



EVALUATION OF CREDIT RATING METHODOLOGIES: ANALYSING THE EFFICACY IN PREDICTING DEFAULT/BANKRUPTCY

GROUP 3



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MARCH 18, 2024

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ABSTRACT

This study explores the usefulness of credit rating techniques in the dynamic field of finance, concentrating on how well they can forecast defaults and bankruptcies in the Indian business environment, with a special focus on manufacturing entities. In view of the constantly changing nature of financial markets and the need to improve risk assessment methods, this research aims to clarify the validity of key components of credit rating models used by reputable Indian agencies. The research intends to provide useful insights for practitioners and policymakers by addressing the modern requirement of heightened vigilance in spotting possible corporate crisis. In addition to assessing current paradigms, the study emphasises how important it is to improve credit risk assessment frameworks in order to build a stronger financial ecosystem. By doing this, it hopes to significantly improve financial management processes strategically in light of the current economic climate.

INTRODUCTION

In today's financial management landscape, credit rating systems play an important role in determining a company's creditworthiness and financial health. This study aims to thoroughly assess the efficacy of credit rating systems, with a particular emphasis on their predictive accuracy in anticipating defaults and bankruptcies in the Indian corporate sector, especially in manufacturing companies. As financial markets continue to evolve and become more complex, the requirement for robust tools to assess firms' credit risk becomes critical. The study conducts an in-depth investigation, applying modern statistical techniques such as logistic regression, to examine the components encompassed inside the credit rating systems used by reputable Indian Credit Rating Agencies.

This examination will look into the dependability of the elements used by credit rating companies, with a particular focus on their accuracy in predicting a company's future default or bankruptcy. The research intends to discover insights into the mechanisms that support credit evaluations by digging into the convoluted nature of these approaches, contributing to the refinement of effective financial management procedures. This study attempts not only to evaluate existing paradigms, but also to identify new paths for improvement in credit risk assessment frameworks, hence promoting a more robust financial ecosystem within the Indian corporate atmosphere. As the financial landscape evolves, this investigation becomes more important in broadening understanding of the relationship between

credit rating methodologies and the early detection of corporate distress, providing valuable insights for practitioners, policymakers, and academics alike.

LITERATURE REVIEW

1. Structural Shifts in Credit Rating Standards by Author(s) Aysun Alp

Alp's (2013) study, "Structural Shifts in Credit Rating Standards," published in The Journal of Finance, investigates the evolution of credit rating standards over time. The study aims to identify and analyse the structural shifts in credit rating practices employed by agencies, focusing on whether these changes reflect stringency or looseness in rating standards. Using an ordered probit model, Alp examines the relationship between various firm characteristics and credit ratings from 1985 to 2007, utilizing data from S&P Long-Term Issuer Ratings. The study encompasses a wide range of variables such as interest coverage, operating margin, long-term debt leverage, and others to assess their impact on credit ratings. Results indicate a stable period until 2002, followed by a gradual stringency in standards thereafter, with credit ratings experiencing a downward trend from 2003 to 2007. This suggests a tightening of standards by rating agencies during this period. The findings contribute to understanding the dynamic nature of credit rating practices and their implications for financial markets and firms' access to capital.

2. Quantifying Credit Risk I: Default Prediction by Author(s): Stephen Kealhofer

Kealhofer's (2003) article, "Quantifying Credit Risk I: Default Prediction," published in the Financial Analysts Journal, January - February 2003, by Taylor & Francis, Ltd., delves into the quantification of credit risk, a significant frontier in modern finance. Building upon the foundational work of Black and Scholes (1973) and Merton (1973, 1974), Kealhofer explores the Merton model, which conceptualizes a company's equity as a call option on its assets. The article compares the Merton model with the KMV model, developed by Vasicek in 1984, which focuses on the probability of default for a company as a whole rather than debt valuation. Kealhofer discusses the implementation and success of the KMV model in measuring credit risk, emphasizing its ability to outperform traditional agency debt ratings in predicting default. The KMV model's reliance on the distance to default measure and its empirical validation using data on actual default rates contribute to a deeper understanding of credit risk quantification,

culminating in the creation of the KMV EDF™ (expected default frequency) credit measure as a robust indicator of default probability within a specified time period.

3. Credit Rating and Debt Crises by Author(s): Steinar Holden, Gisle James Natvik and Adrien Vigier

The paper titled "Credit Rating and Debt Crises" authored by Steinar Holden, Gisle James Natvik, and Adrien Vigier, published in the International Economic Review in May 2018, delves into the relationship between credit ratings and debt crises. The study aims to investigate how credit ratings impact the occurrence of debt crises, focusing on a specific country and industry. The authors employ a robust research methodology, collecting data on credit ratings and debt crises over a specified time period. The sample details are carefully outlined to ensure the representation of relevant cases within the chosen country and industry. Variables such as credit ratings, debt levels, and economic indicators are studied to understand their influence on debt crises. The study hypothesizes the existence of a relationship between credit ratings and the likelihood of debt crises, and the conclusions drawn from the analysis are tested using appropriate statistical methods. The findings of the study provide insights into the role of credit ratings in predicting and potentially preventing debt crises, contributing to the existing literature on financial stability and risk management. Therefore, the paper offers valuable implications for policymakers, financial institutions, and investors in understanding the dynamics of credit ratings and their implications for debt crises.

