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A STUDY ON THE ACCURACY OF ALTMAN Z SCORE MODEL IN PREDICTING BANKRUPTCY OF LISTED INDIAN COMPANIES

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ABSTRACT

Predicting bankruptcy is not a fresh concept in the present world scenario. In the past, there have been a lot of studies made on different models which are applied in predicting corporate insolvency. Over the years, various models have evolved that could predict insolvency from the company financial data. Because of this, certain models such as Altman Z score has obtained a reputation for being comprehensive models of bankruptcy prediction. However, in the Indian context, not many studies are conducted in this field. The purpose of this research revolves around testing the accuracy of Altman Z Score Model when applied on listed Indian companies and also drawing a comparison between the solvent companies and the insolvent companies. The objective of the study involves evaluating if financial information of a company is sufficient to predict any forthcoming bankruptcy and also to check the accuracy and predictive ability of the model on the given sample. Furthermore, this research also challenges the traditional theory of Dr. Edward Altman, which says that Z score can predict Bankruptcy two years prior to its occurrence. The data analysis proves the hypothesis that Altman Z score model can predict bankruptcy as far as 5 years before its occurrence. Precisely, companies from Auto ancillary industry, Infrastructure industry, Construction industry, Pharma, and textile industry form the stratified sample. The population under consideration includes the companies which are under insolvency proceedings of IBC from the year 2014 to 2020 and an equivalent sample of solvent companies is considered for ensuing uniformity in number. The importance of the research can be justified by looking at several instances of bankruptcy in the recent past that has put a lot of pressure on the Indian financial system. This paper reflects the importance of Altman Z score as a predictive model and how it can affect the decisions of various stakeholders.

KEYWORDS

IBC, bankruptcy prediction, financial modelling, altman Z score, insolvency.

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1. INTRODUCTION

Banking in India has gone through several hiccups and quite recently, a lot of banks particularly the public sector banks have faced lot of criticism in terms of its credit evaluation techniques. In the recent couple of years many of the large corporate entities have been declared bankrupt and are under bankruptcy proceedings. Companies like Videocon Ltd, Electrosteel Ltd, Bhushan Steels Ltd, Punj Loyd and many affluent companies went bankrupt during the past two to three years. Such repeated accounts of bankruptcies are not a good sign from the economic perspective. When there are huge quantities of bankruptcies, at that point purchasers and organizations start getting increasingly cognizant about loaning and spending too far in the red, which could smother the economy. On a longer term perspective corporate bankruptcies will tremendously affect the entire economy and will put it into a distress. Evidence of this can be obtained from the 2008 crisis, where large investment banks kept on distributing credit in unconditional terms and finally led to the fall. However, the real cause of bankruptcies may not be improper credit evaluation. Internal politics, biased approvals also can be accounted as a factor affecting the bankruptcies. In this context it is very important that the issue of bankruptcy is addressed at the earliest and there must be a mechanism to identify any potential bankruptcies before the bank or any other stakeholder gets affected by it. The process of identifying potential bankruptcies has already begun with the advent of technologies like core banking solutions and KYC norms. But this is largely limited to the retail banking. Global Investment banks like Morgan Stanley, JP Morgan have initiated several risk management approaches to identify defaulters in their portfolio.

2. REVIEW OF LITERATURE

Pritesh S. and Vivek D. (2020) bring to light that the economy relies on the performance of many sectors such as manufacturing, services, real estate, power etc which drives the growth of the economy. Hence each sectors' financial soundness is very important because investors prefer the stable market places to invest and in turn represent the stable economy. One of the major sectors which mirror the economy is the power sector. This research focuses on analyzing the financially distressed power generation/distribution organizations of India and also aim to find the financial issues associated with the sector during the year 2018 and 2019 from financial reports of selected companies. In this study the Altman Z-score model is applied to assess the sample of ten power sector firms/organizations of India. The results show that all sample companies are distressed and require immediate policy changes and healthy capital structure to reduce the distress. The management of companies and Indian government can come together and form policies to uplift the performance of power sector.

