The Saga of Ruchi Soya Industries Limited : Could Credit Risk Models Predict Bankruptcy?

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Abstract

Purpose : The primary objective of this study was to examine the efficacy of credit risk models in predicting bankruptcy and evaluating the firm's post-acquisition performance.

Design/Methodology : Ruchi Soya Industries Limited, an Indian listed firm that went into bankruptcy in 2018, was identified for back-testing and evaluating the predictive ability of four models: three accounting-based (Altman Z-score, Altman's emerging market score, and Zmijewski) and the market-based KMV model. In the second stage of analysis, the operating and financial performance of the company was evaluated for pre-bankruptcy and post-acquisition by Patanjali Foods using *t*-tests on financial parameters of solvency, profitability, and efficiency.

Findings : The findings of this study revealed that while all the models were accurate in predicting default accurately for up to 1 year before bankruptcy, they failed to do so accurately beyond that. The predictive ability of the models was highest for the KMV model, followed by Zmijewski and Altman's Z-score. The performance of the firm improved significantly post-acquisition on profitability and solvency parameters.

Practical Implications : According to the findings of this research, credit risk models are accurate at predicting financial trouble and bankruptcy up to 1 year in advance. These findings can be used for credit appraisal by lenders to assess any financial trouble and enable effective risk management. These models can also be used to avoid business failure to develop proactive and preventive financial and managerial decisions. The impact on performance parameters post-acquisition can help consultants and advisors evaluate the restructuring process to see whether there has been value creation post-restructuring.

Keywords : accounting-based models, bankruptcy, market-based models, predictive

JEL Classification Codes : C52, G33, G13

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Credit risk management has received increasing significance over the years in India, with the alarming rise in the non-performing assets (NPA) of banks over the last several years, which has been an outcome of the inability of businesses to repay the loans taken from banks. This led the Central Bank to come up with several schemes to reduce the debt exposure of corporates facing financial distress. Before 2016, institutional debt defaults were handled through different laws and regulations, such as the Sick Industrial Companies Act (SICA), 1985; Debt Recovery Act, 1993; Corporate Debt Restructuring (CDR); Strategic Debt Restructuring (SDR);

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SARFAESI Act, 2002; and Company Law, 2013 (amendments to Companies Act). However, these schemes failed to resolve the twin balance sheet problem, which resulted from the inability of the borrowers to repay the banks on time, which in turn caused the banks' standard assets (loans) to turn sub-standard and ultimately into NPAs. The continuing surge in NPAs promoted the need to conceptualize and implement a uniform code for resolving and recovering stressed assets. Thus, the Bankruptcy Code (IBC) in 2016 empowers both operational and financial creditors to register insolvency. This code warrants that the companies in financial crisis would have the resolution routed through the National Company Law Tribunal (NCLT) as the legal body and insolvency professionals (IP) managing these companies. The end result of this process would either be restructuring the stressed assets or liquidating the company under trial. It has been determined that several companies are IBC members and are thus insolvent or in liquidation.

Corporate Insolvency Resolution Process (CIRP)

According to the code, an operational creditor can initiate an application for insolvency against a corporate debtor before an adjudicator. A clear procedure has been established under the code for an operational creditor to apply for insolvency, which is as follows:

(1) When a corporate debtor defaults on commitments, the operational creditor sends a notice under the code to the corporate debtor. Demand notices serve as legal notices that require payment of the defaulted payment.

(2) If the corporate debtor continues to fail to make payments to the operational creditor, the creditor may file a court application. Under Section 9 of the Code, the operational creditor has the authority to apply for the application.

After the adjudicating authority accepts the case, the CIRP process is the same for financial and operational creditors.

The Basel II and its advanced internal rating-based models (AIRBs), which enable banks to assess risk and computation of PDs, as well as the gaps in credit risk evaluation by external credit rating agencies that emerged during the global financial crisis, all contributed to the explosive growth of several credit risk models, including accounting-based and market-based models. The credit risk models are broadly on default prediction, which has been phrased interchangeably as insolvency and bankruptcy prediction or financial distress prediction. Against this backdrop, this study has two main goals:

- To evaluate the predictive ability of the four models for up to 1 year, 2 years, and 4 years before the bankruptcy.
- To analyze the acquisition impact on the operating and financial performance of the firm for post-acquisition by Patanjali Foods.

Review of Literature

The forerunners of accounting-based models are Altman (1968), Altman et al. (1977), and Beaver (1966). Other works on these models have been conducted by Abdelsalam (2008), Agarwal and Taffler (2008), Ahuja and Singhal (2014), Altman et al. (2017), Bandyopadhyay (2006), Chitta et al. (2019), Hussain et al. (2014), Jayadev (2006), Kumar and Kumar (2012), Ohlson (1980), Taffler (1983, 1984), Viswanatha Reddy (2012), and Zmijewski (1984).

