Bankruptcy Prediction Models: An Empirical Comparison

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Abstract: Purpose- The study is intended to evaluate the significance of bankruptcy prediction models. The corporate bankruptcy prediction is an ongoing area of interest in the recent past for which efforts are put to compare five bankruptcy models named Springate, Ohlson, Zmijewski, Grover and Altman. The aim of this research is to identify the best model fit for bankruptcy prediction through comparative analysis in empirical application. Approach-Through an extensive literature review, this study provides a comprehensive analysis of the methodologies and empirical findings from these models in their applications across different bankrupted or likely to be bankrupted companies. Findings-Our empirical findings on the comparison between the bankruptcy prediction models suggests the investor that they might choose any significant model to analyze the companies performances but the Springate and Zmijewski models are found to be the best models which gives early predictions and can be used to avoid the loss for investing money in bankrupted companies. Originality- It is anticipated that this study will be the most extensive to-date review in this field of literature. This paper shed light on the problem of model choice in empirical bankruptcy prediction of corporates and suggesting some directions and scope for future research.

Index Terms- Altman; Bankruptcy Prediction; Grover; Ohlson; Springate; Zmijewski

I. INTRODUCTION

Prediction of Bankruptcy is of increasing importance to corporate governance (Fich & Slezak, 2008). Bankruptcy is a state of insolvency wherein the company or the person is not able to repay the creditors the debt amount (Rao, et al. 2013). Bankruptcy arises when the amount of organization debt is higher than its value of existing assets (Gitman, 1996). Bankruptcy prediction of various companies is considered a necessary substance in the present time in order to avoid the risks that may drive such companies out of business (Ali & Abbas, 2015). A large number of firms have shut their operations around the globe due to financial distress on early stages (Wagas, 2018). Bankruptcy follows payment default or a situation in which the debtor company becomes unable to repay its debts (Harvathova &Mokrisova, 2018). Bankruptcy usually caused by different reasons. One of the most important reasons in bankruptcy of corporations is mismanagement. The high production costs, financial activities weakness, ineffective sales activities, managerial failures or mixture of these reasons can be a warning for a company for bankruptcy (Shankar, 2013).

As a whole, to the various stakeholders of the company as well as to the society the prediction of financial distress is of great importance. The Bankruptcy means risk that the firm will be unable to meet its debt obligations (Campbell, 2012). It is greater when the individual or firm has little or no cash flow, or when it manages its assets poorly. Prediction of bankruptcy is one of challenging tasks for every sort of organization in all over the world (Awais, Hayat, et al., 2015).

Bankruptcy prediction for the management will be effectual if they get earlier signs of the bankruptcy, as management can make further improvements (Khan, 2014). There is a vast need to predict the bankruptcy at early stage to avoid failures. Companies that show signs of concern should start anticipating since the beginning of the bankruptcy of the company (Sinarti & Sembiring, 2015). To prevent the risk of losing investments, investors always intend to predict the possibility of bankruptcy of corporations. Hence, they are always looking for methods that could predict the possibility of bankruptcy of companies (Karamzadeh, 2012).

There are multiple different models that have been used to predict corporate bankruptcy. Each model has its own limitations and financial institutions are always on the look-out for finding the best method to evaluate credit worthiness (Shankar, et. al, 2013). (Aziz & Dar, 2004) indicates that bankruptcy prediction received a vital importance to many investors, creditors, borrowing companies and governments so as to determine the time when companies fail in its operations. After this pioneering work, the multivariate approach to failure prediction spread worldwide among researchers in finance, banking, and credit risk (Altman & Laitinen, 2014). Financial distress prediction models provide help for the credit rating agencies, debt providers & equity holders to analyze the financial health of the firms. For corporate managers financial distress model serve as a whistle-blowing mechanism to initiate remedial measures. The first bankruptcy prediction model was introduced by Altman (1968), known as Altman Z- score. This model has used five ratios to predict a company whether it is bankrupt, in grey area or healthy (Altman, et al. 2017). Later several other models have been introduced to predict bankruptcy such as Springate (1978) which uses four ratios; Ohlson (1980) used nine ratios; Zmijewski (1983) used three ratios; & Grover (2001) also used three ratios to predict the bankruptcy situation of the companies. The names of these five models were given based on the name of the researchers who introduced them for the first time.

