area of AI or Artificial intelligence techniques. They are not discussed in the above book but are found elsewhere at the beginning of various bond rating studies that apply one of the artificial intelligence methods to bond rating studies.

quality of ratings of rating agencies themselves. It could also stimulate more academic research to try to better understand rating agencies' behaviors and their rating processes. The rating research studies, therefore, will serve in this case as an important check and balance mechanism in the securities market. Second, the success of these research studies would also highlight the main factors that determine the credit rating quality of borrowers and make that information available to the wider public. Since rating agencies are not explicit in revealing the actual factors that produce ratings and how they are produced, these research works should greatly enhance the function of the market mechanism by telling borrowers what is expected from them and lenders what they need to look for. Third, rating agencies are also said to be slow in producing or adjusting the ratings. Slow flow of information in the market results in market inefficiency. Therefore, a dynamic rating research environment such as the above could minimize or eliminate such problems. To that end, there have been numerous research studies conducted on credit rating in the developed markets with specific emphasis on analyzing and predicting bond ratings. Examples are Horrigan (1966), Pogue and Soldofsky (1969), West (1970), Kaplan and Urwitz (1979), Ang and Patel (1975), Belkaoui (1980), Larry and Perry (1985), Christina and Ramesh (1993) to name a few of them. The vast majority of the above studies have been conducted in the west, mainly on the U.S. market. It is almost more than a decade now since the establishment of the first rating agency in Malaysia but no such published research effort has been undertaken on the Malaysian markets, at least to our knowledge. Therefore, the main motivation for the current research is an attempt to contribute to filling this gap in the capital market as well as in literature studies and the academic libraries.

1.5 Research Objectives

The main objectives of this research are as follows:

a. To build and empirically test a multivariate statistical bond rating model using selected financial and non financial variables for the purpose of analyzing and predicting corporate long-term bond ratings in Malaysia.

b. To identify several significant variables and their respective signs as important determinants of corporate bond quality ratings.

c. Test the model's ability to replicate the events that triggered large rating changes for outstanding bonds between 1997 and 2001.(the Asian financial crisis and its aftermath)

1.6 Research Questions

To meet our research objectives stated above we will ask and try to find answers to the following specific research questions during model building process:

1. Which multivariate combination of the selected 8 independent variables are the best predictors/discriminators of corporate long-term bond ratings grades?

2. Which of the selected variables are significantly associated with corporate long-term bond ratings?

3. How accurate are these predictions compared to random chance models?

4. Can this model be used to predict the ratings of other bond issues in the market?

1.7 Significance of the Study

Rating agencies serve to reduce the information asymmetry that exists between borrowers and lenders in the capital market through the rating process in which the agencies bury the whole information in single letters or numbers. Investors and other market participants accept it and believe it. Ironically, the rating process of the rating agencies and the specific data used in that process are hard for the public to make out. How to judge the credibility of the information they provide to the public, the justification of the given ratings and their consistency over time? It is considered that any research effort directed to analyze and investigate the ratings given by the agencies with the intention of providing an insight into the rating process of the rating agencies and thus verify its credibility would be of great benefit to all users of credit rating information and to the market at large. This study is expected to contribute in these areas and in other areas by adding a new research output to the existing literature on credit rating research as follows:

First: It will contribute to the literature by testing a model that has theoretical backing and is based on the works of prominent researchers in the study of credit rating research.

Second: by being the first published research work on bond rating prediction in Malaysia, it is expected to provide a good literature review on this subject.

Third: the final model is expected to be a useful tool for corporate managers and investors in their credit assessment and risk management processes as well as for the regulators and the rating agencies themselves.

Fourth: the results of this study, the final model and the conclusion to be arrived at, should serve as a facilitating tool in the designing of government regulatory policies in the capital market.

1.8 Limitations of the Study

The potential combination of financial and non financial variables in various statistical and non statistical rating models is virtually limitless. For that reason, this research has limited itself to using the 8 selected variables and only the two most widely used statistical techniques (The Discriminant Analysis and Logistic Regression Analysis Techniques). This approach should enable us to build upon and validate other previous research studies with some attempt to improve upon them. Another important limitation of this research has to do with the availability of data. For example, Horrigan (1966) utilized 201 observations of Moody ratings and 150 of S&P ratings; West (1970) used the same data. Belkaoui (1980) used 257 observations from 37 different industries. He built his model using 160 observations and validated it with 97observations. Compare those to the use of a total of only 109 observations in the current study. There are currently two rating agencies in Malaysia: The Rating Agency Malaysia Bhd or RAM and MARC. This study confined itself to analyzing and predicting the new corporate long-term bond ratings of RAM. Finally, PDS instruments that corporations use in Malaysia can be classified into two major categories: 1) conventional PDS bonds, 2) Islamic Private Debt Securities bonds (IPDS). The long-term and the short-term ratings of both these two types of PDS are given by RAM. This study will be confined to the conventional PDS long-term bond

ratings as we believe that the two types may need at least some difference in some aspects of modeling.

1.9 Organization of the paper

This research is organized in six chapters. Chapter One introduces the importance of the study and provides the background to it. It spells out the motivation behind the study, the main objective, and the research questions. Finally, the chapter illustrates the significance of the study and lists several possible limitations. Chapter Two provides the literature review on bond rating and the theoretical framework of the study. It is divided into two parts, part 1, which discusses selected studies in a chronological order for the past five decades beginning with the first study that attempted to replicate and explain bond ratings of rating agencies in the mid-sixties up until the 21st century. Part 2 provides the rationale and the theoretical background that guide the selecting of the independent variables included in this study. We provide a justification for the selection of each of the independent variables with reference to various pieces evidence from the main literature or from financial analysis text books as well as from the viewpoint of practitioners and rating agencies themselves. The hypotheses are also made about the likely effect of the predictor variables and their direction based on the evidence cited above. Chapter Three discusses the methodology we follow in our research design. The data and sample selection procedure is first discussed, and then the variables and the two statistical models are discussed in more detail. The chapter then discuses the results of the data screening process and all the changes made to the raw data to make it ready for analysis. Chapter Four presents and discusses the results of the analysis done in this study. It starts the discussion of the