Developing Country Studies
ISSN 2224-607X (Paper) ISSN 2225-0565 (Online)
Vol.6, No.2, 2016

Corporate Bankruptcy Prediction In Pakistan By Employing Multiple Discriminant Analysis Technique

Hakimzadi Wagan[1]*, Mansoor Ahmed Golo[2], Rani Abro[1], Bakhtawar[1], Shahid Hussain Abro[1], Zulfiqar Ali[3]
1. Sindh Agriculture University Tando Jam 70060, Hyderabad, Sindh, Pakistan
2. Department of Management Sciences, Isra Universy Hyderabad
3. Hefei University of Management Sciences, China

Abstract

Aim of this paper is to focus on the utility of traditional financial ratios for predicting bankruptcy of corporate sector of Pakistan. Symptoms of bankruptcy can be judged in any firm long time before. Therefore, a number of methods were developed by researchers to predict and overcome the matter of bankruptcy. Study on Corporate sector of Pakistan was carried out for the period of 2001 to July 2015. Sixteen financial ratios covering different aspects of firms' profitability, solvency, liquidity position and operational activity were tested as predictive variables for four operating years before bankruptcy. A total number of 38 companies were examined into two equally distributed groups (bankrupt and non-bankrupt group). Financial data were collected from official website of Karachi Stock Exchange and from balance sheets of these institutions published by State Bank of Pakistan. Variables from Altman's (1993) revised model were taken into account for the study and weight factor is re-estimated. Simultaneously on the other hand Multiple Discriminant Analysis (MDA) techniques are employed to generate a new model for bankruptcy prediction. Altman's (1993) re-estimated model when employed on failed and non-failed Pakistani firms proved 78.9% and a newly developed model proved 71.1% bankruptcy prediction.

Keywords: corporate sector; bankruptcy prediction; MDA; financial ratios; Altman's (1993) model; Pakistan.

1. Introduction

The concept of bankruptcy dates back to ancient Greece, there was a thought of "debt slavery"[1]. The term bankruptcy was originated from Italian language word "Banca Rotta" stands for "broken bench. Yap et al. (2010) conducted study in Malaysia and developed MDA Model to get better analytical capabilities, accuracy rate between 88% - 94% was observed. Reilly et al. (2005) examined number of ratios for bankruptcy prediction, these ratios individually or grouped together expected to reflect declining liquidity for several years prior to bankruptcy declaration. A financially sound and strong firm always successfully captures attention of creditors, investors, suppliers and customers towards it, because every one of them wants to be its stakeholder. Pakistan is facing severe socio-economic problems; failure of corporate sector is one of the major issues hindering the development of the country. In very short span of time, in two decades a large numbers of companies were declared bankrupt and delisted. Therefore, this is of paramount importance to find out the companies that are going bankrupt, at their early stage of bankruptcy so that creditors, investors, suppliers and customers keep themselves abreast by avoiding further business and may safe their business for future loss. There is relatively dearth of literature on bankruptcy prediction in Pakistan.

2. Literature Review

Literature employs different techniques and tools to develop business failure prediction models. These methods are based on technology, marketing and accounting. Dr. Roli Pradhan. (2013) adopted Altman's model for predicting bankruptcy and Z-Score was forecasted by using Back Propagation Neural Networks-BPNN. Growing impact of BPNN application on the Z-Score model was observed. A. Adam Ding et al. (2012) reported the role of corporate bankruptcy prediction in business operations, government policies and in academic research. Xu Xiaosi et al. (2011) by considering bankruptcy prediction as a vital element for credit risk management conducted a study on extracted data from Chinese stock exchange where accuracy of statistical methods, artificial neural networks method and kernel-based learning method was tested and introduced. Support Vector Machine of the kernel-based learning method proved as a significant method for the purpose of bankruptcy prediction. Ruey Ching Hwang et al. (2011) employed stochastic frontier model, it was found that discrete-time hazard model outperform Merton model in terms of bankruptcy prediction. Brindescu-Olariu Daniel et al. (2013)

[1]When a debtor could not pay, he himself, his wife and children were forced into bonded labor, until the creditor recouped losses via their physical labor

checked the accuracy and reliability of logistic regression model for Timis County, Romania. Model offered overall 70.3% in-sample and overall 67.6% out of sample accuracy in the prediction of the bankruptcy over a 5-year period. Ben Jabeur Sami. (2013) studied macroeconomic factors can cause the financial distress and prolonged distress leads to failure of companies. Thian Cheng Lim et al. (2012) showed that identification of bankrupt firms was driven by empirical testing and exploration of new econometric models. Ben Chin Fook Yap et al. (2012) investigated the ability of financial ratios and logistic regression. Data of sixty four Malaysian firms were examined with sixteen financial ratios. With combination of four ratios a Logit model was developed. Results showed the significance accuracy rate of 88% and 90% for Logistic Regression. Adrian Gepp et al. (2012) discussed the importance of accurate business failure prediction models. Importance of these models had been highlighted due to the enormously expensive crash of high profile trades in Australia and USA. Vineet Chouhan et al. (2014) reexamined the Altman Z score to facilitate the current research. Data was taken from Bombay Stock Exchange sensitive index *i.e.* 30 index. Study found that Altman's model is still widely used by companies for measuring creditworthiness of the companies. Wurim Ben Pam. (2013) conducted study to examine the strength of the Multiple Discriminant Analysis Model on two unhealthy and healthy banks for the period of 1999 to 2003. Malik Rizwan Khurshid. (2013) identified elements of bankruptcy of non financial firms of KSE in sugar and cement industry for the period of 2003 to 2010. Financial distress of organizations can be calculated with the help of Z-Score where model showed negative correlation among liquidity, profit earnings, solvency and leverage, while operational activity was proved positively correlated. Ciotină Daniela et al. (2013) examined the bankruptcy symptoms and prediction models, although lots of advanced models for prediction of business failure were introduced but MDA still proved most prominent and largely used technique in the field. Ani Wilson and Ugwunta David (2012) analyzed various ratios in MDA model for analyzing business failure. Model was employed over collected sample of 11 Nigerian firms. Results proved highly predictive ability of Multiple Discriminant Analysis. Abdul Rashid et al. (2011) conducted research for predicting business failure. Bankruptcy issue was examined by identifying the most applicable financial variables for non-financial Pakistani firms using multiple discriminant analysis.