Some of the models have very good predictive power (Beaver, 1968). The probability of default by the company's due to the financial distress can be predicted based on its current financial statistics of

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the company with the help of the value of these score models. The model's accuracies may significantly decline when using samples from time periods, industries and financial distress situations other than those used to originally develop the models.

The paper is an attempt to predict the bankruptcy of five bankrupted or to be bankrupted companies by using five different bankruptcy prediction models for a period of last 10 years from the date of their bankruptcy.

The major contribution of our study will be to identify a suitable model for bankruptcy prediction in Indian context and made some effective comparison between these models and suggest the most effective and accurate model amongst them for playing safe in future.

II. REVIEW OF LITERATURE

Financial health is a great concern for a business firm (Mohammed, 2016). To estimate the financial capacity, businesses carries enormous information for the institutions and people around it. The measurement of financial soundness shapes the decisions of the shareholders, investors, owner etc. for the investment in different companies. Looking into the context of business today the surety of existence from firms has taken away due to the enhancing uncertainty scenario. The major issue of concern is longevity of the firms. Bankruptcy has shown unexpected and distress outcomes to global economy.

Bankruptcy is a financial failure of an organization. Its impact leads to financial failure, recession, poor economic situations and unemployment. It can produce substantial loss to banks, suppliers, shareholders and to the whole community (Sungbin et al., 2010). Bankruptcy is described as legally declared impairment of ability of an organization to pay its creditors (Ohlson, 1980; Ariel & Marcela, 2007). Bankruptcy is a situation where the liabilities exceeds the assets in the company, it happens because sources are not utilized properly, due to under capitalization , not maintaining sufficient cash, management of activities is inefficient, market situation deteriorates etc. (Venkataramana et al., 2012). (Rybak, 2006) "Bankruptcy risk takes place at all stages of the company's life cycle. Bankruptcy refers to a condition where the total liability exceeds the fair value of assets (Pradhan, 2011). It is a situation where operating cash flows are not sufficient to satisfy the current obligations of a firm and so the firm is forced to take corrective action (Altman, 1968; Deakin, 1972).

The ability to provide accurate predictions of corporate bankruptcy is of great importance. In corporate Finance, the topic of company bankruptcy failure prediction has become a major research domain over the last 35 years. The problem of bankruptcy prediction holds a special place among the theoretical and practical problems of corporate management (Fedorovaa, Douzhenkob, Fedorove, 2015). The more close to reality the prediction is, the more accurate the basic decisions. (Beaver, 1967) believes that it is possible to predict without making a decision, but we cannot make any, even the smallest decision without prediction.

The most important and vital issues in financial management are investing and trust to investors for both real and legal person in different levels of any business. In developed countries wide number of studies about process of decision making in investment have been conducted (Chen et al., 2009). The study of solvency is becoming more relevant and important as even large companies across the world are falling, resulting in economic and social problems to the society. Using financial distress models to predict failure in advance is absolutely essential for most businesses in their decision making process (Kasilingam, 2012). To avoid the high cost of insolvency, prediction and prevention of financial distress is one of the major factors that should be analyzed in advance as an early warning signal (Ramasundaram, 2012).

The first study in the field of bankruptcy prediction is conducted by (Woodlock, 1939). There are lots of techniques available for measuring the financial soundness of a business firm. Various approaches have been adopted to measure the company financial performance one of them is using the bankruptcy prediction models. The bankruptcy prediction models have been used to analyze the company performances of different industries. Many precious empirical studies in the developed countries have used different models to predict the company performances. Among multiple methods available for predicting the bankruptcy only some of them are more famous and well established. In predicting the bankruptcy, these models have different levels of accuracy based on their measurements used (Purnajaya & Merkusiwati, 2014).

Financial ratios are identified as one of the most important factors that affect accuracy when developing bankruptcy prediction model (Liang, Tsai & Shih, 2016). (Pacey & Pham, 1990) referring to (Altman, 1984) stated that high degree of accuracy ranging from 70- 95% can be predicted with the business failure models.

In our study we have tested five bankruptcy prediction models named as Altman, Springate, Ohlson, Grover & Zmikskwi on five bankrupted or likely to be bankrupted companies. Underneath is the related review of literature over models of bankruptcy predictions.

