Modeling Bankruptcy Prediction for Non-Financial Firms: The Case of Pakistan

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Abstract

This paper aims to identify the financial ratios that are most significant in bankruptcy prediction for the non-financial sector of Pakistan based on a sample of companies which became bankrupt over the 1996-2006 period. Twenty four financial ratios covering four important financial attributes namely profitability, liquidity, leverage, and turnover ratios) were examined for a five-year period prior bankruptcy. The discriminant analysis produced a parsimonious model of three variables viz. sales to total assets, EBIT to current liabilities, and cash flow ratio. Our estimates provide evidence that the firms having Z value below zero fall into the "bankrupt" whereas the firms with Z value above zero fall into the "non-bankrupt" category. The model achieved 76.9% prediction accuracy when it is applied to forecast bankruptcies on the underlying sample.

1- Introduction

Bankruptcy is defined as the inability of a company to continue its current operations due to having high debt obligations (Pongsatat et al., 2004). Typically bankruptcy occurs " *when either the firm's operating cash flow is insufficient to meet current obligations — that is, the inability to service its debts — or when the firm's net worth is negative—that is, the value of the assets is less than the value of its liabilities*" (Knox et al., 2008).

The definition of bankruptcy varies from country to country. For example, in the United States, there are two legal chapters through which a firm is considered as bankrupt i.e., liquidation under Chapter 7 and reorganization under Chapter 11(Altman, 1968). Similarly, in Japan, there are three basic laws that files large companies as bankrupt: the Civil Rehabilitation Law, the Corporate Reorganization Law and the Liquidation Law (Xu and Zhang, 2008). Due to the lacking of generalized definition, several studies such as Beaver, 1966 and Tavlin et al, 1989 have defined bankruptcy according to the rationale and scope of their study. Thus, this study keeping in view a concept described in various studies considers a firm bankrupt in Pakistan for which any of the following actions have occurred.

1. Company delisted by Karachi Stock Exchange (KSE) due to liquidation / winding up under court order i.e. violation of listing regulation no. 32 (1) (d).
2. Winding up of company by Securities and Exchange Commission of Pakistan (SECP).

Pakistan is a developing country with emerging different industries. Since the last two decades, a large number of bankruptcy incidences have been occurred in Pakistan. Hence, this study recognized a need to develop a bankruptcy prediction model unique to the corporate environment of Pakistan in order to protect additional failure of the companies. Moreover, there has been no investigation of bankruptcy conducted in Pakistan so far, and none of the world wide studies have focused specifically on Pakistan. So, this study is considered as an initial step to fill up the gap in the bankruptcy prediction area from Pakistan. The findings would provide help to corporate sector of Pakistan in timely monitoring and enhancing the financial position of the companies.

The main objectives of the study are as follows:

1. To identify the financial variables that distinguishes 'healthy' from 'financially troubled' companies.
2. To develop a model that could have the predictive ability of financial health and discrimination between bankrupt and non-bankrupt.

Bankruptcy prediction models are of great significance to regulators, practitioners, and academics alike. This is because of that regulators apply frequently forecasting models to examine the financial wellbeing of the firms. Practitioners utilize the bankruptcy prediction model to charge company debt. Academics make use of bankruptcy forecasts to experiment different hypothesis.

2- Literature Review

Since 1960s, researchers have been devoted much effort to examine the bankruptcy prediction for different countries of the world. For example, Canada (Altman and Lavelle, 1981), Australia (Izan, 1984), UK (Charitou et al., 2004), France (Micha, 1984), Korea (Altman et al., 1995), Japan (Xu and Zhang, 2008), Malaysia (Bidin, 1988), Sudan (Eljelly et al., 2001), India (Bandyopadhyay, 2006), Turkey (Ugurlu and Aksoy, 2006), and Iran (Etemadi et al., 2008), among many others.

Indeed, bankruptcy which is a worldwide problem can happen both in developed and developing economies. However, it occurs overly in developing economic environments. Some of the major causes behind corporate failures that vary across countries are the differences in capital structures, accounting standards and social, political, economic environment (Newton, 1985, Argenti, 1976, Her and Choe, 1999).