3. Data and Methodology

Financial data of non-financial bankrupt companies listed on KSE in the past and those which were currently delisted under the court decree; by violating the LISTING REGULATION OF KSE (Amended up to October 26, 2005) Chapter IX. Regulations; 32 (1) (a) (b) (c) (d) (e) (f) (ff) (g) and (2) and non-bankrupt Pakistani companies was acquired from Balance Sheet Analysis of Joint Stock Companies Listed on The KSE, published by State Bank of Pakistan. Data is examined for four operating years for the period of 2001 to July 2015. Table-1 shows total number of 205 companies are delisted and 111 companies are delisted due to violation of listing regulation 32(1)(2) court decree. There are 26 companies those belong to banking and non-banking financial corporations and remaining 85 companies are from non-financial sector. Delisted companies are short-listed on the basis of following defined standards;

1. Selected population must be non-financial sector of joint stock companies. Bankruptcy situation for financial companies is very much different from non-financial companies.
2. Shares have traded at KSE during the listed period of respective company.
3. Company must have available financial information for the period of four operating years.
4. For managing accuracy in comparison between bankrupt and non-bankrupt companies, it is necessary to select a company from both populations on the basis of same sector and having nearest total assets one financial year before bankruptcy.

During the process of short-listing, there are 84 companies came under observation fulfilling the number (1) and (2) points of the given principles of judgment but as it is mandatory for companies to meet the entire four criterions so other companies are excluded. Thirty eight companies included 19 bankrupt delisted firms and 19 non-bankrupt or healthy corporations for matching purpose are selected. Table-2 contains name of the company, respective bankrupt year and total assets one year before bankruptcy. Sector wise distribution list of companies is given in Table-3.

3.1 Description of Variable

Sixteen financial ratios mentioned in Table-4 are used as explanatory variables under the heading of profitability, liquidity, activity and solvency ratios. **Profitability ratios;** quantify the income of a corporation relative to its

proceeds and invested resources. **Liquidity ratios;** these ratios are used to measure the adequacy of a firm's cash resources to meet its short-term cash obligations. **Activity Ratios;** these ratios assess revenue and output generated by the firms' resources. Operating activity requires short-term venture (Merchandise and Accounts Receivables) and long-term investment (property, plant and equipment). These ratios define the association among firms level of operations (sales) and the assets required to continue operational activity. **Solvency ratios;** examine the firms' capital structure in terms of mix of its financing sources (long-term and short-term obligations) and the ability of the firm to satisfy its financing obligations. S. Vasantha et al. (2013) mentioned ratio analysis as one of the important tool and technique used to measure the financial performance of the company.

3.2 Hypotheses:

H_1: When Liquidity Ratios are higher then there are lower chances of Bankruptcy.

H_2: Larger the amount of debt, higher the chances of corporate Bankruptcy.

H_3: When there are higher Profitability Ratios then there is lower probability of Bankruptcy.

H_4: Lower the Activity Ratios higher the chances of Bankruptcy.

4. Results and Discussion

This section presents the results of our study. Groups are coded as 1 for bankrupt and 2 for non-bankrupt. Financial ratios of bankrupt and non-bankrupt groups are examined with the help of calculated means and standard deviations of financial variables. For further justification T-Test and F-Test is conducted. Altman's revised model is re-estimated by entering variables directly into the SPSS 16.0 version and simultaneously a new model is developed by running multiple discriminant analysis step-wise method in SPSS 16.0 version so that most significant variables are entered in the model. Overall fitness of both models is analyzed by acquiring Wilks' Lambda.

4.1 Means and Standard Deviation of Financial Ratios (Bankrupt Group)

Means and Standard Deviations of sixteen financial ratios are calculated under the heading of profitability, liquidity, activity and solvency for unhealthy group. Table-5 illustrates, that bankrupt group have lower profitability, lesser liquidity, least activity and high insolvency ratios.

4.2 Means and Standard Deviation of Financial Ratios (Non-Bankrupt Group)

Means and Standard Deviations of sixteen financial ratios under the heading of profitability, liquidity, activity and solvency of Non-Bankrupt group in Table-6 is showing that Non-Bankrupt group has higher profitability, Better Liquidity position, capability of generating output is quite better and has optimal mix of capital structure which indicates better solvency position of Group 2. Further T-Test for equality of means and F-Test for equality of variances is also conducted so that results can be justified more effectively.

4.3 T-Test of Groups (Bankrupt and Non-Bankrupt)

T-test is conducted for observing that there is difference in means, basically the meaning of the test is that there are two groups and we are comparing the means of these two groups, the assumption of the test is stated as follows;

$\mathbf{H_0 : \mu_{BG} = \mu_{NBG}}$

Whereas the alternate hypothesis of the test is:

$\mathbf{H_1 : \mu_{BG} \neq \mu_{NBG}}$

μ_{BG}, stands for means of the bankrupt group

μ_{NBG}, stands for means of non-bankrupt group

Results of the t-test in Table-7 illustrates statistical significance for eleven financial ratios in first year, six financial ratios in second year and four financial ratios in third and fourth yea respectively. Earnings Before Interest and Tax (henceforth EBIT) to Total Assets (henceforth TA), Retained Earnings (henceforth RE) to TA

and Net Income (henceforth NI) to TA of Profitability and EBIT to Total Liabilities (henceforth TL) of Solvency ratios were found significant continuously for two years prior to Bankruptcy. Working Capital (henceforth WC) to TA and Current Assets (henceforth CA) to TA of Liquidity ratios were observed significant continuously for three years prior to bankruptcy. Although the significant level was chosen 10%, but the study observed significance level of some ratios at 5% and even at 1% level of freedom. Relying on T-Test results null hypotheses is rejected and alternate hypotheses are accepted. WC to TA and CA to TA from Liquidity ratios are found more significant ratios for continue three years, so that H_1 is accepted and H_0 is rejected, CL to TA is found significant for one year prior to bankruptcy, EBIT to TL is significant for first, second and fourth year prior to bankruptcy and Net Worth (henceforth NW) to TL found significant for first and third year, showing significant difference regarding Solvency of the two groups H_2 was accepted H_0 was rejected. EBIT to TA is found significant in first two years and in fourth year also, RE to TA also find significant for first, second and fourth year, NI to TA find significant for first, second and fourth year from profitability ratios, so H_3 is accepted too whereas H_0 is rejected. Activity ratios; Sales to TA find significant for first and third year, CASH to SALES and WC to SALES were significant for first year before bankruptcy, H_4 is also accepted and H_0 is rejected.