Sailesh Andrade, Vatsal Bhandari (2020), This article throws light on how Altman Z score and its components could have predicted the distressed Indian Companies like reliance telecom, cox and kings Jet Airways, Videocon, It begins with the evolution of this model and how it has been improvised over the years, It then speaks about the components of the Altman Z score model and the weights attached to it. And finally concludes with the calculation of the Z Scores and their comparison with the standards to find out the degree of stress or the probability of a company to go bankrupt in the forthcoming years. However, this article does not throw light on the different weights given to companies belonging to different industries.

R. Kogila and G. Vasanthi (2019) The steel industry is one of the key industries in India. The success of any business is based on efficient financial management. The study has been undertaken to analyze the financial position of selected steel companies in India. The researcher selected the top five steel companies in India for analyzing financial performance during ten years of the study period from 2007-08 to 2016-17. The researcher applied the Altman Z-Score model for analysis using ratio analysis. The study found that financial performance of SAIL and JINDAL was good during the first half of the study period but it was not so during the second half. Financial performance of Tata Steels was good during 2007-08, 2009-10 and 2010-11 and during other years it was not so. Financial performance as measured by Altman Z-score of JSW was good during the first year of the study period and it was not good during the rest of the years. Financial performance of JSL was not good during the entire period of study as shown by the results of the Altman Z-score model.

Ahmed et al (2018) In the paper the first conclusion of the study is that the Altman-Z scores cut-off range $1.81 < Z < 2.99$ should be updated regularly instead of being used as a fixed range. This is especially true since the Z score of market index for Canada is a dynamic variable and the numerators and denominators of the equation do not move in the same proportion from one year to the next. This results in the prevalent Z-scores (which is in fact a very small range) to move much higher than the cut-off ranges. This phenomenon in-turn could render the model useless in its predictability usage. Hence, extreme care must be exercised when assessing firm health on this metric and performance measurement must be relative to the levels persistent in the market at the time of assessment.

R. Pradhan (2014) From traditional times the Z score values have been constantly used for prediction of Bankruptcy. This has been vital to both the lenders and investors whose returns are based on solvency estimates. The terms of credit have gone a U turn from the traditional times to the modern scenario today. The basic concern of prediction is to evaluate the terms of credit and ensure repayment safely. Z score has been used as a tool to evaluate the credibility of the firms. This paper provides the Z score value for the public sector banks. This value is useful when these banks demand loans from the RBI or any other funding agency. The usage of back propagation neural network is to forecast the internal parameters of Z score and then use these internal parameters to forecast the Z score value up to 2020. Thus the paper emphasizes the usage of BPNN for prediction of bankruptcy for public sector banks in India.

S. Ray (2011) This paper attempts to investigate the financial health of automobile industry in India and test whether Altman's Z score model can foresee correctly the corporate financial distress of the automobile industry in Indian context for the study period, 2003-04 to 2009-10. Present analysis reveals that automobile industry under our study was just on the range of intermediate zone. In our study, Z values for all the seven years were more than 1.81 but less than 3 (Z score= In between 1.81 and 3.0= Indeterminate). It is an alarming matter that Z score value is gradually declining since 2007-08 after global recession hits Indian economy in general and automobile industry in particular. This indicates that overall financial performance of automobile sector in India is at present viable as Z score indicates but may lead to corporate bankruptcy in near future unless regulatory measures are undertaken immediately.

B. Nayak, Nahak C. (2011) The paper analyzes the performance of public sector banks in India during the post-liberalization period. There has been a significant improvement in the performance of public sector banks after reform measures. The paper has used various accounting ratios pertaining to profitability, financial efficiency, operational efficiency and financial soundness to build performance index for banks. Principal Component Analysis method has been used to construct index and rank performance of banks over the last 10 years. Twenty-two parameters pertaining to operational and financial efficiency of banks have been considered to construct the performance index for public sector banks. Altman Z-Score of solvency analysis has been applied to banking sector with suitable financial, operational and other efficiency ratios. It is found that reform measures have impacted positively in enhancing the stability and soundness of the public sector banks in India. The analysis has found that State Bank of India continues to be the number one bank in India and there is competition between Punjab National Bank, Canara Bank, Bank of India and Bank of Baroda for the number two place in different years.