A study by Ahmed and Govind (2018) emphasized the efficacy of time-varying coefficients of the Altman *Z*-score on listed firms in Canada. In their study, Al-Manaseer and Al-Oshaibat (2018) also reaffirmed that Altman

Z-score showed strong predictive ability for insurance firms listed on the Amman Stock Exchange (ASE). Chandra and Awasthi (2019) examined the insolvency risk of four commercial banks in India using the *z*-score and found that the percentage of non-performing assets to total advances of the industrial sector was found to be an important determinant that aggravated the insolvency risk of banks. Other similar works by Agarwal and Patni (2019) corroborated the predictive ability of the Altman *Z*-score on public sector units in India; whereas Kapil and Agarwal (2019) focused on the Altman *Z*-score and its correlation to various financial performance indicators and compared the traditional models with new methods such as decision tree framework and neural network framework to predict bankruptcy.

Kittur (2019) evaluated the effectiveness of Altman's *Z*-score and identified NPA as a benchmark stability indicator. Kittur's study showed mixed results, with *Z*-scores capturing the financial distress marginally during the distress period while failing to capture the future NPAs. Kaur's (2019) study tested the Altman *Z*-score on the banking sector in India for the period from 2012–2017. The study also used Tobin's *Q* as the performance measure. The findings revealed that during times of market upturns, the stocks of firms that were financially distressed outperformed stocks of firms that were non-distressed. Tung and Phung (2019) tested the Altman *Z*-score on Vietnamese firms and found that both financial and non-financial factors impacted bankruptcy prediction. They applied the Altman model to firms in Vietnam.

In their research, Shetty and Vincent (2021) developed a default prediction model for the Indian industrial sector by using binary logistic regression analysis. Their analysis found that the return on assets, current ratio, debt-to-total assets ratio, sales-to-working capital ratio, and cash flow-to-total assets ratio were significant. Arora and Saurabh (2022) investigated the financial distress among Indian companies listed on the Bombay Stock Exchange (BSE). The relevance of the market capitalization/debt ratio was discovered in accordance with previous research.

Several research studies focused on the impact of the resolution process of IBC and the subsequent impact on firms' financial and operating performance. Among these include those by Kattadiyil and Umarov (2021) on Alok Industries that went into IBC. Studies on firms' performance post-restructuring included those by Joshi and Desai (2019) on the energy sector.

Research Design and Methodology

The two main objectives of this study are as follows:

- To evaluate the predictive ability of four accounting-based and market-based models on Ruchi Soya Industries Limited, which went bankrupt in 2018. The models are back-tested for up to 4 years before bankruptcy.
- To evaluate and compare the company's performance for pre- and post-acquisition on different ratios.

Scope of the Study

This study focuses on Ruchi Soya Industries Limited, which filed for bankruptcy under the IBC in 2018 and was later acquired by Patanjali Foods. To perform the study, secondary data were utilized. The financial data for the analysis were taken from the company's annual reports. To get at the relevant interpretation and analysis, data from the financial years 2013–2014 to 2021–2022 were evaluated. Financial data were taken from the EIKON database for additional research, and information on the NCLT and CIRP processes was obtained from Ruchi Soya Industries Limited's FPO report. Furthermore, the remaining data were accessed from Prowess CMIE (Centre for Monitoring Indian Economy).

Models Used for the Study

This study has identified three original accounting-based models and the KMV market model for further analysis. The models chosen for this study are as follows:

- Altman's Z-score model
- Altman's emerging market scoring model
- Zmijewski score model
- KMV model

Altman's Original Z-Score Model

The Altman Z-score model was developed by Edward Altman in 1968, which is a bankruptcy predictor model using multivariate discriminant analysis (MDA). This model generates a Z-score, representing the likelihood of a company filing for bankruptcy in the next 2 years. This model uses the financial statements (balance sheet and income statement) to measure the financial status and is based on the combination of five key financial ratios, weighted with coefficients. These five calculated ratios will then be multiplied by the coefficient developed by Altman to calculate the Z-score.

Altman's statistically derived discriminant function takes the form as follows:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \quad (1)$$

where,

X_1 = working capital/total assets

X_2 = retained earnings/total assets

X_3 = EBIT/total assets

X_4 = market capitalization/book value of total liability

X_5 = sales/total assets

The firm is classified as follows:

"Financially sound" if $Z > 2.99$, and

"Financially distressed" or "bankrupt" if $Z < 1.81$,

$1.81 < Z < 2.99$ = grey zone

Altman's Emerging Market Scoring Model (EMS)

The emerging market-scoring model is used to rate emerging market credit and is based on the following two factors:

- Financial evaluation using a qualitative risk model.
- An evaluation of unique credit risk in the emerging market to arrive at a final modified rating.