4.4 F-Test of Groups (Bankrupt and Non-Bankrupt)

F-Test is employed for comparison of variance; assumption of normality is equality of variances. F-test results were significant for eleven financial ratios in first year, six financial ratios in second year, three financial variables in third year and five financial ratios in fourth year prior to bankruptcy. Significance level for observation was set at 10%, but there are many variables found significant at 5% and 1% of significance level. Table-8 illustrates F-test results of both groups.

4.5 Multiple Discriminant Analysis

Discriminant approach is applied to determine that which variable recognize a distinction between two or more group occurring. While, MDA technique following the above approach, can determine a set of Discriminant Coefficients. Discriminant analysis is used to put two or some times more than two variables together linearly and produced result can classify the object into one of two groups. Prasanna Chandra. (2013) defined this as a statistical technique which is very much helpful for classification purposes. Bodie et al. (2005) stated that several tests were conducted to predict financial default risk including financial ratios, but the best known series of these studies was conducted by Edward Altman, who employed the technique of Discriminant Analysis to predict bankruptcy. Dr. Amalendu Bhunia et al. (2011) defined multiple discriminant analysis as, it is a method in statistics with help of which the differences between variables for arrangement of sample in to different categories can be reduced and set number of wide groups. For predicting bankruptcy of corporate sector of Pakistan Altman's revised model is re-estimated and a new model is developed. Both groups have equal classification of 19 firms; it is therefore total 38 companies with four years of inspection which became 152 firm-year observations for companies of both groups. Data was analyzed with an average of four years resulted 38 firm-year observations.

4.6 Altman's (1993) revised Re-estimated model

By applying SPSS direct method of Discriminant Analysis following Abuzar M. A. Eljelly et al. 2001 re-estimated weight factor for Altman's (1993) revised model is obtained and illustrated in Table-9. With combination of financial variables and unstanderized co-efficient the re-estimated model will be as below;

$$Z^* = -1.405 + .094\ X_1 + (-.452)\ X_2 + 1.041\ X_3 + .166\ X_4 + .306\ X_5$$

Where;

Z= Standard Score

X_1= Working Capital to Total Assets

X_2= Retained Earnings to Total Assets

X_3 = EBIT to Total Assets

X_4 = Book Value (Equity) to Total Liabilities

X_5 = Sales to Total Assets

4.7 Newly Developed model

By using SPSS 16.0 version the step-wise method of discriminant analysis is incorporated so that most important variables can only be entered. Table-10 is illustrated most significant financial variables that have to enter. Out of sixteen financial ratios only two financial variables; Current Assets to total assets and EBIT to total liabilities were found more significant and entered. In this paper for predicting corporate bankruptcy of Pakistani firms unstandardized coefficients for most significance variables are extracted from the Table-11. Current assets to total assets have higher magnitude of 1.339 than the EBIT to TL 1.091 which shows that CA to TA discriminates more and ranked accordingly. EBIT to total liabilities ranked number two in the Table-11 and the constant values is (1.731).

Finally the Model of this study from the Table -11 formed as,

$Z^{**} = -1.731 + 1.339\ X_1 + 1.091\ X_2$

Where;

Z= Standard Score

X_1= Current assets to Total Assets

X_2= EBIT to Total Liabilities

In Table-12 the Group Centroids value for classification of groups for both models are given, where Discriminant score or cut-off points for both groups will be the mean of given values for each model which becomes zero. So if a firm falls below zero, it will be classified as bankrupt and if a firm scores above zero will be classified as non-bankrupt in both the models. The results are provide illustrated in Table-13 for the developed model. Z-Score of each individual firm for classification purpose is given in the last column of the table. Groups are coded as 1 for bankrupt and 2 for non-bankrupt group classification, while the predicted group classification column is showing some values marked with stars are misleading results. For all 38 companies there are eleven misleading cases, which shows that newly developed model by employing Multiple Discriminant Analysis have 71.1% accuracy of predicting bankruptcy, when it is employed on the sample population of Pakistani Firms. Further the classification results for same model in both groups are mentioned in Table-14. For original and predicted count of bankrupt group, it can be observed that there are 14 cases those are predicted accurately out of 19 cases and remaining five cases are misleading. Simultaneously for non-bankrupt group there are six cases misleading and remaining are accurately measured by the new model. Whereas the percentage classification of the same model for group 1 is 73.7% for accurately prediction with 26.3% of misclassified results out of 100% cases and for non-bankrupt group there are 31.6% misleading and 68.4% accurate classification out of 100% which is the total number of non-bankrupt firms. Altman's revised re-estimated model when employed on Pakistani firms acquired results which are demonstrated in Table-15. Discriminant Score of firms are mentioned in the last column of the table. In this table it is observable that there are only eight cases having marked with stars as their exponent power means these cases are misleading results of the model. Altman's revised re-estimated model achieved 78.9% accuracy of bankruptcy prediction in Pakistan. Classification results for the model are reported in Table-16. There are total eight misleading results out of 38 firms' population. There are four misclassified results in each group which shows 78.9 % of accurately prediction with 21.1% of misleading results for bankrupt group and 21.1% misleading results with 78.9% of perfect prediction for Group 2.

4.8 Fitness Test of Bankruptcy Prediction Models

Overall fitness of both Models was individually measured as test of function for each model which is illustrated in Table-17 where Wilks' Lambda for newly developed is 0.715, significant at 99.7% level of confidence and Wilks' Lambda for Altman's revised model is .672 significant at 97.9% level of confidence. Both models proved high potency for practical application and can be used as alternate for each other for bankruptcy prediction in Pakistan.