3. STATEMENT OF PROBLEM

Every enterprise big or small, is prone to Risk. Risk Management in itself is a much diversified area. The most crucial part of Risk management in any enterprise is the risk of 'going concern' concept. How does a firm ensure that it is keeping up with the emerging trends, constant competition, changing demands of the clients and customers and at the same time making enough profits or sales and meeting its current obligations so that the company doesn't shut down? There are various tools and techniques to ensure that the company doesn't shut down or goes bankrupt. The most effective of them is the Altman Z Score Model.

In this research, Indian listed companies which filed for bankruptcies during April 2017- March 2020 are classified based on the industry they belong to, a sample from each industry is taken and Industry specific ALTMAN Z score formula is applied on the last 5 years financials of such companies using Financial Modeling. The trend in the Z scores is interpreted. These scores are compared with the Z scores of the last 5 years of the solvent companies belonging to the same strata. Such a multi-industry research has never been performed on the Indian Listed Companies to test the accuracy of the globally recognized and critically acclaimed ALTMAN Z score model.

4. OBJECTIVES OF THE STUDY

1. To identify and analyze the reaction of the Z score to the financials of companies belonging to different sectors and industries.
2. To analyze the Bankruptcy predictive ability of the ALTMAN Z score model.
3. To evaluate the trend of the Z Scores of the last 5 years of each company which filed for bankruptcy.
4. To compare the Z score of the companies with sound financial health with the Z Scores of the companies which have filed for bankruptcy during April 2017- March 2020.

5. HYPOTHESIS OF THE STUDY

H1- Financial performance cannot predict a company to be bankrupt prior to two years.

H2- There is no relation between the Z score and the date of filing of bankruptcy

H3- The trends in the Z scores do not predict/indicate bankruptcy

H4- Altman Z score is not an accurate model to predict bankruptcy

6. RESEARCH METHODOLOGY

The study undertakes 5 years financial data (from the date of filing bankruptcy) of 10 bankrupt companies from 5 industries namely auto ancillary, infrastructure, electronics, construction, pharma and textile and analyses their Z scores and compares them with the data of solvent companies corresponding to the industries they belong to.

List of 4 hypotheses are identified based on the objectives of the study. Financial data are analysed using MS Excel, Descriptive Statistics, Real Stats, Shapiro-Wilk test, and VBA Charts and Figures to prove the acceptance of Null/Alternate Hypothesis. The study is based on secondary data readily available in the respective company websites. 5 years financial data have been considered and analysed for the study. It involves purely quantitative study.

7. LIMITATIONS OF THE STUDY

It is not possible to conduct a research without any limitation, listed below are some limitations of this research.

1. This research mostly concentrates on a smaller sample of 10 bankrupt companies which represents around 8% of the total population size.
2. Further the sample holds a bias towards the industries chosen and the companies chosen as samples which may not justify the situation of bankruptcy in the economy.
3. The research is conducted based on the assumption that the risk of bankruptcy can only be influenced by the financials of the companies. There are other factors that may affect the risk of bankruptcy in the future which can be both macro and micro.
4. Further the sample selected in for the "solvent" companies do not follow any standard category like any index. It is quite random.

The period of bankruptcy is considered to be 3 years. However, the year ending of assumed to be 31st of March and all the bankrupt companies are considered as bankrupt on that day if depending on the year of bankruptcy. For example, if the company got declared bankrupt in the year 2017, then three years prior to bankruptcy will be 2015, even if it may not be actually three years if counted in the days' terms.