Although the basic foundation of this model remains the original Altman Z-score model, which was published in 1968, it can be applied to nonmanufacturing companies and other factors such as firm fragility to exchange rate, industry relatedness, and profitable position in the industry.

The equation for the model is given below:

$$EM\,Score = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4 + 3.25 \qquad (2)$$

where,

X_1 = working capital/total assets

X_2 = retained earnings/total assets

X_3 = EBIT/total assets

X_4 = book value of equity/book value of the total liability

The constant term enables us to standardize the analysis so that default equivalent zones of discrimination are:

$Z > 2.6$ = safe zone

$1.1 < Z < 2.6$ = grey zone

$Z < 1.1$ = distress zone

Zmijewski Score

The X-score model, developed by Zmijewski (1984), is the most widely used model among researchers and practitioners. It uses an approach to predict bankruptcy and uses financial measures to measure the firm's performance, leverage, and liquidity. The ratios were chosen based on their performance in earlier research.

$$Zmijewski\text{'s}\,Score = -4.336 - 4.513X_1 + 5.679X_2 - 0.004X_3 \qquad (3)$$

where,

X_1 = net income/total assets

X_2 = total liabilities/total assets

X_3 = current assets/current liabilities

The cut-off point = 0

- If the X-score is below the cut-off point, the company is in a healthy condition.
- However, if the X-score is above the cut-off point, the company is in financial distress.

KMV Model (1993)

The KMV model is the market-based model and is an extension of the Merton model (1974). Merton pioneered the market models using the application of Black and Scholes (1973). Merton (KMV) implemented the VK model to calculate an expected default frequency (EDF) credit measure, which is the probability of default during the forthcoming year or years for firms with publicly traded equity. There are essentially three steps in the determination of the default probability of a firm, which are as follows:

- **Estimate the value of asset and asset volatility :** In this step, the asset value and asset volatility of the firm are estimated from the market value and volatility of equity and the book value of liabilities.
- **Determine the distance to default (DD) :** The DD is calculated from the asset value and asset volatility (step-1) and the book value of liabilities.
- **Calculate the default probability :** The default probability is determined directly from the DD and the default rate for given levels of DD.

The model assumes that the company's equity is a call option on the company's underlying value with a strike price equal to the face value of the company's debt under the KMV model.

$$V_E = V_A \Phi(d_1) - D_E^{-r.T} \Phi(d_2) \quad (4)$$

$$\sigma_E = (V_A / V_E) \Phi(d_1) \sigma_A \quad (5)$$

The KMV–Merton model basically uses two non-linear equations (4) and (5) to translate the value and volatility of a firm's equity into an implied probability of default. The value of the option is observed as the overall value of the firm's stock in the KMV–Merton model, but the value of the underlying asset (the firm's worth) is not immediately observable. Although V_A must be calculated, V_E can be calculated in the marketplace by multiplying the firm's shares outstanding by the current valuation.

Operating and Financial Performance

For analyzing the second objective of our research, the following hypotheses have been set to investigate the financial performance of sample units:

- **H_1 :** There is no significant difference between the net profit margin of post-acquisition and pre-acquisition.
- **H_2 :** There is no significant difference between the return on equity of post-acquisition and pre-acquisition.
- **H_3 :** There is no significant difference between the earnings per share of post-acquisition and pre-acquisition.
- **H_4 :** There is no significant difference between the return on capital employed post-acquisition and pre-acquisition.
- **H_5 :** There is no significant difference between sales asset turnover post-acquisition and pre-acquisition.
- **H_6 :** There is no significant difference between the debt-equity ratio post-acquisition and pre-acquisition.
- **H_7 :** There is no significant difference between the interest coverage ratio post-acquisition and pre-acquisition.
- **H_8 :** There is no significant difference between the EBITDA margin post-acquisition and pre-acquisition.

Paired sample *t*-test is used to investigate the significant differences in financial ratios in pre-and post-restructuring periods (Joshi & Desai, 2019).