5. Conclusion and Recommendations

At the first stage of the study Altman's revised re-estimated model is tested for the data set of Pakistani firms for the period of 2001 to July 2015 and simultaneously at the second stage a new model is developed to predict bankruptcy in corporate sector of Pakistan and this model identifies areas where non-financial bankrupt group of companies differentiate from Non-Bankrupt group. In Pakistan. There are number of firms were leaved without

assessment due to non availability of complete financial data. It is of great concern for the regularity authorities of Pakistan such as Securities Exchange Commission of Pakistan, Karachi Stock Exchange and State Bank of Pakistan to maintain old and new financial data to analyze financial health of the firms. Both models can practically be used as an alternate of each other by regulatory authorities, creditors, investors and firms themselves. This paper examined four years financial data as taken average. This research can be extended in different ways such as researchers can conduct research for predicting bankruptcy on annual basis whereas this study investigated the sample data as taken average for four years. Study can be conducted by enhancing the number of financial ratios whereas this study examined sixteen financial variables. .

REFERENCES

A. Adam Ding, Shaonan Tian, Yan Yu and Hui Guo. (2012) A class of discrete transformation survival models with application to default probability prediction, *Journal of the American Statistical Association*, Vol. 107, No. 499, pp. 990-1003.

Abdul Rashid and Qaiser Abbas. (2011) Predicting bankruptcy in Pakistan. *Theoretical and Applied Economics*, Vol. 18, No. 9, pp. 103-128.

Abuzar M. A. Eljelly and Ilham Hassan F. Mansour. (2001) Predicting Private Companies Failure in the Sudan, *Journal of African Business*, Vol.2, No.2, pp. 23-43.

Adrian Gepp and Kuldeep Kumar. (2012) Business failure prediction using statistical techniques: A review, *Business papers.* Paper No. 675. pp.1-25.

Ani Wilson Uchenna and Ugwunta David Okelue. (2012) Predicting Corporate Business Failure in the Nigerian Manufacturing Industry, *European Journal of Business and Management,* Vol. 4, No.10, pp.86-93.

Ben Chin Fook Yap, Dr. Shanmugam Munuswamy and Dr. Zulkifflee Bin Mohamed. (2012) Evaluating company failure in Malaysia using financial ratios and logistic regression. *Asian Journal of Finance & Accounting,* Vol. 4, No. 1, pp. 330-344.

Ben Chin-Fook Yap, David Gun-Fie Yong and Wai-Ching Poon. (2010) How Well Do Financial Ratios and Multiple Discriminant Analysis Predict Company Failures in Malaysia, *International Research Journal of Finance and Economics ,* Vol. 1, No. 54 pp.166-175.

Ben Jabeur Sami. (2013) Corporate failure: a non-parametric method. *International Journal of Finance & Banking Studies,* Vol.2, No.3, pp. 103-110.

Brindescu-Olariu Daniel and Golet Ionut. (2013) Prediction of corporate bankruptcy in Romania through the use of logistic regression, *The Journal of the Faculty of Economics - Economic,* Vol. 1, No. 1, pp. 976-986.

Ciotina Daniela, Ciotina Ioan Marius. (2013) Symptoms of bankruptcy and prediction models of bankruptcy risk, *Annals Economics Science Series*, Vol. 19, No.1, pp. 114-121.

Dr. Amalendu Bhunia and Mrs. Ruchira Sarkar (Bagchi). (2011) A Study of Financial Distress based on MDA, *Journal of Management Research*, Vol. 3, No. 2, pp.1-11.

DR. Roli Pradhan. (2013) Application of BPNN for bankruptcy prediction. *International Journal of Technological Exploration and Learning (IJTEL),* Vol. 2, No. 2, pp. 89-92.

Edwar I. Altman, (1993), Corporate Financial Distress and Bankruptcy (John Wiley and Sons, New York.

Edwar I. Altman. (1968) Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, *The Journal of Finance*, Vol. 23, No.4, pp. 589-609.

Frank K. Reilly and Keith C. Brown. (2005) *Investment Analysis and Portfolio Management,* 8th ed., CFA Institute, USA, 1171 pp.

Malik Rizwan Khurshid. (2013) Determinants of Financial Distress Evidence from KSE 100 Index, *Business Review*, Vol.8, No.1, pp.7-19.

Prasanna Chandra. (2013) *Financial Management; Theory and Practice,* 8th Edition, Tata McGraw Hill education (Pvt) ltd., 1062 pp.

S. Vasantha, V. Dhanraj and Thiayalnayaki. (2013) Prediction of Business Bankruptcy for Selected Indian Airline Companies Using Altman's Model, *IMPACT: International Journal of Research in Business Management (IMPACT: IJRBM)*, Vol. 1, No 4, pp. 19-26

Thian Cheng Lim, Lim Xiu Yun, Jessica, Siwei Gan and Haozhe Jiang. (2012) Bankruptcy prediction: theoretical framework proposal. *International Journal of Management Sciences and Business Research,* Vol. 1, No. 9, pp.69-74.

Vineet Chouhan, Bibhas Chandra and Shubham Goswami. (2014) Predicting financial stability of select BSE companies revisiting Altman Z score, *International Letters of Social and Humanistic Sciences,* Vol. 15, No. 2. pp. 92-105

Wurim Ben Pam. (2013) Discriminant Analysis and the Prediction of Corporate Bankruptcy in the Banking Sector of Nigeria, *International Journal of Finance and Accounting*, Vol. 2 No.6, pp. 319-325.

Xu Xiaosi, Chenying and Zheng Haitao. (2011) The comparison of enterprise bankruptcy forecasting method. *Journal of Applied Statistics*, Vol. 38, No. 2, pp. 301-308.

Table 1. Information of Non-Financial Delisted Firms (2001- July 2015)[1].

Year of Delisting	Total no. of companies delisted.	Delisted by court order/violation of listing regulation number. 32 (1) & (2).	Banking/ non-banking financial companies.	Total no. of (non-financial) delisted companies.
2001	12	07	00	07
2002	24	15	02	13
2003	08	00	00	00
2004	18	03	00	03
2005	14	00	00	00
2006	05	02	01	01
2007	06	00	00	00
2008	07	02	01	01
2009	02	01	01	00
2010	09	05	00	05
2011	07	05	01	04
2012	68	63	16	47
2013	15	04	01	03
2014	08	03	02	01
July 2015	02	01	01	00
Grand Total	205	111	26	85

[1] Source: KSE official website.