Table-1 Summary Of The Literature Review Of Bankruptcy Prediction Models From Year 2000

Author & Publication Year	Area Covered	Findings & Conclusions
Joy Begley, Jin Ming &Susan Watts (2000)	The study uses secondary data of 20 listed companies for the period of 10 years.	In the present study comparison is made between Altman's original model and modified model to that of Ohlson's original and modified models. Then Author finds that Ohlson's original model displays the strongest overall performance.

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•	Surapol Pongsatat, Judy Ramage & Howard Lawrence (2004)	Over the years 1998 to 2003, a matched pair sample of 60 bankrupt and 60 non bankrupt firms were examined.	The study signifies that for predicting bankruptcy of small asset Thai firms none of the two models could be considered superior to the other.
•	J. Efrim Boritz , Duane B. Kennedy & Jerry Y. Sun (2010)	The study compares Canadian bankruptcy prediction models formed by Springate (1978),Véronneau (1986), Altman andLevallee (1980), against the Altman and Ohlson models using recent data to determine the applicability of the Altman and Ohlson models to the Canadian environment.	Results indicate that the models developed by Springate (1978) and Véronneau (1986) yield similar results to the Ohlson (1980) model and requiring less data. Further, findings regarding the Altman and Ohlson models are consistent and suggest that Ohlson model is superior to the Altman model.
•	Kasilingam, R; Ramasundaram, G(2012)	The study is confined to 25 Non-Banking Finance companies with an analysis of financial statements for a period of 5 years (2005-2009).	The study results that both Springate and Fulmer model can be used to predict the solvency of not only manufacturing industry but also for Non-banking finance companies and banks.
•	Narendar V. Rao, Gokhul Atmanathan, Manu Shankar, &Srivatsan Ramesh (2013)	The author has applied different prediction models across the data of nine companies picked from the Indian Manufacturing sector which had filed for bankruptcy in the period 2007-2012.	The paper suggests that in comparison to KMV Merton model, Altman Z-score model is able to predict bankruptcy filing efficiently for the Indian Manufacturing sector at least two years prior to the situation occurring.
•	Mani Shehni Karamzadeh (2013)	Statistical population of 90 companies in Tehran Stock Exchange were considered for this study. Data for4 year period from 2007 to 2010 were taken into consideration.	The findings of the study reveals that Altman model can predict bankruptcy of Iranian listed companies with 50% of accuracy at least three years prior to the occurring and Ohlson model without any modification made in the independent Variables and coefficients, can predict bankruptcy with the accuracy of 33.3%, respectively for 3 years before. Further, author suggests to investors Altman a better model to predict bankruptcy of companies.
•	Aris Wahyu Kuncoro (2013)	This study is to examine the predictions of bankruptcy in basic industrial and chemical companies listed on the Indonesia Stock Exchange during the period from 2007-2011.	The findings of the paper reveals that Springate is one of the most effective bankruptcy prediction models which can be used for prior prediction of financial distress.
•	Mahmoud Bani , Mostafa Zadehbagher& Mohammad Ali Saberimanesh (2014)	The population of this study is of 17 public and private banks during the period ranging 2008 to 2012.	Finding of the paper says that there are significant differences between the results of rejection the models. Zmijewski model of bankruptcy prediction model Toffler confirmation more conservative act.
•	Chandana Gunathilaka (2014)	The study observes a sample of 82 firms listed on Colombo Stock Exchange across different sectors, over a period of five years from 2008 to 2012.	The study finds that Altman's *Z* and *Z*'' models show a higher degree of accuracy in predicting the financial distress.
•	Sinarti &Tia Maria Sembiring(2015)	This study uses secondary data of 11 companies in the basic industry and the metal type which listed in Indonesia Stock Exchange	The conclusions of the three models showed a significant difference to the approach of Z-Score with Zmijewski and Springate with Zmijewski, but there is no significant difference between the approaches of the Z-Score with Springate.
•	Shariq Mohammed (2016)	The present study has been conducted to assess the financial health of a firm namely Raysut Cement Company SAOG and its subsidiaries in Oman. This study covers 8 years of secondary data ranging from 2007 to 2014 which was obtained from the published sources.	The conclusion of the paper suggests that Altman Z score is the best measurement that can shape the decision of the stakeholders.