8. DATA ANALYSIS

The Altman Z-score is the output of a credit-quality test that checks a traded on an open market traded organization's probability of bankruptcy. The Altman Z-score depends on five monetary proportions that can be ascertained from information found on an organization's annual report.

$$Z\text{-Score}=1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

Where,

X_1 = working capital / total assets

X_2 = retained earnings / total assets

X_3 = earnings before interest and tax / total assets

X_4 = market value of equity / total liabilities

X_5 = sales / total assets

Initially a score of less than 1.8 was conceived to be dangerous and a company having that score would undergo a financial distress in next few years. Further with time, more refined version of the model came out which categorized the companies based on the score level. A score of above 2.9 is safe. A score between 1.23 and 2.9 is under grey zone and below 1.23 was declared to be financially distress.

For Altman Z Score, the dataset includes a set of financial figures are tested. For the purpose of descriptive analysis, the following results are obtained.

TABLE 1: DESCRIPTIVE STATISTICS OF THE Z SCORES OF BANKRUPT COMPANIES

	5th year	4th year	3rd year	2nd year	1st year
Mean	15.5729	7.89676	-40.1094	-29.2805	-84.2507
Standard Error	8.579501	7.380893	25.36252	17.4606	67.06753
Median	16.53059	7.081057	-19.6084	-22.7204	-16.324
Mode	#N/A	#N/A	#N/A	#N/A	#N/A
Standard Deviation	27.13076	23.34043	80.20333	55.21526	212.0861
Sample Variance	736.0783	544.7759	6432.574	3048.725	44980.53
Kurtosis	-0.48438	-1.20833	5.20744	3.282956	9.048805
Skewness	0.01057	0.085071	-2.033	-1.58313	-2.9567
Range	88.21077	67.33056	291.4642	188.881	721.2021
Maximum	59.15574	41.56364	47.2801	27.59064	44.08103
Minimum	-29.055	-25.7669	-244.184	-161.29	-677.121
Sum	155.7294	78.96761	-401.094	-292.805	-842.507
Count	10	10	10	10	10
AAD	21.35582	19.57097	52.11071	39.37733	118.5741
MAD	16.80262	17.3093	31.68753	30.39473	37.411
IQR	30.41452	31.27646	62.41821	56.82205	67.58988

The above variables are used in the model of Altman Z score wherein the data shows the above descriptive statistics of the entire sample. Since the focus is on the bankrupt companies, it is better to derive the statistics for the bankrupt sample companies.

According to theoretical study, some variables like working capital by total assets and retained earnings ratio might be correlated, However, the variable is not eliminated in order to exercise the test in the traditional bankruptcy model of Altman Z Score.

As per the formula of Altman Z score, the companies are categorized into different groups depending on the score obtained. The company which obtains a score of less than 1.23 is regarded as a distress zone. A score between 1.23 and 2.9 is considered to be under the grey zone. A score of above 2.9 would be regarded as safe zone. The test is applied into a sample of 10 bankrupt companies and 10 non-bankrupt companies.

TABLE 2: DATA OF SAMPLE FOR NORMALITY TEST

Insolvent Companies	5th year	4th year	3rd year	2nd year	1st year
Amtek Auto Ltd	21.27693	-3.70535	-21.9641	20.20072	-8.925
Ang Industries Ltd	47.66008	38.72054	47.2801	-161.29	0
Indosolar Ltd	2.489924	-19.6279	10.80626	-32.7852	-677.121
Jaypee Infratech Ltd	11.78424	-9.2709	-42.1026	-12.6557	-23.723
Ivrci Ltd	-13.7471	17.54467	-62.492	-54.4427	-80.4514
Gammon India	62.49041	-79.3384	-125.889	-157.156	-111.647
Mic Electronics Ltd	-29.055	41.56364	-244.184	-50.5699	-50.8144
Videocon Industries Limited	33.21878	0	13.35199	-44.2009	-71.3713
Orchid Pharma Ltd	-0.38645	-25.7669	-17.2527	7.334084	1.810449
Alok Industries Ltd.	23.3323	14.16211	-72.2126	27.59064	24.00759

Before proceeding with the data analysis, it is important to arrive at the normality of the data. The normality of the data is necessary to check if the sample is representing the population. The normality of sample can be tested using Shapiro Wilkins Test. Each of the variables is tested for their normality to proceed with the model testing.