4. Are Ratings Consistent with Default Probabilities? Empirical Evidence on Banks in Emerging Market Economies by Author(s): Christophe J. Godlewski

The paper titled "Are Ratings Consistent with Default Probabilities? Empirical Evidence on Banks in Emerging Market Economies" authored by Christophe J. Godlewski and published in the Emerging Markets Finance & Trade journal in July-August 2007, investigates the alignment between credit ratings and default probabilities, particularly focusing on banks within emerging market economies. The primary objective of the study is to examine whether credit ratings assigned to banks accurately reflect their default probabilities. Conducted within the context of emerging market economies, the research aims to shed light on the reliability and effectiveness of credit ratings in assessing the creditworthiness of banks operating in these regions. The study analyses a set of variables related to credit ratings and default probabilities using a rigorous research methodology, including data collection from relevant sources and sample selection criteria to ensure representation across emerging market economies.

Hypotheses are formulated to test the consistency between credit ratings and default probabilities, with the conclusions drawn from the analysis subjected to appropriate statistical tests for validation. The findings of the study provide empirical evidence regarding the correspondence or divergence between credit ratings and default probabilities in the context of emerging market banks. Thus, the paper contributes to the existing literature by offering insights into the effectiveness of credit ratings as a measure of credit risk for banks in emerging market economies, thereby informing policymakers, investors, and financial institutions about the implications of credit rating accuracy for decision-making processes.

5. An Examination of the Association of Firm Credit Ratings with Real Activities Manipulation, Audit Quality, Corporate Governance, and Credit Default Swaps by Author(s) Logan Browning

The paper titled "An Examination of the Association of Firm Credit Ratings with Real Activities Manipulation, Audit Quality, Corporate Governance, and Credit Default Swaps" by Logan Browning from Kent State University's Department of Accounting, published in 2018, aims to investigate the relationship between firm credit ratings and various firm characteristics including real activities manipulation, audit quality, and corporate governance, within the context of the subprime crisis and subsequent credit crunch. The study, conducted in the United States, focuses on firms' financing abilities during this crisis period, emphasizing the crucial role played by credit rating agencies in determining firms' access to financing. Browning explores how credit rating agencies' inclusion or exclusion of certain characteristics in their rating processes could impact firms' financing capabilities, with even a slight change in credit rating having significant financial implications for firms. The research employs a comprehensive methodology involving data collection, sample selection, and statistical analysis to examine the associations between firm characteristics and credit ratings, as well as credit default swaps (CDS) spreads. The findings reveal significant negative associations between real activities manipulation and credit ratings, while audit quality demonstrates a positive correlation with ratings. Additionally, the study uncovers nuanced relationships between corporate governance components and credit ratings, with certain aspects showing limited associations. The research contributes valuable insights for academics, investors, firms, rating agencies, and regulators involved in the credit rating process, providing implications for understanding the factors influencing firms' creditworthiness and financial stability during periods of economic turmoil.

6. An Analysis of The Use of Debt Default Calculations and Online Credit Ratings in Predicting Bankruptcy by Author(s) Faye A. Brathwaite

The paper titled "An Analysis of the Use of Debt Default Calculations and Online Credit Ratings in Predicting Bankruptcy" by Faye A. Brathwaite explores the prediction of bankruptcy through debt default calculations and online credit ratings, particularly focusing on the relationship between credit quality and default probability. Published in 2002, the study addresses the context of corporate defaults reaching record levels in 2001, highlighting the correlation between credit quality and default remoteness as observed in Standard & Poor's default studies. Brathwaite's research investigates the predictive power of debt default, cash flow ratios, and Standard & Poor's credit ratings in determining bankruptcy. By examining the timeliness and accessibility of online credit ratings, the study aims to provide insights into bankruptcy prediction for market participants and potential stockholders, emphasizing the importance of alternative tools beyond traditional auditor assessments. However, the study concludes by questioning the utility of Standard & Poor's ratings as a bankruptcy predictive tool, contrary to previous findings, suggesting that lower S&P ratings are associated with a higher likelihood of bankruptcy. This conclusion challenges the conventional wisdom that higher ratings imply lower default probabilities, highlighting the need for further research and critical evaluation of credit rating agencies' predictive accuracy in the context of bankruptcy prediction.

7. Investigating the Role of Systematic and Firm-Specific Factors in Default Risk: Lessons from Empirically Evaluating Credit Risk Models by Author(s) Gurdip Bakshi, Dilip Madan and Frank Xiaoling Zhang

The paper titled "Investigating the Role of Systematic and Firm-Specific Factors in Default Risk: Lessons from Empirically Evaluating Credit Risk Models" by Gurdip Bakshi, Dilip Madan, and Frank Xiaoling Zhang, published in The Journal of Business in July 2006, presents an empirical examination of credit risk models and their ability to predict default risk by considering both systematic and firm-specific factors. The authors address the conceptual framework of default risk, drawing on seminal works by Merton (1974) and subsequent refinements in the literature. They emphasize the challenges associated with implementing structural models due to the complexity of specifying recovery in the event of default and the counterfactually low short-term credit spreads generated by these models for high-quality borrowers. The paper highlights the importance of developing credit risk models that accurately capture variations in default risk and perform well in hedging dynamic credit

exposures. The authors propose and empirically evaluate a family of credit risk models driven by a two-factor structure for short interest rates and an additional factor for firm-specific distress, incorporating characteristics such as leverage, book-to-market ratio, profitability, equity volatility, and distance-to-default. Their analysis demonstrates the significance of interest rate risk in explaining variations in single-name defaultable bond yields and the effectiveness of models that consider leverage in reducing absolute yield mispricing. The study contributes to the empirical understanding of credit risk modelling by investigating the relevance of various systematic and firm-specific factors in predicting default risk, providing insights into the pricing and hedging of credit-sensitive securities. The paper concludes with discussions on the implications of the findings and avenues for future research, highlighting the importance of empirically grounded approaches in assessing default risk and managing credit exposures.