Table 2. Non-Financial Bankrupt (Delisted) and Non-Bankrupt Firms[1]

Bankrupt Group[2]	**Year[3]**	**Total Assets[4]**	**Non-Bankrupt Group**	**Total Assets**
Lafayette Industries Synthetics.	2005	221	Ravi Textile Mills Ltd.	216
Kashmir Edible Oils Ltd.	2005	432	S.S. Oil Mills Ltd.	502.3
Baig Spinning Mills Ltd.	2008	166.4	Regent Textile Industries Ltd.	263
Callmate Telips Telecom Ltd.	2008	3465	TRG Pakistan Ltd.	3638
Siftaq International Ltd.	2003	76	Data Textiles Ltd.	104.3
Polyron Ltd.	2007	410.5	Bannu Woollen Mills Ltd.	619.1
Indus Polyester Company Ltd.	2008	256	Tri-Star Polyester Ltd.	469.3
Pak Fibre Industries Ltd.	2003	164.6	The National Silk & Rayon Mills.	157.4
Saitex Spinning Mills Ltd.	2004	178.5	Salman Noman Enterprises Ltd.	188.1
Qayyum Spinning Ltd.	2004	34.4	Chaudhry Textile Mills Ltd.	36.2
Modern Textile Mills Ltd.	2003	31	Safa Textiles Ltd.	38
Crescent Spinning Mills Ltd.	2003	551.1	Al-Qadir Textile Mills Ltd.	562.4
Adil Polypropylene Ltd.	2003	160.2	Moonlite (Pak) Ltd.	285
Fawad Textile Mills Ltd.	2009	1360.6	Ali Asghar Textile Mills Ltd.	1235
Zahur Textile Mills Ltd.	2005	1044	Ahmed Hassan Textile Mills Ltd.	1064
Amin Spinning Mills Ltd.	2009	130.4	Haji Mohammad Ismail Mills Ltd.	288.8
Harum Textile Mills Ltd.	2007	942.7	Reliance Cotton Spinning Mills Ltd.	1056.3
Indus Fruit Products Ltd.	2009	182	Quice Food Industries Ltd.	73.7
Shahpur Textile Mills Ltd.	2010	476.5	Saritow Spinning Mills Ltd.	570.3

Table 3. Sector-Wise Distribution of Companies

S.No.	**Sectors [5]**	**Number of Companies [6]**
01	Textile Spinning	20
02	Technology and Communication	02
03	Vanaspati and Allied Industries	02
04	Other Textiles	08
05	Textiles Composite	04
06	Food and personal care products	02
TOTAL		38

[1] Included firms are categorized sector wise as 20 from Textile Spinning, two from Vanaspati & Allied Industries, two from Technology and Communication, eight from Other Textiles, four from Textile Composite and two from Food & Personal Care Products sector. Table-3 is representing sector wise break-up of selected number of companies.

[2] Bankrupt group included companies, delisted by KSE under court order by Violation of Listing Regulation no: 32 (1) & (2), business is winding up by rules of Securities and Exchange Commission of Pakistan.

[3] The year of bankruptcy is taken on the basis of four years financial data available for respective company, prior to the year mentioned.

[4] Total Assets amount in Million Rupees.

[5] Sectors name were categorized on the basis of sector-wise distribution of companies available on official website of KSE and sector-wise distribution of companies recorded as on the BSA_5 of joint stock companies published by SBP.

[6]) Number of companies included both (Bankrupt and Non-Bankrupt) companies equal in number.

Table 4. Financial Ratios that are used as Explanatory Variables

Financial Ratios		Formulae
X_1	PROFITABILITY RATIOS	EBIT/ Total Assets
X_2		Retained Earnings/ Total Assets
X_3		EBIT/ Sales
X_4		Net Income/ Net Sales
X_5		Net Income/ Total Assets
X_6		Cash Flow/ Total Assets
X_7	LIQUIDITY RATIOS	Working Capital/ Total Assets
X_8		Current Assets/ Total Assets
X_9		Cash/ Total Assets
X_{10}	ACTIVITY RATIOS	Sales/ Total Assets
X_{11}		Equity/ Sales
X_{12}		Cash/ Sales
X_{13}		Working Capital/ Sales
X_{14}	SOLVENCY RATIOS	Current Liabilities/ Total Assets
X_{15}		EBIT/ Total Liabilities
X_{16}		Net Worth (B.V)/ Total Liabilities

Table 5. Means and Standard Deviations (Bankrupt Group)

GROUP 1		BANKRUPT				Average
PROFITABILITY RATIOS		Years Before Bankruptcy				
		Year 1	Year 2	Year 3	Year 4	
EBIT / TA	Means	(0.06)	(0.05)	0.07	(0.07)	(0.05)
	Standard Deviation	0.20	0.12	0.41	0.14	0.53
RE / TA	Means	(0.09)	(0.08)	0.03	(0.10)	(0.16)
	Standard Deviation	0.18	0.12	0.41	0.13	0.51
EBIT / SALES	Means	(3.23)	(2.22)	(1.68)	(0.36)	(7.22)
	Standard Deviation	10.05	7.46	7.32	0.62	22.80
N I / NET SALES	Means	(3.33)	(2.27)	(1.73)	(0.40)	(7.43)
	Standard Deviation	9.99	7.44	7.31	0.61	22.72
N I / TA	Means	(0.09)	(0.08)	0.03	(0.10)	(0.16)
	Standard Deviation	0.18	0.13	0.41	0.13	0.51
CF / TA	Means	0.02	0.02	0.09	(0.05)	0.11
	Standard Deviation	0.29	0.26	0.42	0.12	0.68
LIQUIDITY RATIOS		Years Before Bankruptcy				Average
		Year 1	Year 2	Year 3	Year 4	
WC / TA	Means	(0.82)	(0.71)	(0.37)	(0.54)	(2.04)
	Standard Deviation	1.09	0.96	0.39	0.89	2.37
CA / TA	Means	0.24	0.26	0.29	0.30	0.87
	Standard Deviation	0.18	0.15	0.18	0.17	0.49
CASH / TA	Means	0.01	0.01	0.03	0.03	0.05
	Standard Deviation	0.01	0.01	0.06	0.06	0.08
ACTIVITY RATIOS		Years Before Bankruptcy				Average
		Year 1	Year 2	Year 3	Year 4	
SALES / TA	Means	0.63	0.75	0.76	0.77	2.33
	Standard Deviation	0.67	0.64	0.52	0.57	1.82
EQ / SALES	Means	10.89	0.10	(3.35)	(1.26)	7.33
	Standard Deviation	98.49	25.74	17.77	6.71	117.25
CASH/ SALES	Means	0.06	0.03	0.04	0.03	0.13