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•	Ghazali Syamni, M. Shabri Abd. Majid & Widyana Verawaty Siregar (2018)	Data of this study covered 19 companies in the coal mining sector that are listed on the Indonesian Stock Exchange (IDX) over the period 2013 to 2015.	The findings suggest that the investors should give more attention to the Ohlson and Grover models, because they gave negative
			prediction towards the stock prices. This means that when these models' prediction Value is at one point in a company, and then there would be a stock price reduction at one point in the future.
•	Natalia Scacun & Irina Voronova, (2018)	In this paper 21 companies were selected for primary research from one industry –manifesting of metals and metal products for a period of 5 years.	Altman, the accuracy is 70.59% and 64.71% respectively , In Ohlson (1980) model, the highest accuracy is 83.33% & 70.59% to 76.47% respectively show the model of Zmijewski (1984)

Source: Based on review of studies

A. Objective

The objective of this study was to test and evaluate the efficiency and accuracy of five bankruptcy prediction models and made a comparative study to find which model results are more accurate and giving early prediction for the bankruptcy of the companies.

III. RESEARCH METHODOLOGY

Data of this study is gathered from the financial statements of five bankrupted or to be bankrupted companies over the period of last 10 years from the year in which bankruptcy occurs. These data are accessed through the website of money control, Bombay Stock Exchange & Stock Screener.

To predict the bankruptcy of the companies, the bankruptcy prediction models of the Ohlson, Altman, Springate, Grover and Zmijewski are used. The extracted data was then put into the formula of above stated models. This provides us with a view if model was able to predict the bankruptcy or not.

We analyzed the frequency of correct predictions by different models which gave us a clear picture as to which model is most effective and suited for the Indian Context companies.

The companies which were taken under consideration are shown in *Table-2*

Table-2 Names of Bankrupted or likely to be Bankrupted Companies

SR No.	Name	Year Data
1.	Kingfisher Airlines Ltd.	2004-2013
2.	Reliance Communications	2009-2018
3.	Prag Bosimi Synthetcis	2009-2018
4.	Cranes Software International	2009-2018
5.	Prakash Industries	2009-2018

The formula, description and score categorization for each model are presented in *Table-3*

Table-3 Bankruptcy Prediction Models

Models	Formula	Description	Category
hlson **(1980)**	OS= -1.32-0.407X 1+6.03X2-1. 43X3+0.0757 X4-2.37X5-1. 83X6+0.285 X7-1.72X8-0. 521X9	OS = Ohlson Score **X1** = Log (total assets/GNP index) **X2** = Total liabilities/to tal assets **X3** = Working capital/tota l assets **X4** = Current liabilities/cu rrent assets **X5** =1 if total liabilities>to tal assets; 0 if otherwise **X6** = Net income/tot al assets **X7** = Cash flow from operations/ total liabilities	OS < 0.38 = Healthy OS = 0.38 = Grey area OS > 0.38 = Bankrupt
		X8 = 1 if Net income negative ; 0 if otherwise **X9** = Change in Net Income	

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Springate (1978)	SS = 1.03X1 + 3.07X2 +0.66X3+0.4 X4	SS = Springate Score **X1** = Working capital/Total asset **X2** = Net profit before interest taxes/ total asset **X3** = Net profit before Taxes/Current liabilities **X4** = Sales/Total asset	SS > 0.862 = Healthy SS < 0.862= Bankrupt
Zmijewski (1983)	Z = -4.3 -4.5X1 + 5.7X2 – 0.004X3	ZS = Zmijewski Score **X1**=ROA (Net income/ total assets) **X2**= Leverage (Total liabilities/total assets) **X3** = Liquidity (Current assets/current liabilities)	ZS < 0= Healthy ZS > 0 = Bankrupt
Grover (2001)	G = 1.650X1 + 3.404X3 –0.016ROA + 0.057	GS = Grover Score **X1** = Working capital/Total assets **X2** = Earnings before interest and taxes/Total assets **ROA** = net income/total assets	GS ≥ 0.01 = Healthy GS ≤-0.02 = Bankrupt
Altman-*Z*-Score (1995)	ZM = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4	ZM = Modified Altman-Z-Score **X1** = Working Capital/Total Asset **X2** = Retained Earnings/Total Asset **X3** = Earnings Before Interest and Taxes/Total Asset **X4** = Book value of (Equity/total debt)	ZM > 2.60 = Healthy ZM = 1.10-2.60= Grey ZM < 1.10 = Bankrupt