8. Tiebreaker: Certification and Multiple Credit Ratings by Author(s) Dion Bongaerts, K. J. Martijn Cremers and William N. Goetzmann

The paper titled "Tiebreaker: Certification and Multiple Credit Ratings" by Dion Bongaerts, K. J. Martijn Cremers, and William N. Goetzmann, published in The Journal of Finance in February 2012, delves into the role of credit rating agencies (CRAs) in the corporate bond market, particularly focusing on the demand for multiple credit ratings. The authors investigate three hypotheses regarding multiple ratings: information production, rating shopping, and regulatory certification. They utilize differences in rating composition, default prediction, and credit spread changes to evaluate these hypotheses, ultimately finding evidence supporting the regulatory certification hypothesis. Their analysis suggests that marginal additional credit ratings are primarily sought for regulatory purposes rather than providing significant additional information related to credit quality. The paper highlights the institutional and regulatory importance of credit ratings, particularly in influencing institutional demand and serving as triggers in regulatory oversight. The study emphasizes the role of regulations in shaping the demand for multiple credit ratings and sheds light on the incentives for issuers and investors in the corporate bond market. By exploring the tiebreaking role of credit ratings, the paper contributes to the understanding of the economic implications of CRAs' activities and regulatory frameworks in the corporate bond market. The findings have implications for market participants, regulators, and policymakers, particularly regarding the proper incentives for issuers to disclose information and the role of credit ratings in investment decisions and regulatory compliance. The paper concludes with discussions on the implications of the

findings and avenues for future research, underscoring the importance of regulatory frameworks in shaping the behaviour of market participants and the functioning of credit rating agencies in the corporate bond market.

9. The Financial Crisis and Credibility of Corporate Credit Ratings by Ed deHaan

DeHaan's (2013) dissertation titled "The Financial Crisis and Credibility of Corporate Credit Ratings" examines the impact of the financial crisis on the credibility of corporate credit ratings, focusing on how credibility damage affects the usage of ratings and accounting information in debt pricing. The study aims to address whether the financial crisis influenced market participants' perceptions of credit rating agencies' (CRAs) credibility regarding corporate credit ratings, and how this credibility damage altered the reliance on ratings and accounting data in debt markets. DeHaan's investigation is grounded in the recognition that certain structured finance products' credit ratings underestimated default risk before the crisis, leading to credibility concerns. The author explores whether similar credibility issues extend to corporate credit ratings, considering the differences in economic incentives between structured finance and corporate ratings. DeHaan's study utilizes empirical analysis based on market participants' expectations about rating quality (i.e., credibility) and assesses changes in the debt market relevance of corporate ratings and accounting data post-crisis. Using credit default swap spreads as a measure of default risk, DeHaan finds a decline in the relevance of corporate credit ratings compared to accounting information in the post-crisis period, suggesting credibility damage. Further analyses reveal an increase in discordance between credit ratings and observed debt prices, supporting the notion of declining credibility. Additionally, the study addresses alternate explanations and performs robustness tests to strengthen the findings. DeHaan's work contributes to the literature by providing empirical evidence on the relation between credit rating credibility and usage, as well as insights into the substitutability between corporate credit ratings and accounting information in debt markets, especially during turbulent financial periods like the recent crisis.

10. "Internal Credit Rating Practices of Indian Banks," written by Author(s) M. Jayadev

The current state of internal credit rating methods among Indian banks is critically examined in the study "Internal Credit Rating Practices of Indian Banks," written by M. Jayadev and published in the Economic and Political Weekly in 2006. The study emphasizes the alignment of capital needs with risk sensitivity and is placed within the framework of the second Basel accord. The main goal is to evaluate internal credit rating models that banks use in order to

assess the likelihood of default and the amount of damage in the event of a failure, in accordance with the Basel II framework.

Significant differences in the internal rating systems' components, architecture, and functioning among the Indian banks assessed are revealed by the report. The variation in grades and related risks points to possible variations in these institutions' lending choices. The author points out flaws in the current grading systems and suggests fixes to improve their caliber. Notably, the first Basel Accord (Basel I) had shortcomings that led to the introduction of the New Basel Capital Accord (Basel II), which focused on risk management and internal rating systems.

With the help of credit rating documents from six banks and a survey questionnaire given to 19 banks, the research technique covers a total of 25 banks, or 75% of the loan portfolio of scheduled commercial banks in India. The study explores the internal rating models' architecture, design, and constituent parts, providing insights into the different institutions' credit decision-making procedures. The analysis in the report is somewhat anonymous because the banks' identities are kept under wraps. Overall, the findings emphasize the need for improvements in the quality of internal credit rating models within Indian banks, aligning with global best practices and standards.

11. Markets: The Credit Rating Agencies, Author(s): Lawrence J. White

The 2010 Journal of Economic Perspectives paper "Markets: The Credit Rating Agencies" by Lawrence J. White critically looks at the development and history of credit rating agencies (CRAs), especially Moody's, Standard & Poor's (S&P), and Fitch, as well as their function in the US bond market. The first section of the article provides a historical perspective, going back to John Moody's creation of bond ratings in 1909. It then goes on to describe the development and mergers of significant rating agencies over time.