Amit (2003) analyze the data of 339 failed Canadian firms to identify the causes of failure among the younger and older firms. The author finds that lack of managerial understanding and financial management aptitude were the main reasons behind the failure of younger firms, whereas lack of ability to adapt environmental change was the main cause of failure among older Canadian firms. Similarly, Hall (1992) analyzes the factors of UK corporate failures and argues that inefficient marketing is explicitly the basic cause of business failure. According to Bongini et al. (1998) Asian firms leads to bankruptcy due to their high leverage and investments in property and plant.

Argenti (1976) comprehensive study on "corporate collapse" reveals several causes and symptoms of business failure. Among various causes recognized by the author includes- poor management, deficient accounting information, overtrading, high debentures, social-political-technological and economic change. Moreover, the author provide symptoms of business failure that comprise- employees low morale, decline in quality and service, tight credit policy, declining market share, growing volume of customer complaints, consistent failure to achieve targets, and over drafting.

Although the literature presents a number of causes of business failure, but the most critically examined factor to a firm collapse is inadequate experience. It has been examined that experienced entrepreneurs possess enough potential for the survival of the business and vice versa (Chandler and Hanks, 1998). Similarly, adequate access to financial and human resources plays an essential role in new venture performance. Indeed, inadequate financial resources frequently are cited as a major reason of emerging businesses failure (see, Cooper, 1994).

The Quantitative approach has been applied by a large number of studies utilizing various statistical techniques based on financial information obtained from published data of the companies. The key objective of these studies is to reveal the distinctive financial indicators among the bankrupt and survived companies.

Through the review of studies, we conclude that that the evolution of business failure research can be categorized into following three broad statistical techniques[1].

[1] See, for details, Etemadi et al.2008, Min and Jeong, 2008, Xu and Zhang, 2008

1. Accounting-Based Bankruptcy Prediction Models
2. Market –Based Bankruptcy Prediction Models
3. Artificial Intelligence-Based Bankruptcy Prediction Models

The above three techniques have been frequently applied by numerous studies for predicting bankruptcy. A review of these studies is presented in details as follows.

2.1- Accounting-Based Bankruptcy Prediction Models

Accounting-based bankruptcy prediction models take into consideration firm's past performance as a base for predicting the firm's future likelihood of survival (Xu and Zhang, 2008). Several studies that include accounting variables for predicting corporate bankruptcy are Beaver (1966); Altman (1968); Ohlson (1980); Dichev (1998), Shumway (2001), etc.

The most fundamental and crucial works in the bankruptcy prediction field is Beaver's empirical study (1966).The author analyzes thirty financial ratios among failed and survived firms. Employing univariate analysis, three financial ratios i.e., total debt / total assets, net income/total assets and cash flow/total debt were found significant in determining financial distress of a company. Altman (1968) study extended the work of Beaver by employing multivariate discriminant analysis on twenty two financial variables with a sample of 66 (33 bankrupt and 33 non-bankrupt) manufacturing companies. The discriminant analysis selected 5 variables suggesting a cutting point of z-score greater than 2.99 falls into "non-bankrupt" category while firms having a z-score below 1.81 are all bankrupt.

In 1980, study of Ohlson introduced logit models to predict bankruptcy. The author successfully developed O-score by using 9 accounting variables representing 4 factors (current liquidity, size of the company, performance and capital structure) with a sample of 2163 companies (105 bankrupt and 2058 non-bankrupt) over a 1970-1976 period. Ohlson suggests the O-score for discriminating between bankrupt and non-bankrupt firms. Thus, firm with O-score greater than 0.038 was classified to be bankrupt, ceteris paribus.

The Z-score and O-score developed by Altman (1968) and Ohlson (1980), respectively, prompted later researchers to find out the bankruptcy prediction model with the best predictive ability. Pongsatat et al. (2004) study examines the predictive capability of Ohlson's and Altman's model for bankruptcy of small and large firms in Thailand. The study concludes that for bankrupt firms Altman's model exhibits a higher predictive accuracy than Ohlson's model. Similarly, Bandyopadhyay (2006) using logistic and z-score approaches develop a model with high classification power of 91% to predict default for Indian firms. Furthermore, Ugurlu and Aksoy (2006) study following Altman's (1968) and Ohlson's (1980) statistical techniques developed a model for predicting the bankruptcy of Turkish firms. In addition, (Eljelly et al., 2001) developed a three-variable (cash flow/total debt, current asset/current liabilities, operating profit/total assets) model for predicting private company's failure in Sudan. Similarly Gu (2002) develop MDA model for estimating the failure of USA restaurant firms by declaring that firms with high total liabilities and low EBIT (earnings before interests and taxes) have less chances of survival and vice versa. Consequently, the main premise of accounting based bankruptcy studies is to extract those financial variables that discriminate between the healthy and failing companies for forecasting the business failure.