III. DATA ANALYSIS AND INTERPRETATION

Five model's formula applied on data of five bankrupted or likely to be bankrupted companies shown in *Table- 4*

Table -4Data and model values of five companies over the period of last 10 years from their date of filing bankruptcy along with their interpretation

KINGFISHER AIRLINES										
Models	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**	**2005**	**2004**
Ohlson	1038.36	682.366	377.45	74.607	743.74	123.47	44.495	170.749	13.376	14.818
Springate	-6.238	-1.499	-0.373	-0.815	-0.908	-1.441	-0.562	-0.859	0.253	0.860

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Zmijewski	8.222	2.519	2.406	2.378	2.371	1.862	2.444	2.854	1.609	1.359
Grover	-7.978	-1.932	-0.670	-1.011	-1.213	-1.409	-0.626	-0.885	0.197	0.764
Altman	-41.574	-8.507	-4.425	-5.041	-5.037	-3.295	-0.799	-1.312	0.742	2.316

RELIANCE COMMUNICATION LTD.

Models	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**
Ohlson	4209.432	740.87	119.47	462.65	-51.270	-239.92	-472.3	646.83	2256.43	-1151.62
Springate	-0.014	-0.131	0.012	0.301	0.013	0.167	0.092	-0.080	0.317	0.414
Zmijewski	2.190	1.507	1.420	1.404	1.354	1.359	1.388	1.435	1.369	0.730
Grover	0.008	-0.190	0.068	0.271	0.006	0.135	0.083	-0.121	0.282	0.322
Altman	0.296	0.039	1.179	2.080	1.010	1.462	1.663	1.002	2.572	2.104

PRAG BOSIMI SYNTHETCIS

Models	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**
Ohlson	4.710	7.366	10.42	11.257	NA	11.000	39.498	NA	39.155	-35.486
Springate	-0.407	-0.409	-0.032	-0.971	NA	-0.258	-0.271	NA	-1.119	-0.465
Zmijewski	1.74	1.70	1.59	2.08	NA	1.80	1.60	NA	1.89	1.39
Grover	-0.179	-0.092	-0.076	-0.361	NA	-0.180	-0.139	NA	-0.208	-0.088
Altman	-0.606	-0.059	-0.155	-1.173	NA	-0.519	-1.201	NA	-0.579	-0.167

CRANE SOFTWARE INTERNATIONAL

Models	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**
Ohlson	90.564	2.777	34.74	-35.46	-74.594	123.304	-47.606	39.741	164.088	-6.517
Springate	-2.178	-1.462	-1.222	-0.696	-1.542	-1.403	-1.021	-0.661	-0.64331	0.941
Zmijewski	1.914	1.743	1.686	1.487	1.775	2.339	1.485	1.803	1.999	0.313
Grover	-3.180	-2.229	-1.780	-1.098	-1.993	-1.731	-1.181	-0.819	-0.067	0.905
Altman	-14.966	-10.948	-7.686	-5.276	-7.453	-6.093	-3.513	-2.537	1.507	3.910

PRAKASH INDUSTRIES

Models	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**
Ohlson	-201.198	-25.186	-2.47	90.155	0.361	58.410	3.964	4.016	-28.05229	1.163
Springate	0.169	0.446	0.308	0.381	0.860	0.938	1.284	1.350	1.991277	1.757

Zmijewski	6	1	8	6		5	7		1	6
Grover	-0.179	-0.092	-0.076	-0.361	NA	-0.180	-0.139	NA	-0.208	-0.088
Altman	-0.606	-0.059	-0.155	-1.173	NA	-0.519	-1.201	NA	-0.579	-0.167

CRANE SOFTWARE INTERNATIONAL

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Zmijewski	1.914	1.743	1.686	1.487	1.775	2.339	1.485	1.803	1.999	0.313
Grover	-3.180	-2.229	-1.780	-1.098	-1.993	-1.731	-1.181	-0.819	-0.067	0.905
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Springate	0.169	0.446	0.308	0.381	0.860	0.938	1.284	1.350	1.991277	1.757

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Zmijewski	0.949	1.290	1.366	1.384	1.170	1.167	1.014	0.942	0.768	-3.003
Grover	0.474	0.133	0.074	0.090	0.321	0.339	0.441	0.493	0.877	0.847
Altman	2.687	1.977	1.834	1.865	2.425	2.498	2.655	2.792	4.066	3.645

The values are calculated by multiplying each of several financial ratios by an appropriate coefficient & then summing the results.