TABLE 3: SHAPIRO-WILK TEST

	5th year	4th year	3rd year	2nd year	1st year
W-stat	0.98921	0.954811	0.797876	0.848819	0.547172
p-value	0.99576	0.725478	0.013662	0.056239	1.31E-05
alpha	0.05	0.05	0.05	0.05	0.05
normal	yes	yes	no	yes	no

From the above table, it can be inferred that the data is normally distributed. That data of 3rd year, and 1 year is said to be not normal due to the discrepancies arising out of missing data of some companies. The default hypothesis was the data was not normal. Since the significance value is less than 0.05, the hypothesis is rejected.

TABLE 4: ALTMAN Z SCORE OF BANKRUPT COMPANIES

Insolvent Companies	5th year	4th year	3rd year	2nd year	1st year
Amtek Auto Ltd	21.27693	-3.70535	-21.9641	20.20072	-8.925
Ang Industries Ltd	47.66008	38.72054	47.2801	-161.29	0
Indosolar Ltd	2.489924	-19.6279	10.80626	-32.7852	-677.121
Jaypee Infratech Ltd	11.78424	-9.2709	-42.1026	-12.6557	-23.723
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Alok Industries Ltd.	23.3323	14.16211	-72.2126	27.59064	24.00759

FIG. 1: ALTMAN Z SCORE OF INSOLVENT COMPANIES

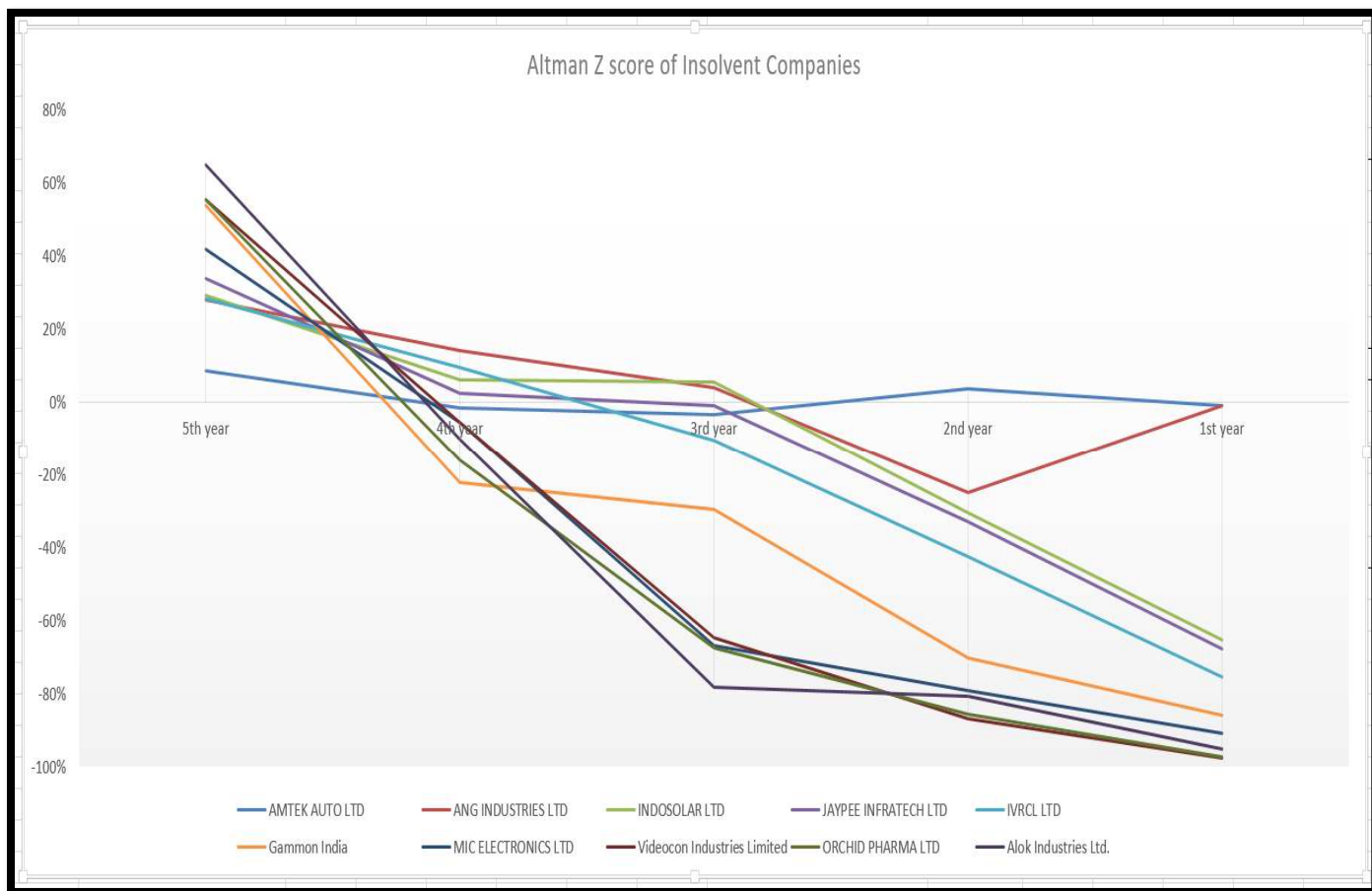


Figure 1 represents the Z scores of bankrupt companies mentioned in the table that it follows. It can be inferred that, in almost all 99% of the companies, a decreasing trend in the Altman Z scores 5 years prior to the filing of bankruptcy was seen. However, the rate of decline increased from the 3rd year onwards. Thus the hypothesis that Altman Z score can predict bankruptcy prior to 3 years, as constituted in the traditional theoretical model is proved. Hence, null hypothesis which claims that Z Score model cannot predict bankruptcy prior to 3 years is rejected.