In light of the 2008 financial crisis, these agencies' critical role is emphasized. The housing market bubble and subsequent crises were boosted by the sale of securities linked to subprime residential mortgages, which was made possible by Moody's, S&P, and Fitch's good ratings. The study looks into how the regulatory framework put these organizations at the center of financial decision-making and highlights the effects of their errors on the larger financial industry.

The study explores the regulatory mechanisms that resulted in financial institutions depending on the particular bond creditworthiness data that major rating agencies give. It examines the change in the credit rating business model from "investor pays" to "issuer pays," highlighting

the obstacles to entrance produced by the relationship between regulatory bodies and credit rating organizations, and it examines the growth of the industry.

The role that credit rating organizations had in the subprime mortgage scandal and the subsequent financial catastrophe is also examined in this study. Lastly, it examines two possible public policy strategies to deal with problems in the credit rating sector: one stresses stricter regulation of rating agencies, while the other calls for a less central role for rating agencies in the bond information process, thereby encouraging a more transparent approach more in line with pre-1930s customs.

12. Credit Rating, Default Probability and Structural Credit Risk Models by Author(s) Yu Du

In 2004, Yu Du submitted a thesis to Queen's School of Business titled "Credit Rating, Default Probability, and Structural Credit Risk Models." The thesis consists of three essays that cover important facets of credit risk assessment. The first essay shows that a multinomial, multiple-cycle hazard rate model can be dynamically estimated as a multinomial logistic model by extending Shumway's (2001) hazard rate model estimation technique to a general example. Based on empirical data, this new method appears to be more effective in forecasting out-of-sample credit ratings than conventional static models. The impact of length, momentum, and rating rules on changes in credit ratings is examined in the second essay. It demonstrates a non-monotonic influence of length on credit rating changes, in contrast to previous findings, and predominantly relates downgrade effects to downgrade momentum. The analysis backs up the claim that rating criteria have gotten stricter over time.

In contrast to conventional statistical models, the third essay examines how well Merton's (1974) structural credit risk model explains and predicts credit ratings. Empirical findings show that the structural credit risk model underutilizes market value, casting doubt on the idea that distance-to-default is a suitable statistic of stock market information connected to credit quality. The introduction highlights how important credit ratings are in determining a company's or bond issue's creditworthiness and default probability. Credit ratings are provided by organizations such as Moody's and Standard & Poor's. It emphasizes how important credit ratings are to the financial markets, impacting portfolio modifications, regulatory oversight, risk assessments for investments, and scholarly studies on credit spread and risk. Given that credit ratings are a major factor in financing decisions and that derivatives connected to firm credit ratings are becoming more and more popular, the thesis seeks to advance knowledge of credit ratings and their fluctuations.

13. Parameterizing Credit Risk Models with Rating Data" by Author(s) Mark Carey and Mark Hrycay

The empirical analysis of techniques to estimate average default probabilities for debtors within internal credit risk rating grades is presented in the October 18, 2000, publication "Parameterizing Credit Risk Models with Rating Data" by Mark Carey and Mark Hrycay. The capital structure, internal control, compensation, and regulatory capital requirements of financial institutions all depend on these estimations, which are basic inputs for portfolio credit risk models. The writers methodically examine the characteristics of the main techniques used to calculate average default probability, pointing out possible bias, instability, and game problems. The importance of quality estimations in influencing different financial decisions is emphasized in the study.

The study's introduction situates it within the broader framework of financial institutions' growing embrace of value-at-risk (VaR) methodologies for credit risk management and monitoring. Credit risk models rely heavily on credit ratings, and the paper delves into the various methods of estimating credit loss distributions, with a particular focus on the rating quantification process.

The two primary strategies that are being discussed are using commercial credit scoring models and mapping internal grades to external agency grades. Because credit ratings are ordinal, the study emphasizes how important it is to estimate the natural likelihood of default for each internal grade. It tackles the difficulties caused by the absence of records of default and loss experience by internal grade in portfolios that are useful.

The study is the first systematic investigation in this field, according to the authors, who also point out that although mapping and scoring-model-based techniques are widely used, their characteristics are not well recognized. The empirical data that is provided highlights the possibility of notable differences in outcomes from seemingly small methodological differences, which may have an impact on equity capital allocation ratios in sizable bank portfolios. The analysis focuses on bias, stability, and gaming concerns, shedding light on the potential economic effects of measurement errors in rating quantification. The paper offers valuable insights into the complexities of estimating credit risk within financial institutions.

14. "Credit default prediction modelling: an application of support vector machine" by Author(s) Fahmida E. Moula, Chi Guotai, and Mohammad Zoynul Abedin

The paper "Credit Default Prediction Modeling: An Application of Support Vector Machine" explores credit default prediction (CDP) using the support vector machine (SVM) algorithm, emphasizing its crucial role in financial institutions. Comparing SVM with various approaches like discriminant analysis, logistic regression, and others, the study addresses gaps in CDP literature related to inconsistent conclusions about classifier performance. To remedy this, the paper proposes a comprehensive set of performance metrics, including Discriminant Power, likelihood ratios, and an enhanced application of Youden's index from clinical diagnosis, aiming for a more thorough evaluation of classifiers.

Methodologically, SVM-based credit prediction models are constructed, and classifier accuracy is improved using diverse features. The proposed metrics are then applied to evaluate different approaches across three standard credit databases (Australian, German, Japanese) and three new ones. Results indicate SVM's marginal superiority over counterparts, particularly CART with discriminant analysis, demonstrating greater robustness in credit prediction modeling. These findings align with traditional metrics, supporting the proposed novel metrics' usability in both academic and industrial settings.