B Analysis and Interpretation

As observed from the Table 3 of the five models applied on five companies, it infers the following things:

Kingfisher Airlines Ltd: Ohlson model is able to predict the bankruptcy since from the year 2004 itself as the value in 2004 is 14.81 which are greater than its zone value i.e 0.38. Springate model is giving the predictions from the year 2005 while Zmijewski is able to predict the bankruptcy from the year 2004 where the value of the model is showing 1.35 which is greater than zone value i.e 0 which signifies high. Springate showing the bankruptcy in the year 2017 and 2018 prior to those values were stating the company to be the healthy one. Zmijewski stating the bankruptcy situation from the year 2010 onwards while Grover under that company going to be bankrupt in near future. According to Grover also chances of the company to become bankrupt are high from the year 2004 and further as per Altman model in the year 2004 company is in Grey area and from 2005 till 2013 is showing high chances of bankruptcy.

Reliance Communications: Ohlson results are coming quite fluctuating under this, In the year between 2015-2018 its showing bankruptcy chances of the company as value model is greater than 0. In year 2012-2014, it stating the company to be healthy, in year 2010-2011 again the chances of the company for bankruptcies are this is not able to give the correct predictions about the company bankruptcy further as per Altman results states the company is in Grey area between the years 2009-2016 which means it needs some improvements while from the year 2017 onwards bankruptcy chances are high.

Prag Bosimi Synthetcis: Ohlson value stating the company to be healthy in the year 2009 later from 2010 till 2018 its showing the bankruptcy chances of the company as values are greater than its zone stated value i.e 0.38. Springate model values are negative throughout the study under consideration which states the prediction about bankruptcy is quite high as value is greater than 0.862 results the Zmijewski and Grover model stating high chances of bankruptcy throughout the study under consideration whereas Altman model states the company to be healthy in year 2009, in grey zone in 2010 and bankrupt from the year 2011 till 2018.

Prakash Industries: Ohlson values showing the company healthy position in the year 2009 till 2015 but from the year 2016 onwards values are stating high chances of filing bankruptcy. Springate value states the bankruptcy situation from the year 2013 onwards. In the year 2009 company is healthy as per Zmijewski value but from 2010 till 2018 it showing high chances of bankruptcy. Grover model is not able to predict the Bankruptcy of the company as the values stating the company is healthy throughout the study period while according to Altman model, company is in Grey zone between the year 2012 to 2018 and it was healthy in the years till 2011.

The Ohlson model documented more firms in the bankruptcy category but giving quite later predictions as compared to Springate and Zmijewski models. Grover stating two companies throughout in the healthy zone while Altman model founds more firms in the grey area category.

IV. LIMITATIONS & FURTHER SCOPE OF THE STUDY

The study is limited to five bankruptcy models applied on the data of five bankrupted or to be bankrupted companies based on the published data of financial statements of last 10 years from the year of filing for bankruptcy.

Further studies can be extended using multiple bankruptcy models and large number of companies from different sectors can be taken into consideration.

V. VI. CONCLUSION

This is one of the few studies focused on the comparison between the multiple bankruptcy prediction models to find the most productive and early predictor of bankruptcy. This study investigated the effectiveness of five models named as Ohlson, Springate, Zmijewski, Grover and Altman to examine the financial soundness of the firms. The study covers five bankrupted or likely to be bankrupted companies and data of prior ten years of time frame from the year they are going for bankruptcy are taken.

According to the findings, the different values across the bankruptcy prediction models were simply due to different measurements used to predict the company's bankruptcy. These findings further imply that the bankruptcy prediction models have different levels of accuracy in predicting the performance of the firms. Further it is suggested that the company to be healthy. Further as per Zmijewski, Grover & Altman model also the chances of the company to become bankrupt is high from the year 2009 itself.

Crane Software International: Ohlson values stating company to be healthy in the years between 2014 &2015 whereas from 2016 till 2018 chances for filing bankruptcy are high. In the year 2009 Crane software is healthy as per Springate model and from the year 2010 till 2018 values is showing the bankruptcy situation. Investors should give more attention to the Springate and Zmijewski models as they are come out as the early predictor of bankruptcy. While in predicting the performance of the firms, the investors, and policy makers should not only rely on a single bankruptcy model to predict the performance of the firm.

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