2.2- Market –Based Bankruptcy Prediction Models

Market-based bankruptcy prediction models use information derived from the market i.e., market prices. Since such information is inherently forward looking, market based approach depicts a firm's future performance considering market variables (Xu and Zhang, 2008). In the literature, this new methodology that uses market based variables for bankruptcy prediction follows Black and Sholes (1973) and Merton (1974) option pricing theory that express probability of bankruptcy occurring depends on the volatility between the market value of the assets and the strike price (value of debt obligations).The critical level where firm will default is that when the worth of firm's assets moves down below a certain level (i.e., debt obligations). However, these theories provide no incremental information when the market is semi-strong form efficient (see, for details, Hillegeist et al., 2004).Several recent studies that have used market based variables for predicting default probability of a firm include Crosbie and Bohn (2002), Brockman and Turtle (2003), Vassalou and Xing (2004), and Reisz and Perlich (2007).

Hillegeist et al. (2004) compares the market based approach (i.e., Black Sholes and Merton) with some accounting based approaches (i.e., MDA and logit) and conclude that the market-based approach provides significantly more information about the default probability of a firm comparatively accounting-based approach. Contrary to Hillegeist, a study of Reisz and Perlich (2007) examine default probability of 5784 industrial firms by employing both market and accounting based approaches. This study concludes that the accounting-based measure outperforms Black- Sholes-Merton measure and recommends to upcoming studies for achieving an optimal default prediction.

2.3- Artificial Intelligence-Based Bankruptcy Prediction Models

The technological advancement in informatics has evolved artificial intelligence techniques/methods that provided researchers to employ computer databases to estimate failure prediction models (Charitou et al., 2004). Artificial Intelligence (AI) methods include decision tree, fuzzy set theory, genetic algorithm, support vector machine, data envelopment analysis, case-based reasoning, rough sets theory, and various types of neural networks such as PNN (Probabilistic Neural Networks), BPNN (Back Propagation Trained Neural Network), SOM (Self-Organizing Map), Cascor (Cascade Correlation Neural Network) and many others (see, for more on this, Min and Jeong, 2008).

Artificial intelligence technique has been applied in various countries such as Iran, Greece etc. Etemadi et al. (2008) employ both genetic programming (GP) and MDA technique for forecasting the default probability in Iranian firms. The results of his study declare GP with a high accuracy of default prediction for Iranian firms. Moreover, Zanakis and Zopounidis (1997) employ a case study technique to distinguish between the financial variables of acquired and non-acquired Greek firms. The estimation results were found mixed because of using similar financial ratio profiles between acquired and non-acquired firms. Furthermore, researchers have used different artificial intelligence techniques and propose alternative bankruptcy prediction model. Jo and Han (1996) employ both the discriminant technique and two artificial intelligence models (i.e., case-based forecasting and neural network) and suggest integrated approach for attaining high classification accuracy in predicting default characteristics of firms. Min and Jeong (2008) suggest a new binary classification technique for forecasting default probability of firm by validating its prediction power through empirical analysis.

All the above three broadly categorized approaches proposed by different researches have essential merits and limitations. Therefore, lacking standardized bankruptcy theory has leaded studies to employ different techniques according to their unique structure of corporate environment and country (Etemadi et al., 2008).

3- Methodology and Data

As mentioned in previous chapter, the following four econometric/statistical techniques have been intensively used to estimate the bankruptcy prediction model: (i) Logit, (ii) Probit (iii) linear probability, and (iv) Multivariate discriminant analysis (MDA). However, Altman and Saunders (1998) study regards MDA as leading/dominant technique among all the four statistical methods. This study employs MDA as it has relatively high predictive ability in bankruptcy prediction.