	Standard Deviation	0.10	0.06	0.06	0.07	0.17
WC / SALES	Means	(21.06)	(10.58)	(8.97)	(3.05)	(41.37)
	Standard Deviation	46.25	35.82	35.91	9.08	110.33
SOLVENCY RATIOS		Years Before Bankruptcy				Average
		Year 1	Year 2	Year 3	Year 4	
CL / TA	Means	1.07	0.98	0.66	0.84	2.91
	Standard Deviation	1.03	0.89	0.36	0.81	2.16
EBIT/ TL	Means	(0.04)	(0.03)	0.04	(0.07)	(0.04)
	Standard Deviation	0.16	0.14	0.32	0.18	0.47
N W (B.V)/ TL	Means	0.40	0.40	0.18	0.61	1.13
	Standard Deviation	0.97	0.92	1.97	0.94	3.70

Table 6. Means and Standard Deviations (Non-Bankrupt Group)

GROUP 2		NON BANKRUPT				
PROFITABILITY RATIOS		Years Taken as of Group 1				Average
		Year 1	Year 2	Year 3	Year 4	
EBIT / TA	Means	0.05	0.05	0.22	0.21	0.37
	Standard Deviation	0.12	0.07	0.68	0.70	0.89
RE / TA	Means	0.01	0.03	0.02	0.21	0.11
	Standard Deviation	0.18	0.18	1.17	0.71	1.42
EBIT / SALES	Means	0.03	(0.27)	0.18	(0.02)	(0.07)
	Standard Deviation	0.10	1.44	1.77	1.90	3.33
NI / NET SALES	Means	(0.02)	(0.57)	(0.11)	(0.06)	(0.72)
	Standard Deviation	0.11	1.73	2.13	1.93	3.68
NI / TA	Means	0.00	(0.00)	(0.02)	0.19	0.03
	Standard Deviation	0.13	0.08	1.16	0.70	1.32
CF / TA	Means	0.04	0.03	0.02	0.22	0.15
	Standard Deviation	0.13	0.08	1.16	0.71	1.34
LIQUIDITY RATIOS		Years Taken as of Group 1				Average
		Year 1	Year 2	Year 3	Year 4	
WC / TA	Means	(0.18)	(0.19)	(0.11)	(0.25)	(0.55)
	Standard Deviation	0.51	0.53	0.47	0.63	1.61
CA / TA	Means	0.42	0.44	0.40	0.40	1.36
	Standard Deviation	0.15	0.19	0.21	0.22	0.58
CASH / TA	Means	0.02	0.01	0.02	0.01	0.06
	Standard Deviation	0.05	0.02	0.03	0.02	0.08
ACTIVITY RATIOS		Years Taken as of Group 1				Average
		Year 1	Year 2	Year 3	Year 4	
SALES / TA	Means	1.38	1.12	1.31	1.16	4.10
	Standard Deviation	0.87	0.78	0.91	1.17	2.53
EQ / SALES	Means	0.88	12.30	0.53	2.43	14.31
	Standard Deviation	2.42	37.98	0.87	8.07	41.48
CASH/ SALES	Means	0.01	0.14	0.02	0.04	0.18
	Standard Deviation	0.02	0.41	0.03	0.11	0.46
WC / SALES	Means	(0.15)	3.86	(0.65)	0.97	3.30
	Standard Deviation	0.40	17.01	2.44	8.64	19.57
SOLVENCY RATIOS		Years Taken as of Group 1				Average
		Year 1	Year 2	Year 3	Year 4	
CL / TA	Means	0.60	0.63	0.52	0.64	1.91
	Standard Deviation	0.48	0.48	0.43	0.56	1.48

EBIT/ TL	Means	0.15	0.07	0.21	0.17	0.48
	Standard Deviation	0.36	0.09	0.48	0.50	0.71
N W (B.V)/ TL	Means	1.09	0.87	1.17	0.74	3.31
	Standard Deviation	1.23	0.86	1.11	0.64	2.76

Table 7. T-Test Results (bankrupt and non-bankrupt group)

PROFITABILITY RATIOS		Years Before Bankruptcy			
		Year 1	Year 2	Year 3	Year 4
EBIT / TA	Means	(0.03)	(0.02)	0.18	0.03
	Significance	0.05**	0.01***	0.43	0.10*
RE / TA	Means	(0.08)	(0.07)	0.04	0.00
	Significance	0.10*	0.04**	0.95	0.07*
EBIT/ SALES	Means	(3.22)	(2.36)	(1.59)	(0.37)
	Significance	0.17	0.28	0.30	0.46
NI / NET SALES	Means	(3.34)	(2.55)	(1.78)	(0.43)
	Significance	0.17	0.34	0.37	0.48
NI / TA	Means	(0.08)	(0.08)	0.03	(0.01)
	Significance	0.10*	0.04**	0.86	0.10*
CF / TA	Means	0.04	0.04	0.09	0.06
	Significance	0.75	0.81	0.81	0.12
LIQUIDITY RATIOS		Years Before Bankruptcy			
		Year 1	Year 2	Year 3	Year 4
WC / TA	Means	(0.91)	(0.81)	(0.43)	(0.66)
	Significance	0.03**	0.05**	0.08*	0.25
C A / TA	Means	0.45	0.48	0.49	0.50
	Significance	0.00***	0.00***	0.09*	0.13
Cash / TA	Means	0.02	0.01	0.04	0.03
	Significance	0.25	0.12	0.82	0.30