In conclusion, the paper underscores that a classifier's supremacy is intricately linked to the evaluation metrics employed. The study offers valuable insights into credit default prediction modeling challenges and methodologies, contributing to the ongoing research agenda in this domain.

15. "Modelling Default Risk: Theory and Empirical Evidence" by Author(s) Heikki Monkkonen

"Modeling Default Risk: Theory and Empirical Evidence" by Heikki Monkkonen, which was published in November 1997, is the study that is being discussed. This thesis's first essay introduces a default risk model that builds on Das and Tufano's (1995) model by adding stochastic recovery rates and state-dependent default probability. The default-free spot rate, default time, and recovery rate are the three state variables in this discrete-time model that may be connected. Relying on time and default-free spot rate, the default time is represented as the initial jump of a Poisson process. To match the initial credit yield spread, a forward induction algorithm is created. Six jump default risk models are compared empirically in the second article, including a benchmark model with state-independent default probability and constant recovery rate by Jarrow and Turnbull (1995). Stochastic recovery rates and state-dependent

default probability are taken into consideration in alternative models. Testing is conducted using month-end corporate bond trading data for 1994 from Lehman Brothers, which demonstrates the superior performance of the benchmark model in investment-grade credit ratings. Models with default-free spot rates and negatively associated default risk are preferred over those with ratings below investment-grade. Regarding debt outstanding, credit rating, default-free yield movements, and stock market returns, systematic biases are found across models.

Monkkonen makes a contribution to the goals by creating the first model that accounts for stochastic recovery rates and state-dependent default probability. The thesis provides an extensive empirical evaluation of jump default models, illuminating how well they function under various credit rating conditions. These contributions advance the understanding and application of default risk models, with implications for pricing, hedging, and risk management in financial markets.

RESEARCH METHODOLOGY

I. Hypothesis

Hypothesis H0: Credit rating is not an effective method of determining if a company will default

This hypothesis challenges the effectiveness of credit ratings in predicting a company's default. It posits that the credit rating system, as currently implemented by CRAs, does not provide a reliable measure of a company's ability to meet its financial obligations. Companies with favorable credit ratings may still be prone to default, and those with lower ratings may not necessarily face higher default risks. This hypothesis questions the accuracy and adequacy of the credit rating methodology employed by CRAs and suggests that other factors, beyond those considered in the credit rating process, may significantly influence the default outcomes of companies.

Hypothesis H1: Credit rating is an effective method of determining if a company will default

This hypothesis suggests that the credit rating assigned by credit rating agencies (CRAs) is a reliable and valid indicator of a company's likelihood to default on its financial obligations. According to this hypothesis, the credit rating system, which considers various financial ratios and indicators, accurately reflects the creditworthiness of a company. Therefore, if a company receives a higher credit rating, it is expected to have a lower probability of defaulting, and vice versa. This hypothesis implies confidence in the integrity and predictive power of the credit rating process as conducted by CRAs.

1. Research Design:

This study adopts a quantitative research design to investigate the factors influencing a company's credit rating and to assess the accuracy of credit ratings provided by credit rating agencies (CRAs). The research design involves the collection and analysis of secondary data obtained from reputable sources, including financial databases and credit rating agency websites.

2. Data Collection:

a. Selection of Sample: The study focuses on publicly listed companies in India, both default and non-default, to ensure uniformity and reliability of data. Defaulted companies were identified using news articles and public notices from financial regulators, while non-defaulted companies were randomly selected based on their credit ratings from major CRAs.

b. Data Sources: Financial data for defaulted companies were collected from the year before default, ensuring accuracy and relevance. Data for non-defaulted companies were obtained from the most recent financial year. Key financial ratios were extracted from the Capitaline website.

3. Data Pre-processing:

The collected data underwent pre-processing to ensure consistency and accuracy. For defaulted companies, key financial ratios were manually entered, while for non-defaulted companies, ratios were extracted from available sources. Debt Service Coverage Ratio (DSCR) was computed manually using a specific formula.

4. Feature Selection:

The study focused on eight influential factors for credit rating, including DSCR, Interest Coverage Ratio (ICR), Debt-Equity Ratio (D/E), Return on Capital Employed (ROCE), Return on Net Worth (RONW), Profit After Tax Margin (PATM), Current Ratio (CR), and EBITDA. These factors were selected based on CRISIL's credit rating methodology and their relevance in assessing a company's creditworthiness.

5. Logistic Regression Analysis:

Logistic regression was employed to model the relationship between the dependent variable (default/non-default) and independent variables (financial ratios). The logistic regression model was chosen due to its suitability for binary or ordinal dependent variables. Assumptions such as collinearity were checked using the Variance Inflation Factor (VIF) to ensure the accuracy of the model.

6. Interpretation of Results:

The results of the logistic regression analysis were interpreted to identify the most influential factors in determining credit ratings and predicting default/non-default events. Coefficients and odds ratios were analyzed to understand the impact of each independent variable on the likelihood of default. Additionally, statistical tests such as Wald Chi-square and p-values were used to assess the significance of the relationships between variables.

7. Evaluation Metrics:

The accuracy of the logistic regression model was evaluated using metrics such as sensitivity, specificity, and the Area Under the ROC Curve (AUC). These metrics provided insights into the model's ability to classify default and non-default companies correctly and its overall predictive performance.