3.1- Multiple/Multivariate Discriminant Analysis (MDA) Approach

MDA technique determines a set of discriminant coefficient and transforms individual variable values to a single discriminant score or Z-value which is then used to classify the object. In our study the two groups of object are bankrupt and non-bankrupt companies. The model that is developed through MDA take the form as follows.

$$Z = \beta_1 x_1 + \beta_2 x_2 + ... \beta_n x_n$$

where Z is the overall index, $\beta_1, \beta_2, \cdots, \beta_n$ are discriminant coefficients, $x_1, x_2 .... x_n$ are independent variables The discri minant Score (Z) is taken to estimate the bankruptcy character of the company. Lower the value of Z, greater is the firm's bankruptcy probability and vice versa.

Although MDA approach has been frequently used due to its high predictive ability, it has certain limitations. This approach does not have a feature to adjust proxies for non-financial events and users should be familiar with that the Z-score model does not capture all events that may cause bankruptcy (Grice and Ingram, 2001). In addition, the estimated model based on 3, 4, ... and 'n' years make it difficult to decide the bankruptcy variation/rate in particular year (Eisenbeis, 1977). Further, MDA approach assumes the matched/paired sample equally likely (Balcaen and Ooghe, 2004).

3.1- The Sample and Variable Definition

The population for this study is all the joint stock companies delisted by Karachi Stock Exchange (KSE) due to liquidation / winding up under court order i.e. violation of listing regulation no. 32 (1) (d) and/or wind up by Securities and Exchange Commission of Pakistan (SECP) during the period 1996-2006.

The criteria followed by this study for the selection of the sample are as under:

1. The shares of company have been traded at Karachi Stock Exchange (KSE) in the listing period.
2. The firm must belong to non-financial sector. It is because financial sector has different bankruptcy environment.
3. The company must have at least five years of financial information.

4. The bankrupt company must have a matched non-bankrupt company with same industry and closest total assets 1 year prior to bankruptcy.

The total number of companies meeting the aforementioned sample selection criteria was about 43. However, some firms were excluded due to having incomplete data. Further, the companies with complete 5 years of published data were only included in the sample. Thus, the total sample of both bankrupt and non-bankrupt companies used in this study is 52 that consist of 26 bankrupt and 26 non-bankrupt companies (see, Annexure 1).

The data has been extracted from various issues of "Balance Sheet Analysis of Joint Stock Companies Listed on Karachi Stock Exchange" published by the State Bank of Pakistan for both bankrupt and non-bankrupt companies with 5 years data during the period of 1996-2006.

The dependent variable (Z) is the discriminant score that forecast the bankruptcy probability of the company in year t. This variable takes the value '1' or '2' for any firm observation. In this study, value '1' has been assigned to bankrupt firms and value '2' for non-bankrupt firms while estimating the model.

Following the existing literature, we employ 24 financial ratios as independent variables. These 24 financial ratios have been classified into 4 broad categories (see, annexure 2). Leverage ratios measure the capability of a firm in paying its debt obligations. Argenti (1976) argues high debentures as one of the main cause that leads a company to bankruptcy. This study uses 9 ratios as a proxy for measuring leverage capability of a company (i.e., bankrupt and non-bankrupt). Liquidity ratios measure the performance of a firm in availability of cash to pay its debt obligations.

Beaver (1966) argues that the firms with lower liquid assets are more prone to bankruptcy and vice versa. This study uses 6 ratios as a proxy for measuring liquidity of a company. Profitability ratios measure the performance of firm in efficient and effective utilization of its assets and management of its expenditure to produce adequate earnings for its shareholders.

Gu (2002) argues that unprofitable firms having continuous losses are likely to lead bankruptcy. This study uses 5 profitability ratios as a proxy for measuring profitability of a company. Turn over ratios measure the effectiveness/efficiency of the firm in utilizing its resources. According to Eljelly et al. (2001) higher efficiency/effectiveness while utilizing resources may lead a company profitable and thus to lower bankruptcy risk. This study uses 4 ratios as a proxy for measuring the turnover/activity of a company.

The above arguments yield the following hypothesis (i.e., null: Ho and alternative: H_A) for testing.

Ho1: Larger the amount of debt held, greater the probability of bankruptcy.
Ho2: Higher the liquidity ratio, lower the probability of bankruptcy.
Ho3: Higher the profitability ratio, lower the probability of bankruptcy.
Ho4: Lower the activity ratio, higher the probability of bankruptcy.