ACTIVITY RATIOS		Years Before Bankruptcy			
		Year 1	Year 2	Year 3	Year 4
SALES / TA	Means	1.32	1.31	1.42	1.35
	Significance	0.01***	0.13	0.03**	0.19
EQ / SALES	Means	11.33	6.25	(3.08)	(0.05)
	Significance	0.66	0.26	0.36	0.14
CASH/ SALES	Means	0.06	0.10	0.05	0.05
	Significance	0.08*	0.29	0.24	0.85
WC / SALES	Means	(21.13)	(8.65)	(9.30)	(2.57)
	Significance	0.06*	0.13	0.33	0.17
SOLVENCY RATIOS		Years Before Bankruptcy			
		Year 1	Year 2	Year 3	Year 4
CL / TA	Means	1.37	1.29	0.92	1.16
	Significance	0.09*	0.15	0.28	0.40
EBIT / TL	Means	0.04	0.01	0.14	0.02
	Significance	0.04**	0.01***	0.21	0.06*
NW (B.V) / TL	Means	0.95	0.83	0.77	0.98
	Significance	0.06*	0.11	0.07*	0.63

Notes: *** level of significance at 1%
**level of significance at 5%
*level of significance at 10%

Table 8. F-Test Results (bankrupt and non-bankrupt group)

PROFITABILITY RATIOS		Years Before Bankruptcy			
		Year 1	Year 2	Year 3	Year 4
EBIT / TA	P-Value	0.05**	0.01***	0.43	0.09*
RE / TA	P-Value	0.10*	0.03**	0.95	0.06*
EBIT/ SALES	P-Value	0.17	0.27	0.29	0.46
NI / NET SALES	P-Value	0.16	0.34	0.36	0.48
NI / TA	P-Value	0.10*	0.04**	0.86	0.09*
CF / TA	P-Value	0.75	0.80	0.81	0.12
LIQUIDITY RATIOS		Years Before Bankruptcy			
		Year 1	Year 2	Year 3	Year 4
WC / TA	P-Value	0.03**	0.04**	0.08*	0.25
CA / TA	P-Value	0.00***	0.00***	0.13	0.08*
CASH / TA	P-Value	0.25	0.12	0.82	0.30
ACTIVITY RATIOS		Years Before Bankruptcy			
		Year 1	Year 2	Year 3	Year 4
SALES / TA	P-Value	0.01*	0.12	0.03**	0.19
EQ / SALES	P-Value	0.66	0.25	0.35	0.13
CASH / SALES	P-Value	0.08*	0.28	0.24	0.85
WC / SALES	P-Value	0.06*	0.12	0.32	0.17
SOLVENCY RATIOS		Years Before Bankruptcy			
		Year 1	Year 2	Year 3	Year 4
CL / TA	P-Value	0.08*	0.15	0.28	0.40
EBIT / TL	P-Value	0.04**	0.01***	0.21	0.06*
NW (B.V) / TL	P-Value	0.06*	0.11	0.06*	0.63

Notes: *** level of significance at 1%
**level of significance at 5%
*level of significance at 10%

Table 9. Canonical Discriminant Function Coefficients Re-estimated for Altman's (1993) revised model

Altman (1993) Revised model Variables	Coefficients
WC_TA	.094
RE_TA	-.452
EBIT_TA	1.041
BVEQ_TL	.166
SALES_TA	.306
(Constant)	-1.405

Unstandardized coefficients

Table 10. Variables Entered / Removed (a)(,)(b)(,)(c)(,)(d)

Step	Entered	Wilks' Lambda	df1	df2	df3	F-Statistic	df1	df2	Sig.
1	Current Assets to Total Assets	0.815	1	1	36	8.173	1	36	0.007
2	EBIT to Total Liabilities	0.715	2	1	36	6.992	2	35	0.003

At each step, the variable that minimizes the overall Wilks' Lambda is entered.

a. Maximum number of steps is 32.

b. Maximum significance of F to enter is .05.

c. Minimum significance of F to remove is .10.

d. F level, tolerance, or VIN insufficient for further computation.

Table 11. Canonical Discriminant Function Coefficients for newly developed model

Ratios and Constant	Coefficients
CA to TA	1.339
EBIT to TL	1.091
(Constant)	-1.731

Table 12. Functions at Group Centroids for Both models

GROUP	Discriminant Score for Developed Model	Discriminant Score for Altman's (1993) Revised Re-Estimated Model
BANKRUPT	-0.615	-.680
NON-BANKRUPT	0.615	.680

Table 13. Group Classification Results of Newly Developed Model (Bankrupt and Non-Bankrupt Group)

S.No.	Corporation	Actual Group	Predicted Group	Probability of group 1	Probability of group 2	Z-Score
1	Lafayette Ind. Synthetics ltd	1	1	0.672	0.328	-0.583
2	Kashmir edible oils ltd	1	2**	0.723	0.277	0.779
3	Baig spinning mills ltd.	1	1	0.68	0.32	-0.612
4	Callmate telips telecom ltd	1	2**	0.891	0.109	1.708
5	Siftaq international ltd	1	1	0.651	0.349	-0.507
6	Polyron ltd.	1	1	0.669	0.331	-0.57
7	Indus polyester co Ltd	1	1	0.955	0.045	-2.484
8	Pak fibre industries ltd	1	1	0.783	0.217	-1.042
9	Saitex spinning mills ltd	1	1	0.803	0.197	-1.141
10	Qayyum spinning ltd	1	1	0.913	0.087	-1.912
11	Modern textile mills ltd	1	1	0.602	0.398	-0.337
12	Crescent spinning mills ltd	1	1	0.874	0.126	-1.571
13	Adil polypropylene ltd	1	1	0.728	0.272	-0.798
14	Fawad textile mills	1	2**	0.619	0.381	0.396