TABLE 5: ALTMAN Z SCORE OF SOLVENT COMPANIES

Solvent Companies	5th year	4th year	3rd year	2nd year	1st year
Pricol Ltd	181.8528743	115.7171	108.7999	50.68359	42.75795
Sai Automative	209.4125371	191.7926	182.3247	216.4654	139.5454
Larsen and turbo	81.59021215	84.09161	82.01661	87.97394	75.18809
Jaiprakash Associates	36.99668001	33.28164	33.48934	38.92041	27.71244
JMC Projects	82.29333561	52.18373	84.86807	76.46177	80.55294
PUNJ LLOYD LTD	59.15573503	25.34771	-12.3244	8.014537	44.08103
Bharat Heavy Electricals Ltd.	39.06624747	51.10342	51.20928	54.85057	28.1918
Bharat Electronics Ltd.	68.85287845	83.35753	83.49603	92.14663	80.47454
Cipla Ltd.	90.80899572	81.87117	77.68812	79.36534	71.92741
Century Textiles & Inds. Ltd.	79.90165076	78.89169	92.20308	389.9165	75.74407

The scores of solvent companies are positive and most importantly above the stress levels as proposed in the Altman Z score model. However, some Z scores raise an alarm because in spite of being positive and above stress level, some companies like Pricol Ltd. and Century textiles Z Scores are seen on a decreasing trend. An exponential fall and rise can be seen from one year to another in companies like century textiles and Punj Lloyd. This could either be due to some internal change in strategy or effect of trade cyclical fluctuations of economy on such companies.