Table 1. ***Findings on Altman's Z-Score***

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022
Altman's *Z*-score	2.51	2.50	2.19	0.91	–3.15	–0.88	3.20	5.28	7.18

Table 2. ***Findings on Altman's EMS Model***

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022
Emerging markets	4.51	4.24	3.26	0.26	–12.15	–7.45	7.06	10.71	13.84

Table 3. ***Findings on the Zmijewski Model***

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022
Emerging markets	0.35	0.43	0.92	1.43	4.80	3.17	–4.57	–1.19	–1.68

Analysis and Results

It can be observed from Table 1 that when the company filed for bankruptcy in 2018, it was in the distress zone and also for 1 year before bankruptcy. The company was in the grey zone for 2 years to 4 years before the bankruptcy. If we observe the Altman *Z*-score for post-acquisition, the company was close to 3.88 in the score, which is in solvency; thereafter, the *Z*-score was >3.88, implying the company was in a safe zone. Thus, as per the Altman *Z*-score, the company was in the safe zone after being acquired by Patanjali Foods, and the strategy of restructuring could successfully turnaround the company into solvency status.

For Altman's emerging market score, FY2018 is the year for the firm to enter into bankruptcy, and it is observed from Table 2 that the company was in the financial distress zone in the year of bankruptcy and 1 year before bankruptcy. However, for up to 4 years before 2018, the year of entering IBC, the company was depicted in the safe zone. Thus, this model could accurately predict the company in a distress zone up to 1 year before bankruptcy. Post-acquisition, the score was >2.66, indicating that the company was in the safe zone. Thus, this model also corroborates that restructuring of the company led to the company being in solvency status. We conclude that the Altman EMS model could also predict bankruptcy and financial distress for Ruchi Soya for 1 year before being under IBC.

As evident from Table 3, the Zmijewski *X*-score for 1 year before entering into IBC was greater than 0 and depicted that the firm will default in the next 2 years. However, for up to 2 years and up to 4 years before IBC, this model could not accurately predict the company in the distress zone. After the acquisition, the score was less than 0, showing that the company was in solvency status and was in the safe zone. Thus, this model could also predict financial distress up to 1 year before being filed for bankruptcy.

All three accounting-based models are tested for validity for post-acquisition by Patanjali Foods and clearly show consistent findings in the company entering into solvency status and being in a "safe" zone. Also, there is a common pattern with all three models: financial distress could be predicted for 1 year before filing for bankruptcy.

Testing the KMV Model on Ruchi Soya Industries Limited

The inputs taken for this model are market capitalization, outstanding debt, risk-free rate (R_f), and risk premium (R_m–R_f). For the KMV model, the equity volatility was calculated using the firm's annualized daily volatility, and

Table 4. ***Data for the KMV Model***

Variables	Values
r	0.069
Market capitalization	531.22
Sigma_equity	0.195
Book value of debt	72274.3
Maturity period	5
Beta	0.87
Market return	0.136

for the stock prices, 1-year before the CIRP process is taken (from July 27, 2017 – July 26, 2018). Returns, standard deviation, and beta were calculated using these values in Excel. The standard deviation of equity is computed as 19.5%. Treasury bond yield 10Y (2017) has been taken into consideration as a risk-free rate. R_f is taken as 6.69%, and R_m is taken as 13.6%. Therefore, the risk premium ($R_m - R_f$) is taken as 6.91%. At last, the figures of market capitalization and outstanding debt for 2018 are being taken. The KMV approach will allow for estimating the market value of assets and volatilities of assets and then using this to measure the probability of default (Table 4).

By solving the two simultaneous non-linear equations, the probability of default is computed, which is 0.99 for Ruchi Soya Industries Limited. The PD of the defaulted firm is 99.09%. The PD for 5 years is 0.43, which is 43%; depending on a firm's default probability, the lenders decide the rate of interest applicable for the debt. Hence, our model could predict the insolvency of Ruchi Soya Industries Limited.

Findings on Post-Acquisition by Patanjali Foods in 2019 on Operating and Financial Performance

The findings from the ratios and *t*-test in Table 5 show that the acquisition strategy helped the company in improving its operating and financial performance. The resolution process of IBC emphasizes restructuring and turnaround through acquisition. This is reflected in the improved financial parameters of the firm. The company's performance in the year ending on March 31, 2018, alongside the EPS and the EBITDA margin, went on to become unfavorable, leading to a decline in the key financial parameters. The unanticipated rapid decline and persistent low pricing of castor oil, adverse global demand conditions, and the market environment — all had a

Table 5. ***Findings of t-test for Ratios Pre- and Post-Acquisition***

Activities	*t* calculated	*t* table value	*p*-value	Hypotheses Accepted or Rejected
Net profit margin	–2.5511	4.302653	0.125397	Rejected
ROE	–3.168266913	3.182446305	0.050548083	Rejected
EPS	–2.24888597	4.30265273	0.153469992	Rejected
ROCE	–3.67911907	4.30265273	0.066583668	Rejected
Sales turnover	–1.132908033	3.182446305	0.339609174	Rejected
Debt-equity ratio	0.008344351	3.182446305	0.99386612	Rejected
Interest c	–7.266779257	3.182446305	0.00537777	Accepted
EBITDA margin	–4.866808823	2.776445105	0.008238654	Accepted

substantial influence on the performance of the company's castor business and contributed considerably to its poor performance. The results show a significant difference in three financial parameters in the pre-and post-restructuring periods as per the paired *t*-test.