8. Conclusion and Recommendations:

Based on the findings of the logistic regression analysis and evaluation metrics, conclusions were drawn regarding the accuracy of credit ratings provided by CRAs and the factors influencing credit rating outcomes. Recommendations were made to enhance the credit rating process, emphasizing the importance of objective evaluation and consideration of all relevant data to mitigate the impact of market sentiment on credit ratings.

9. Limitations:

Any limitations encountered during the research process, such as data availability, sample size, or methodological constraints, were acknowledged and discussed to provide a comprehensive understanding of the study's scope and implications.

1. Unlisted companies are not considered due to lack of data
2. Sample size is less than 50 because we are considering ratings only over the last decade
3. Only considering manufacturing companies due to differences in rating methodology of service entities or any other sector.
4. We are only considering quantitative factors and not qualitative factors.

DATA ACQUISITION

Data collection for this topic was a challenging decision for our team. Primary data collection wasn't an option as our network was limited and it would be an arduous task to get the qualitative aspects CRAs consider in the rating process. At the same time, the quantitative data required to assess the topic was available for the general public because we decided to focus on publicly listed companies. Secondary data published directly by company management and approved by the auditors was key in keeping our assessment reliable and accurate.

We started by collecting data of companies which defaulted on their Debt obligations in the last decade, news articles and public notices from financial regulators were used to list down defaulted companies. The reason for limiting ourselves to a decade is to make sure that the data related to these defaulting companies is available and is accurate, we used financial data of the companies from the year before the default. This was to ensure that market sentiment after the default does not tamper with the data we selected 23 companies which defaulted in the last decade and data for which was readily available.

To assess the non-default companies from a quantitative aspect of credit rating and the financial abilities of the companies that receive these ratings we collected financial data of companies, these companies were selected at random based solely on the credit ratings that they have received from major credit rating agencies (CRAs). All of these companies are based, registered, operated and managed in India, this is important as this would help maintain uniformity among data. The specific financial data points were obtained from the financial section of Capitaline, this ensured the quality and authenticity of data. Although the selection of companies for research was completely random, the number of companies selected in the sample for each stratum (credit rating bands) is closely representative of the population i.e. listed Indian companies with credit ratings.

DATA PRE-PROCESSING

The data sample used in this paper consists of structured data extracted from the Capitaline website for both defaulted and listed non-defaulted companies. Capitaline is a trusted source for financial data extraction worldwide and is commonly used by finance-based entities.

For defaulted companies, data was manually entered as each defaulted company had a different year of default, which varied from each other. It's important to note that only the key financial ratios from

one year before each company defaulted were used to gauge the company's health right before it defaulted.

For non-defaulted companies, we used the key financial ratios from the most recent year, i.e. 2023.

Debt Service Coverage Ratio (DSCR) is an important metric for determining creditworthiness, as it measures a company's ability to pay back its debt. This ratio was manually computed manually using a formula since it was not readily available on Capitaline. These components were extracted from the Profit & Loss Statement and Balance Sheet of the company.

The remaining ratios were obtained by importing the company records in Excel format (xlsx), which were then transferred to multiple string codes in Python. The code function located the required ratios for each company and provided the data to run a logistic regression.

FEATURE SELECTION

There are a number of important factors that determine the credit rating of a company. Moreover, we need factors that have been verified and attested by a reputed entity. Hence, it was in this project's best interest to extract published data from CRISIL's website.

We chose CRISIL's data as a reference for this project due to several reasons. CRISIL is a leading credit rating agency in India, and its credit ratings can provide valuable insight into the creditworthiness of an individual or organization. Banks, financial institutions, and investors often refer to credit ratings provided by CRISIL before deciding to lend money or invest in a company.

As per CRISIL's credit rating methodology, they take into account a set of ratios.

- ❖ **Debt Service Coverage Ratio-** The debt-service coverage ratio (DSCR) indicates a company's ability to service its debt obligations, both principal and interest, through earnings generated from its operations. The computation DSCR is as follows
$$\text{DSCR} = (\text{Profit After Tax} + \text{Interest} + \text{Depreciation}) / (\text{Short-Term Borrowings} + \text{Current Maturities of Long-Term Borrowings})$$
- ❖ **Interest Coverage Ratio-** A key indicator of a company's ability to meet its debt obligations in a timely manner. The computation for ICR is as follows,
$$\text{ICR} = (\text{Profit before depreciation interest and tax}) / (\text{Interest and finance charges})$$
- ❖ **Debt-Equity Ratio-** The proportion of a company's financing that comes from debt versus equity.

- ❖ **Return On Capital Employed-** The profitability of a company based on the capital it has invested in its operations.
- ❖ **Return On Net Worth-** A company's profitability as a percentage of its shareholders' equity.
- ❖ **Profit After Tax Margin-** A company's profitability before taking into account the impact of interest payments and depreciation expenses.
- ❖ **Current Ratio-** A company's ability to meet its short-term obligations with its current assets.

RESULTS AND DISCUSSION

Binomial Logistic Regression

Model Fit Measures

Model	Deviance	AIC	BIC	R^2_{McF}	Overall Model Test		
					χ^2	df	p
1	27.7	39.7	51.9	0.640	49.2	5	< .0001

We used secondary data to conduct a logistic regression analysis, which revealed important factors that will be discussed in further detail. Logistic regression is a statistical technique used to model the relationship between a categorical dependent variable and one or more independent variables. It is commonly used when the dependent variable is binary (i.e., only has two possible outcomes) or ordinal (i.e., has ordered categories). We have chosen this model since we wanted to predict whether a company in question that has been assigned a particular rating by a company is going to default or not and hence check the accuracy and legitimacy of such a rating. ***Our overall model's p-value is <0.05, which means it is significant and we can reject the null hypothesis and accept the alternative hypothesis.***

In our model, the categorical variable is whether a company in question is going to default or not default. The value 1 has been assigned for a success, i.e. a company which is not defaulting and 0 for a failure or a defaulting company. The independent variables are the 8 most influencing factors for a credit rating which are : Debt Service Coverage Ratio (DSCR), Interest Coverage Ratio(ICR), Debt-to-Equity Ratio(D/E), Return on Capital Employed(ROCE), Return on Net Worth(RONW), Current

Ratio(CR) and Profit after Tax margins(PATM). Out of these 8 factors, we had to eliminate 3 factors due to collinearity issues.