FIG. 2: ALTMAN Z SCORE OF SOLVENT COMPANIES

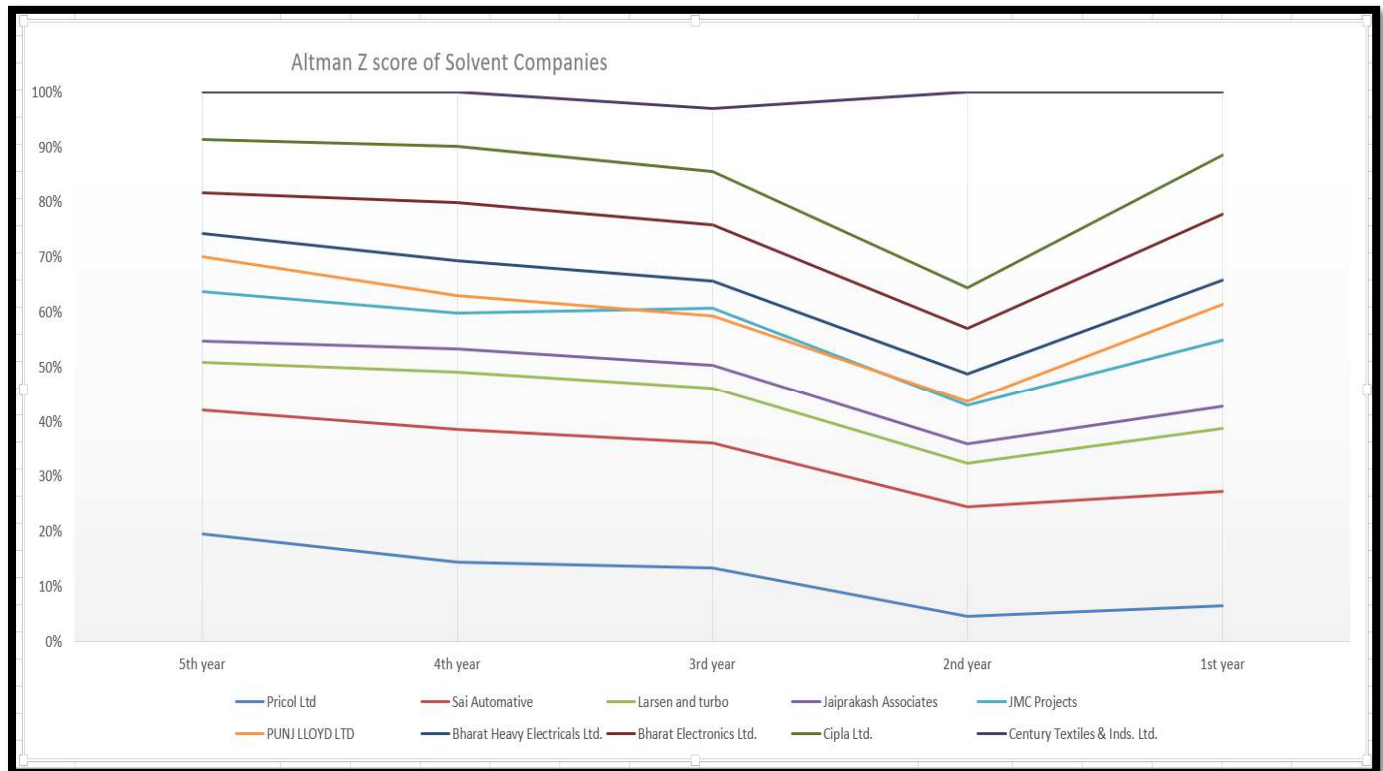


Figure 2, represents Altman Z scores of solvent companies belonging to similar sector or industry which the insolvent companies belong to. Contrary to the trend seen in the bankrupt companies, it can be inferred that the Z scores are increasing after second year. This trend also throws light on the cyclical fluctuations of global economic recession which started 4 years ago and its impact on certain sectors. Since, the financials were effected, the z scores of even the sound companies declined but not at a rate which the bankrupt ones did. However, in 2019, when the economy started recovering, the Z scores can be seen on a rising trend. The fall in the Z scores are not that deep.

Industry wise, Comparative Z score analysis

The automobile industry has seen and been through the worst phases in the past few years. However, very little has been spoken and written about auto ancillary industry. The two bankrupt companies in this industry show negative Z scores contrary to the solvent companies.

The stress level of infrastructure and construction industry go hand in hand because one supports the other. The companies belonging to textile and pharma industry can also be seen effected but as poorly as the companies belonging to infrastructure and construction industry. The Z scores are after all a byproduct of the financial statements of companies and reflection of them. The auto ancillary industry is represented by Pricol Ltd. And Sai Automotive. Where on one hand the latter has stable Z scores, the former's Z scores can be seen in a decreasing trend. If the Z scores of solvent companies were to be compared with those of bankrupt companies, there can be seen a horizon of a difference, where on one hand the solvent companies not only have positive Z scores but are also way above the stress level of the proposed model, and on the other hand the insolvent companies are not only below the stress level, but are negative and how.