The null hypothesis (H_1) is rejected, implicating a significant difference in the net profit margin for the company in the two periods of pre-acquisition and post-acquisition. Considering the *p*-value calculated for ROE, the null hypothesis (H_2) will not be accepted, and there is a significant difference between the two time periods based on the sample taken. The *p*-value for the EPS is calculated as 0.15346, which is more than the significance value of 0.05, and the null hypothesis (H_3) is stated to be rejected. The null hypothesis (H_4) gets rejected for return on capital employed as the *p*-value shows a significant difference between the ratio for pre-acquisition and post-acquisition periods.

The sales turnover ratio significantly differs in the pre-acquisition and post-acquisition periods considering the *p*-value; hence, the null hypothesis H_5 is rejected. The debt-to-equity ratio for the corporation in the two periods of pre-acquisition and post-acquisition is significantly different, suggesting that the null hypothesis H_6 is rejected. The interest coverage ratio does not show a significant difference in both periods inferring from the *p*-value, indicating that we will fail to reject the null hypothesis H_7. The *p*-value suggests we cannot reject the null hypothesis H_8 because the EBITDA margin does not differ significantly between the two periods.

Conclusion

This study has been conducted on Ruchi Soya Industries Limited, an Indian-listed firm that entered into bankruptcy in 2018 under the IBC. Three accounting-based models and one market-based KMV model are tested for up to 4 years before bankruptcy in the first stage of analysis. In the second stage of analysis, the company's performance is evaluated for post-acquisition by Patanjali Foods. Although the accounting models could predict financial distress up to 1 year before default, the KMV model could depict a high probability of default and is thus the most robust. Our *t*-test on ratios clearly indicates that the company's overall performance improved on several parameters after Patanjali Foods was acquired in 2019.

Managerial and Theoretical Implications

Credit risk models have practical applications for a wide set of end users: management, investors, and lenders. There has been a growing emphasis on these models in the last few decades, with growth in derivatives, the Basel framework, and risk management techniques. These models can provide a framework to lenders and help them evaluate the financial risk profile of client borrowers. Lenders can use the models to define credit limits for different borrowers and also set credit limits for different sectors. They can help mitigate firms' business failure by developing proactive and preventive financial and managerial decisions. The change in financial parameters after the resolution of distressed firms and their subsequent acquisition can help consulting firms evaluate the restructuring process to see if there has been value creation post-restructuring. This would pave the way for better decision-making in future advisory roles. Although accounting models are based on financial information that can be accessed in the public domain, the market models are continuously evaluating the risk and can monitor the risk profiles more frequently as compared to the accounting models.

Limitations of the Study and Suggestions for Future Research

The study is based on financial information from annual reports that are likely to be subject to "creative accounting practices" or window dressing. The scope of the study can be enhanced by factoring in business risks, industry-specific factors, macro variables, and management quality in addition to financial variables, as these parameters also play a crucial role in the firm's overall risk profile. A wider study with a larger sample size would allow us to identify and create a more robust model. It is also felt that data mining techniques such as decision tree, random forest, and support vector machines can substantiate our findings further, and although no one method can be 100% accurate, a combination of models could best define the default prediction for firms. These models can serve to mitigate the financial risk of lenders by pre-empting default risk and evaluating the solvency status of firms. Early identification of financial distress would enable the respective company to take immediate steps to work on the firm's survival. Many large firms face financial distress, but with efficient strategies, they can tide over being bankrupt in the near future. Thus, a combination of models (parametric and non-parametric) and additional variables could provide a better insight into the credit risk for firms.

Authors' Contribution

Dr. Vandana Gupta conceived the idea of analyzing the company and testing the reliability of accounting-based models and the market-based model on the bankruptcy of Ruchi Soya. Dr. Gupta has done extensive research on bankruptcy prediction models and identified the models to be used for analysis. Nidhi Gupta did her summer internship at Ruchi Soya (now Patanjali Foods) and was keen to work on a research project. She downloaded data from Prowess CMIE and the company's website. Dr. Gupta wrote the manuscript with initial inputs from Nidhi Gupta.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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