Collinearity is a potential issue in logistic regression that occurs when there is a high degree of correlation between the independent variables in the model. The independent variables should not be collinear and for that we need to run an assumption check. We check the Variance Inflation Factor (VIF) for each variable. This assumption check reveals a high degree of collinearity between ROCE, RONW and Current Ratio. Eliminating these factors, rest all the VIF values are less than 5 we can safely conclude that these variables are not collinear and the model results will be accurate.

Our model equation now looks like this:

$$\text{logit}(p) = a + b(\text{DSCR}) + c(\text{ICR}) + d(\text{D/E}) + e(\text{EBITDAM}) + f(\text{PATM})$$

The Wald Chi square value tells us the factor which is the most influential. In our model we find the PATM to be the most determining factor for success, followed by EBITDA Margin and ICR. We can check the respective p-values in support of this statement, where the p-value of PAT and EBITDA Margin is less than 0.05 signifying that the relationship between them and the dependent variable is not caused by chance.

The table alongside shows the accuracy of the model. There are 33 true positives (non-default companies correctly classified as non-default) and 19 true negatives (default companies predicted as default). There are 4 false positives (default companies predicted as non-default) and 1 false negatives (non-default companies predicted as default). From these observations it can be concluded that the accuracy(hit-rate) of the model is 91%. The sensitivity is 97.1% which refers to the proportion of true positives that are correctly identified by the model, i.e., the proportion of non-defaulters that are correctly predicted as non-

Omnibus Likelihood Ratio Tests

Predictor	χ^2	df	p
DSCR	0.0557	1	0.8134
Interest Coverage Ratio	2.1832	1	0.1395
Debt Equity	0.0235	1	0.8782
EBITDA margin	6.4600	1	0.0110
PAT margin	6.9605	1	0.0083

Classification Table – ...

Observed	Predicted		% Correct
	0	1	
0	19	4	82.6
1	1	33	97.1

Note. The cut-off value is set to 0.5

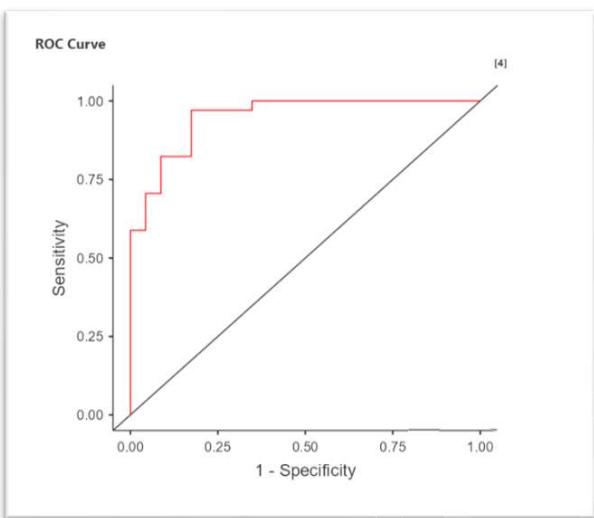
Predictive Measures

Accuracy	Specificity	Sensitivity	AUC
0.912	0.826	0.971	0.949

Note. The cut-off value is set to 0.5

defaulters. On the other hand, specificity refers to the proportion of true negatives that are correctly identified by the model, i.e., the proportion of defaulters that are correctly predicted as defaulters, which in this case is 82.6%.

In logistic regression, the AUC (Area Under the ROC Curve) is a commonly used metric to evaluate the performance of the model in predicting binary outcomes. The ROC (Receiver Operating Characteristic) curve is a plot of sensitivity (True Positive Rate) against 1 - specificity (False Positive Rate) at various classification thresholds. The AUC is the area under the ROC curve, which ranges from 0 to 1. Generally, an AUC value of 0.7 or higher is considered to be a good discrimination ability



of the model, while an AUC value of 0.8 or higher is considered to be excellent. The AUC is a useful metric in logistic regression because it provides an overall measure of the model's ability to correctly classify the binary outcomes. With an AUC of 0.949, our model has a good ability to accurately distinguish between default and non-default companies.

CONCLUSION

After studying the results of the logistic regression, we can conclude that, solely based on quantitative data, our model can predict an event of default/non default 91% if the time. It is important to focus on quantitative data to enhance the credit rating procedure. It is essential to overlook market sentiments to provide accurate and timely ratings. It was seen from our data that companies that have defaulted have had very good ratings a year before they defaulted. The financial data of such companies show that they would have a poor credit rating compared to what was assigned to them. It appears that the assigned credit rating was inflated because of the market sentiment to the credit rating agency. This highlights the need for credit rating agencies to be more vigilant and objective in their credit rating process, considering all relevant data and avoiding being swayed by market sentiment.