9. FINDINGS OF THE STUDY

1. The overall accuracy of Altman Z score model in determining the risk of insolvency is high.
2. The financial ratios of the companies were sufficient to determine the risk of bankruptcy and can be applied in all of the industries. Although this research didn't cover the external factors.
3. The Altman Z score declared 9 out of 10 companies bankrupt, prior to 4 years as against the 2 years' prior in the proposed traditional theory.
4. The accuracy of the Z score model was based on the historical data and ratio analysis of financial statements. Any tampering of such data by the companies' administration itself may have affected the researches adversely.
5. It was noted that there were several modifications made to the Altman Z score with successive research paper which evaluated critically the original formula and came out with modified version to suit the new business models. However, in this paper, the original model is only considered.
6. Even though the ratios were obtained out of the similar financial data where in most cases was overlapping, there was still no high degree of correlation because of which that can be avoided.
7. Standalone ratio didn't fetch any useful insight. Among financial ratios, Debt Equity ratio was found to be a relevant ratio for determining the insolvency ratio. Debt to Equity ratio of ANG Industries stands at 0.55 which is better in terms of solvency but the bank came under IBC in the year 2016. Thus, ratios should be looked in tandem with each other.
8. If the models keep repeating the process of achieving higher accuracy, it may be more specific to the given sample. The sample of the solvent companies is quite small. Thus it fails to give a generic model if remain persistent with the model.

10. CONCLUSION

The predictive ability and accuracy of Altman Z score model is based on the underlying theory. In this paper there is involvement of Altman Z score model in predicting bankruptcy. Even though there have been several models developed in the past, the accuracy of the model under different circumstances can reflect non-uniform results. The data in this research includes the sample of Indian companies which are under bankruptcy proceedings or under IBC. The insolvency of Indian companies is a critical issue in the current context. Due to the insolvency of the companies, there is a spillover effect in the entire economy, this could be a reason why the Indian Government passed a ruling to not file for bankruptcy in 2020. Particularly when strategically important companies become insolvent. In the recent past, there were a lot of instances where in the insolvency of big companies like Bhushan Steel Ltd, Videocon Ltd and PC Jewelers Ltd have created a severe havoc in the entire banking system. Keeping this in mind, there is strict need to install a coherent system that could predict any forthcoming insolvency and could alert the banking system and save several stakeholders in the process. Keeping the value of the stakeholders in different businesses, there is a significant need of predicting the bankruptcy. This is because of the fact that the stakeholders should be cognizance if the firm with whom the a deal is going to get struck is under a risk of bankruptcy.

It is evident that the method and model applied in this paper are not exhaustive in nature. This is a major gap in this research. Thus, with evolution of several methods over the years the importance is mostly laid on the mathematical model instead of the theoretical model. Working with a mathematical model and information expands the objectivity of this examination. Be that as it may, there is some subjectivity related in the advancement of the model. In particular, the subjectivity concerns the time duration prior to which the proposed model is subjected to predict bankruptcy.

The research found that model does not produces any statistically significant difference in terms of the output. But, the output range differs in terms of the level of accuracy. This is based on the given sample, which may not be consistent with a different sample.

The paper concludes that; the market gives a prior indication of any forthcoming downturn. But the market is the effect of simultaneous expectation of several stakeholders which is based on the fundamentals of the company. Thus, there is no significant difference among the outputs. Given that, all the objectives of the research are achieved.

11. SCOPE FOR FURTHER RESEARCH

1. Different methods for obtaining a better sample that can represent the population in the specific manner.
2. Research in the areas of other methods like decision trees and geometric models and determining their accuracy in terms of the given updated sample.
3. An extensive Industry wise analysis can be made with more industries into consideration and industry specific models can be developed to check the feasibility of different models.

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