15	Zahur textile mills ltd	1	1	0.791	0.209	-1.081
16	Amin spinning mills ltd	1	2**	0.562	0.438	0.203
17	Harum textile mills ltd	1	2**	0.513	0.487	0.043
18	Indus fruit products ltd	1	1	0.832	0.168	-1.298
19	Shahpur textile mills ltd	1	1	0.747	0.253	-0.88
20	Ravi textile mills ltd	2	2	0.439	0.561	0.2
21	S.s. oil mills ltd	2	2	0.082	0.918	1.958
22	Regent textile Ind. ltd	2	1**	0.44	0.56	-0.197
23	Trg pakistan ltd	2	2	0.067	0.933	2.135
24	Data textiles ltd	2	2	0.456	0.544	0.143
25	Bannu woollen mills ltd	2	2	0.347	0.653	0.515
26	Tri-star polyester ltd	2	1**	0.296	0.704	-0.705
27	The national silk & rayon mills ltd	2	1**	0.423	0.577	-0.253
28	Salman noman enterprises ltd	2	2	0.31	0.69	0.651
29	Chaudhry textile mills ltd	2	1**	0.394	0.606	-0.349
30	Safa textiles ltd	2	2	0.26	0.74	0.851
31	Al-qadir textile mills ltd	2	1**	0.447	0.553	-0.174
32	Moonlite (pak) ltd	2	2	0.089	0.911	1.895
33	Ali asghar textile mills ltd	2	1**	0.428	0.572	-0.235
34	Ahmed hassan textile mills ltd	2	2	0.459	0.541	0.134
35	Haji Mohammad Ismail mills ltd	2	2	0.49	0.51	0.033
36	Reliance cotton spinning mills ltd	2	2	0.199	0.801	1.134
37	Quice food industries ltd	2	2	0.019	0.981	3.184
38	Saritow spinning mills ltd	2	2	0.279	0.721	0.772

Table 14. Group Classification Results of Developed Model

CLASSIFICATION		PREDICTED GROUP MEMBERSHIP		TOTAL
		Bankrupt	Non-Bankrupt	
Original Group	Bankrupt	14	**5**	19
	Non-Bankrupt	**6**	13	19
Percentage	Bankrupt	73.7	26.3	100
	Non-Bankrupt	31.6	68.4	100

Table 15. Group Classification Results of Altman's (1993) Revised Re-estimated Model (Bankrupt and Non-Bankrupt Group)

S.No.	Corporation	Actual Group	Predicted Group	Probability of group 1	Probability of group 2	Z-Score
1	Lafayette Ind. Synthetics ltd	1	1	0.763817	0.236183	2.380919
2	Kashmir edible oils ltd	1	2**	0.861564	0.138436	4.097949
3	Baig spinning mills ltd.	1	1	0.56229	0.43771	0.746811
4	Callmate telips telecom ltd	1	2**	0.706119	0.293881	1.754482
5	Siftaq international ltd	1	1	0.753306	0.246694	2.252459
6	Polyron ltd.	1	1	0.819999	0.180001	3.221807
7	Indus polyester co Ltd	1	2**	0.637913	0.362087	1.202137
8	Pak fibre industries ltd	1	1	0.968952	0.031048	10.30314
9	Saitex spinning mills ltd	1	1	0.766461	0.233539	2.414423
10	Qayyum spinning ltd	1	1	0.994183	0.005817	19.89287
11	Modern textile mills ltd	1	1	0.830547	0.169453	3.417827

12	Crescent spinning mills ltd	1	1	0.689465	0.310535	1.603994
13	Adil polypropylene ltd	1	1	0.725448	0.274552	1.944475
14	Fawad textile mills	1	1	0.592812	0.407188	0.91431
15	Zahur textile mills ltd	1	1	0.81075	0.18925	3.061654
16	Amin spinning mills ltd	1	2**	0.852979	0.147021	3.891712
17	Harum textile mills ltd	1	1	0.613407	0.386593	1.039313
18	Indus fruit products ltd	1	1	0.906383	0.093617	5.519025
19	Shahpur textile mills ltd	1	1	0.701347	0.298653	1.71018
20	Ravi textile mills ltd	2	2	0.18114	0.81886	3.201519
21	S.s. oil mills ltd	2	2	0.230893	0.769107	2.448447
22	Regent textile Ind. ltd	2	1**	0.445007	0.554993	0.709674
23	Trg pakistan ltd	2	2	0.150541	0.849459	3.811494
24	Data textiles ltd	2	2	0.217463	0.782537	2.629404
25	Bannu woollen mills ltd	2	2	0.229893	0.770107	2.461442
26	Tri-star polyester ltd	2	1**	0.247316	0.752684	2.245081
27	The national silk & rayon mills ltd	2	2	0.44398	0.55602	0.714838
28	Salman noman enterprises ltd	2	2	0.064865	0.935135	6.980107
29	Chaudhry textile mills ltd	2	2	0.236246	0.763754	2.380131
30	Safa textiles ltd	2	2	0.136224	0.863776	4.15373
31	Al-qadir textile mills ltd	2	2	0.220356	0.779644	2.589214
32	Moonlite (pak) ltd	2	1**	0.395382	0.604618	0.984712
33	Ali asghar textile mills ltd	2	1**	0.394667	0.605333	0.989084
34	Ahmed hassan textile mills ltd	2	2	0.193296	0.806704	2.994721
35	Haji Mohammad Ismail mills ltd	2	2	0.487598	0.512402	0.513386
36	Reliance cotton spinning mills ltd	2	2	0.40263	0.59737	0.941102
37	Quice food industries ltd	2	2	0.15694	0.84306	3.671565
38	Saritow spinning mills ltd	2	2	0.109506	0.890494	4.932801

Table 16. Group Classification Results of Altman's (1993) revised re-estimated Model

CLASSIFICATION		PREDICTED GROUP MEMBERSHIP		TOTAL
		Bankrupt	Non-Bankrupt	
Original Group	Bankrupt	15	**4**	19
	Non-Bankrupt	**4**	15	19
Percentage	Bankrupt	78.9	21.1	100
	Non-Bankrupt	21.1	78.9	100

Table 17. Wilks' Lambda for both Models

TEST OF FUNCTION(S)	Wilks' Lambda	Chi-square	df	Sig.
Newly Developed Model	0.715	11.765	2	0.003
Altman's(1993) Revised Re-estimated Model	.672	13.317	5	.021