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Appendix

1. Results

Binomial Logistic Regression

Model Fit Measures

Overall Model Test

Model	Deviance	AIC	BIC	R ² McF	χ ²	df	p
1	27.7	39.7	51.9	0.640	49.2	5	< .0001

Omnibus Likelihood Ratio Tests

Predictor	χ ²	df	p
DSCR	0.0557	1	0.8134
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PAT margin	6.9605	1	0.0083

[3]

Model Coefficients - Default0/Non Default1

Predictor	Estimate	SE	Z	p	Odds ratio
Intercept	1.3327	1.454	0.9169	0.3592	3.791
DSCR	0.3557	1.709	0.2081	0.8352	1.427
Interest Coverage Ratio	0.5296	0.541	0.9787	0.3277	1.698
Debt Equity	-0.0491	0.702	-0.0699	0.9443	0.952
EBITDA margin	-0.2314	0.116	-2.0027	0.0452	0.793
PAT margin	0.3174	0.268	1.1829	0.2369	1.374

Note. Estimates represent the log odds of "Default0/Non Default1 = 1" vs. "Default0/Non Default1 = 0"

Assumption Checks

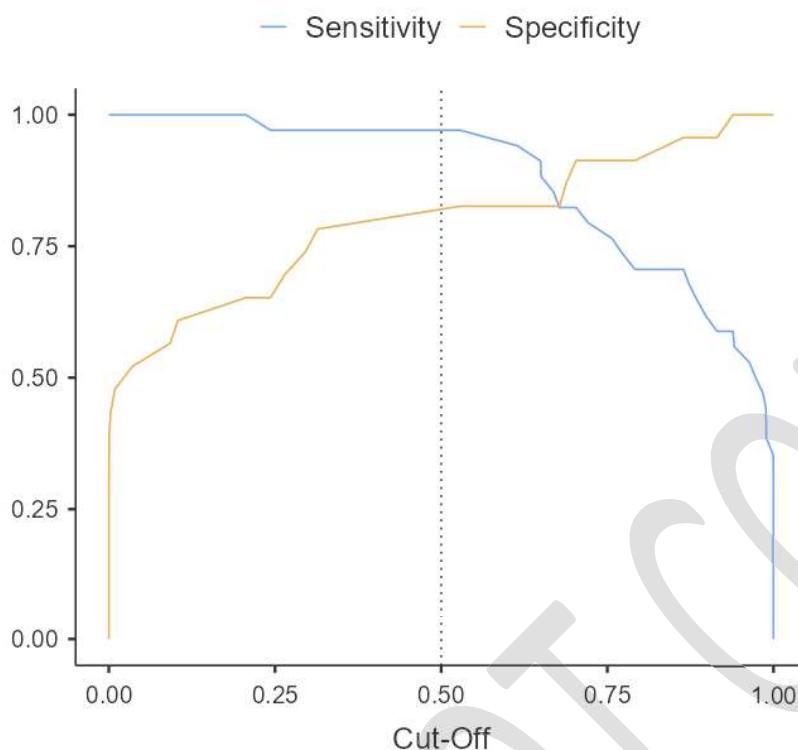
Collinearity Statistics

	VIF	Tolerance
DSCR	1.04	0.960
Interest Coverage Ratio	1.82	0.549
Debt Equity	1.64	0.610
EBITDA margin	3.14	0.319
PAT margin	3.20	0.312

[3]

Prediction

Cut-Off Plot



Classification Table – ...

Predicted			
Observed	0	1	% Correct
0	19	4	82.6
1	1	33	97.1

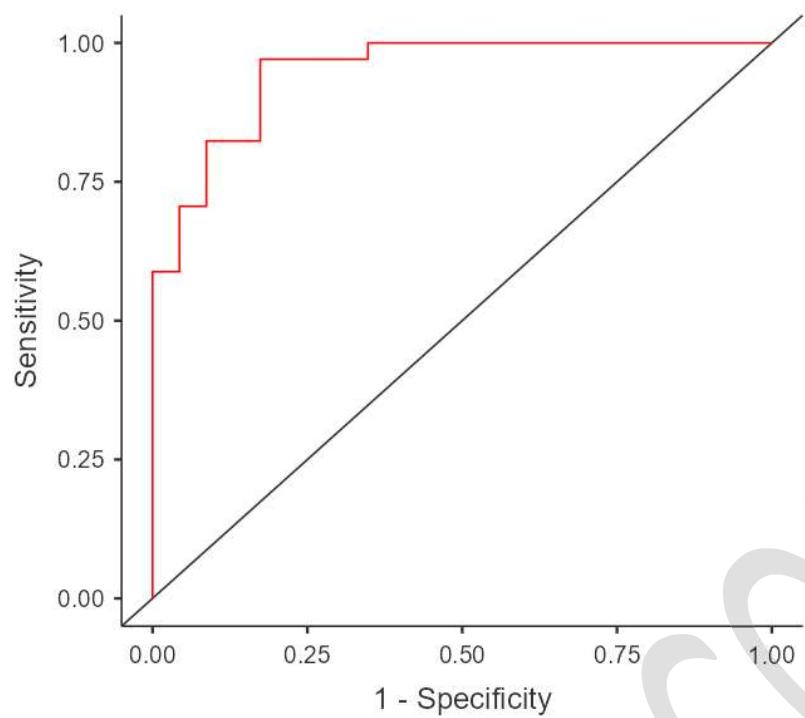
Note. The cut-off value is set to 0.5

Predictive Measures

Accuracy	Specificity	Sensitivity	AUC
0.912	0.826	0.971	0.949

Note. The cut-off value is set to 0.5

ROC Curve



[4]

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