4- Data Analysis and Findings

In this section, all the twenty four financial variables grouped under the leverage, liquidity, profitability and turnover ratios were examined separately for bankrupt and non-bankrupt companies by calculating their means and standard deviations for five years prior bankruptcy. In addition, T-tests and F tests were employed to get about the similarity and difference of financial variables each year prior to bankruptcy. Furthermore, MDA model was estimated (through SPSS soft ware version 15) by employing stepwise discriminant analysis to derive the discriminant variables with their coefficients and finally, the model developed through this study was tested on the sample to understand the accuracy and significance of the discriminant model.

4.1- Means and Standard Deviations of Bankrupt Companies

The means and standard deviations of the 24 financial ratios for the bankrupt firms are shown in Tables 4.1a-4.1d. It is evident that the bankrupt companies have higher indebtness, lower liquidity, poor profitability and turnover ratios that are in support of our predictions. In addition, most of ratios grouped under liquidity, profitability and turn over ratios have shown negative signs and declining trend with the movement of the company towards bankruptcy.

Insert Table 4.1a-4.1d about here

4.2- Means and Standard Deviations of Non-bankrupt Companies

The means and standard deviation of non-bankrupt companies with 24 financial variables five years prior bankruptcy were calculated separately in order to determine the financial variables behavior of the non-bankrupt firms during the critical period in which they survived. It was expected that the companies might have been survived by their strong financial variables. Unexpectedly, it was observed that some of the profitability, liquidity and turn over ratios have declining trend that fails to accept our null hypothesis. Consequently, for further investigation T-test and F-test was conducted. However, it is evident from Tables 4.2a-4.2d that the average values of liquidity, profitability, leverage and turn over ratios of non-bankrupt companies were stable as compared to bankrupt companies and in some cases they were improving with the approach of the critical time period (i.e., bankruptcy).

Insert Table 4.2a-4.2d about here

4.3- T-test for Equality of Means

T-test was performed in order to determine whether 24 financial ratios of two groups (bankrupt and non-bankrupt) are likely to have the same mean underlying five years. The statistical T-test and the F-statistics are used to check for any significant differences between the two groups mean. The statistical results presented in Tables 4.3a-4.3d indicate that there is a statistically significance difference for 6 financial ratios out of the 24 financial ratios in the first year, 7 financial ratios for the second year, 11 financial ratios for both third and fourth year and 7 financial ratios are significantly different in the fifth year prior to bankruptcy. Since the most significant ratios in all five years prior bankruptcy and six financial ratios were found significant in all three years prior bankruptcy. Thus, in this case, our null hypothesis is accepted, and it is concluded that there is a significant difference between the two populations means with three financial variables namely EBIT to total

assets, market value of equity to book value of debt and equity to long term debt. Besides, Table 4.3 reveals that with the movement of the company towards bankruptcy the significance of most of the financial variables increases.

Insert Table 4.3a-4.3d about here

4.4- F-Test for Equality of Variances

F-test was performed in order to determine whether 24 financial ratios of bankrupt and non-bankrupt group have different variances underlying 5 years. It is evident from the Table 4.4 that 15 financial variables show the high significant variance (p-value) in all 5 years whereas 5 financial variables show significant variance for 4 years between the two groups. Therefore, it is concluded that 90% of the financial variables have shown significant variance between the bankrupt and non-bankrupt groups with the approach of the critical time period (i.e., bankruptcy).

Insert Table 4.4a-4.4d about here

4.5- Statistical Results of Multivariate Discriminant Analysis (MDA)

The total sample of 52 companies with five years data resulted in 260 firm-year observations. However, the data has been analyzed with an average of 5 years which becomes 52 observations for both bankrupt and non-bankrupt companies.

Table 4.5.1
Variables Entered/Removed (a, b, c, d)

Step	Entered	Wilks' Lambda	df1	df2	F-Statistic	df1	df2	Sig.
1	Sales to total assets ratio	0.838	1	50	9.65	1	50	0.003
2	EBIT to current liabilities ratio	0.713	1	50	9.841	2	49	0.000
3	cash flow ratio	0.647	1	50	8.714	3	48	0.000

At each step, the variable that minimizes the overall Wilks' Lambda is entered.
a Maximum number of steps is 48.
b Maximum significance of F to enter is 0.05.
c Minimum significance of F to remove is 0.10.
d F level, tolerance, or VIN insufficient for further computation.

The discriminant analysis procedure concluded significant variables and excluded insignificant variables for further analysis as shown in Table 4.5.1. Consequently from twenty four variables, only three variables viz. EBIT to current liabilities ratio, sales to total assets ratio and cash flow ratio were found highly significant at 5% significance level. Among these three variables, EBIT to current liabilities ratio discriminated the most with the p-value 0.000, and cash flow ratio with the p-value 0.032 discriminating the least.

Standardized canonical discriminant function coefficients were determined and ranked accordingly is shown in Table 4.5.2. EBIT to current liabilities ratio discriminated the most with the highest discriminant magnitude 1.147 followed by sales to total asset ratio with 0.701 and cash flow ratio with -0.732 that discriminating the least.

Table 4.5.2
Standardized Canonical Discriminant Function Coefficients

Ratios	Coefficients
EBIT to current liabilities ratio	1.147
Sales to total assets ratio	0.701
Cash flow ratio	- 0.732

Group centroids function determines optimum Z value based on which a firm is classified as bankrupt and non-bankrupt. Table 4.5.3 reveals that if a firm having Z score equals to -0.724 is classified as "Bankrupt" whereas firm having Z score equal to 0.724 is classified as "Non-bankrupt".

Table 4.5.3
Functions at Group Centroids

Group	Z-Score
Bankrupt	-0.724
Non-Bankrupt	0.724

4.6- Z Score/ MDA Model

The final Z score/ discriminant score derived from table 4.5.2 and 4.5.3 respectively, takes the form as follows:

$$Z = 1.147X_1 + 0.701X_2 - 0.732X_3$$

where

Z = Discriminant Score
X_1 = Sales to total assets ratio[2]
X_2 = EBIT[3] to current liabilities ratio
X_3 = Cash flow ratio[4].

The midpoint or the cut off value of bankrupt and non-bankrupt group centroid is zero which suggests that the movement of a firm with the Z-value above zero is approaching toward "non-bankruptcy" whereas the movement of firm with the Z-value below zero is approaching towards "bankruptcy" at each year prior the event. At last, the firm having a Z value = -0.724 classified as "bankrupt" and the firm having a Z value = 0.724 classified as "non-bankrupt". The classification reported in Table 4.5.4 compares the actual and predicted results. It is evident that the model classification accuracy is 76.9 percent which suggests the high classification power of the significant three financial variables on the analysis sample. The

[2] It is the only ratio that was found significant from Altman (1968) five variables in zeta model.
[3] It is the profit earned by the company during a year and has been denoted as net profit before taxation in the Balance Sheet analysis of joint stock companies listed on Karachi Stock Exchange (KSE).
[4] Cash flow ratio has been calculated as: Net profit after tax plus depreciation for the year divided by depreciation for the year plus changes in capital employed (see, balance sheet analysis of joint stock companies by SBP).

outstanding model's accuracy rate achieved implies that it has the potential for practical application in predicting the corporate failure of Pakistan.

Table 4.5.4
Classification Results

		Predicted Group Membership		Total
	Z-Score	**Bankrupt**	**Non-Bankrupt**	
Original Count	Bankrupt	20	6	26
	Non-Bankrupt	6	20	26
Percentage	Bankrupt	76.9	23.1	100.0
	Non-Bankrupt	23.1	76.9	100.0

The accuracy of the discriminant model was analyzed by applying it on the total sample of 52 companies. From the total sample of 52 companies, only 12 cases were misclassified. It is evident from Table 4.5.5 that the model developed through our study has 76.9% accuracy/predictive ability in forecasting the default character of a firm.

Insert Table 4.5.5 about here

4.7- Wilks' Lambda of the Estimated MDA Model

Wilks Lambda (reported in Table 4.5.6) evaluates the overall discriminant function fitness. We obtain (0.647) Wilks Lambda, significant at 99% level of confidence that provide the evidence that our model has the potential to be applied practically.

Table 4.5.6
Wilks' Lambda

Test of Function (s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.647	21.086	3	0.000

5- Conclusions

In this we identify the financial ratios that are most significant in bankruptcy prediction for the non-financial sector of Pakistan using a sample of companies which became bankrupt over the 1996-2006 period. In doing so, twenty four financial ratios that measures important financial attributes of a company (i.e., profitability, liquidity, leverage, and turnover ratios) were examined for a five-year period prior bankruptcy. The discriminant analysis produced a parsimonious model of three variables viz. sales to total assets, EBIT to current liabilities, and cash flow ratio. Our estimates provide evidence that the firms having Z value below zero fall into the "bankrupt" whereas the firms with Z value above zero fall into the "non-bankrupt" category. The model achieved 76.9% prediction accuracy when it is applied to forecast bankruptcies on the underlying sample.

In addition to estimating bankruptcy prediction model for Pakistan, the study shows that most of the companies that went bankrupt during the period from 1996 to 2006 have shown signs of financial distress i.e., poor financial performance. Further, our study contributed in the existing literature by exploring three significant financial variables namely sales to total assets, EBIT to current liabilities, cash flow ratio that can be used to explore the bankruptcy risk in Pakistan. These three financial variables are among popular financial ratios contributing business failure in bankruptcy literature (Eljelly et.al, 2001).

In aggregate, we suggest that the regulatory authorities in Pakistan should keep these three significant financial variables in monitoring/assessing the financial health of the firm. Finally, it can be argued that our model provides insight into assessing the complex financial situation of a firm and could suggest avenues for future research among academia and practitioner for developing better bankruptcy prediction model for Pakistan.

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Table 4.1a: Mean and Standard Deviation of Leverage Ratios for Bankrupt Companies

Financial Ratios	Years prior to Bankruptcy					Average
	1	2	3	4	5	
Cash flow ratio	-0.66	-1.56	-0.71	-0.45	-5.23	-1.48
	(1.31)	(4.18)	(0.78)	(0.50)	(24.64)	(5.29)
Cash flow to total debt	-0.07	-0.04	0.04	0.07	0.08	0.05
	(0.13)	(0.23)	(0.51)	(0.48)	(0.45)	(0.39)
Current liabilities to total assets	-0.01	0.1	0.21	0.19	0.35	0.24
	(0.49)	(0.46)	(0.52)	(0.76)	(0.41)	(0.56)
EBIT to fixed assets at cost	-0.28	-0.27	-0.28	-0.29	-0.25	-0.06
	(0.23)	(0.17)	(0.25)	(0.40)	(0.24)	(1.18)
EBIT to total liabilities	-3.85	-3.92	-2.08	-1.52	0.14	-1.63
	(11.52)	(10.5)	(8.54)	(7.34)	(11.25)	(8.63)
Equity to long term debt	0.85	0.79	1.07	1.08	1.07	1.44
	(0.89)	(0.90)	(1.33)	(1.07)	(0.88)	(2.61)
MVE to BVD	-0.32	-0.22	-0.12	-0.05	-0.04	-0.11
	(0.70)	(0.19)	(0.41)	(0.42)	(0.45)	(0.42)
Net income to fixed assets at cost	-0.31	-0.33	-0.47	-0.18	-0.2	-0.41
	(0.37)	(0.25)	(0.81)	(0.72)	(0.35)	(0.45)
Net income to total debt	1.1	0.85	0.72	0.62	0.53	0.63
	(0.99)	(0.71)	(0.52)	(0.44)	(0.37)	(0.70)
Total debt to total asset	2.03	2.52	6.3	7.96	4.46	3.79
	(2.55)	(3.22)	(17.98)	(28.03)	(10.32)	(10.58)

Table 4.1b: Means and Standard Deviations of Liquidity Ratios for Bankrupt Companies

Financial Ratios	Years prior Bankruptcy					Average
	1	2	3	4	5	
Current assets to current liabilities	-0.20	-0.16	-0.06	-0.02	-0.01	-0.32
	(0.26)	(0.17)	(0.23)	(0.21)	(0.19	(1.06)
Liquid assets to current liabilities	-0.56	-0.9	-0.35	-0.17	-2.73	-0.84
	(0.80)	(2.57)	(0.59)	(0.42)	(13.32	(3.12)
Net liquid assets to current liabilities	-0.96	-1.02	-0.92	-0.95	-0.9	-0.95
	(0.11)	(0.33)	(0.39)	(0.06)	(0.20)	(0.22)
Working capital to total asset	-0.71	-0.4	0.54	-0.17	-0.1	-0.17
	(1.07)	(0.78)	(0.89)	(0.52)	(0.41)	(0.73)

Table 4.1c: Means and Standard Deviations of Profitability Ratios for Bankrupt Companies

Financial Ratios	Years prior Bankruptcy					Average
	1	2	3	4	5	
EBIT to current liabilities	-0.9	-0.55	-0.42	-0.25	-0.14	-0.52
	(1.85)	1	0.92	0.73	0.6	1.37
EBIT to sales	78.27)	74.98	39.85	8.25	6.87	37.05
	408.58	410.34	204.26	22.55	18.29	191.2
EBIT to total assets	-0.05)	-0.04	-0.03	-0.03	-0.01	0.09
	0.27	0.27	0.3	0.29	0.3	0.34
Net income to sales	1.95)	1.17	1.06	0.86	0.87	14.07
	3.3	0.67	0.52	0.37	0.37	83.18
Net income to total asset	0.43)	0.69	0.34	0.25	2.46	0.42
	0.4	1.62	0.33	0.21	11.33	3.75
Retained earnings to total assets	0.70)	0.88	0.76	0.91	0.92	0.67
	0.88)	0.83	0.44	0.49	0.37	0.62

Table 4.1d: Means and Standard Deviations of Turn Over Ratios Bankrupt Companies

Financial Ratios	Years prior Bankruptcy					Average
	1	2	3	4	5	
Expenses to sales	-0.18	-0.14	0.01	0.25	0.11	1.03
	(0.20)	(0.15)	(0.35)	(1.41)	(0.51)	(5.78)
Sales to fixed assets	52.06	-25.98	144.4	139.25	160.88	78.5
	(511.7)	(434.72)	(846.94)	(594.79)	(571.34)	(493.87)
Sales to total assets	-0.39	-0.32	-0.27	-0.22	-0.21	-0.25
	(0.47)	(0.30)	(0.22)	(0.20)	(0.19)	(0.30)
Working capital to sales	-0.13	-0.12	-0.04	-0.01	0.00	6.12
	(0.12)	(0.09)	(0.29)	(0.30)	(0.24)	(32.04)

Table 4.2a: Means and Standard Deviations of Leverage ratios for Non-bankrupt Companies

Leverage Ratios	Years prior to Bankruptcy					Average
	1	2	3	4	5	
Cash flow ratio	-0.71	-0.23	-0.24	-0.19	-0.14	-0.31
	(2.72)	(0.35	(0.33)	(0.22)	(0.17)	(0.78)
Cash flow to total debt	-0.08	-2.96	1.63	0.24	0.26	-0.3
	(1.17)	(15.53	(3.16)	(1.05)	(0.66)	(5.11)
Current liabilities to total assets	1.19	-8.69	0.51	0.48	0.66	-0.87
	(3.30)	(46.11	(0.86)	(0.80)	(0.93)	(9.07)
EBIT to fixed assets at cost	-0.81	-4.69	-0.29	-0.33	-0.31	-1.06
	(3.47)	(22.6	(0.47)	(0.51)	(0.40)	(5.10)
EBIT to total liabilities	-1.94	-0.28	-0.25	-0.11	-0.24	-0.02
	(8.27)	(0.82	(0.64)	(0.60)	(0.87)	(2.44)
Equity to long term debt	1.62	1.84	2.44	1.62	1.82	2.68
	(0.77)	(1.04	(3.32)	(1.09)	(1.62)	(3.40)
MVE to BVD	0.19	0.12	0.2	0.19	0.26	0.18
	(0.44)	(0.40)	(0.59)	(0.87)	(0.61)	(0.57)
Net income to fixed assets at cost	-0.8	-0.96	-0.81	-0.61	-0.42	-0.89
	(2.54)	(2.56	(2.18)	(1.49)	(0.89)	(2.72)
Net income to total debt	0.74	1.23	1.19	0.79	0.73	0.6
	(2.81)	(2.64	(1.94)	(1.25)	(0.97)	(2.41)
Total debt to total asset	5.11	8.8	9.53	8.64	8.92	6.75
	(6.32)	(14.81	(17.54)	(16.55)	(18.32)	(12.59)

Table 4.2b: Means and Standard Deviations of Liquidity Ratios for Non-bankrupt Companies

Liquidity Ratios	Years prior Bankruptcy					Average
	1	2	3	4	5	
Current assets to current liabilities	-0.2	-0.18	-0.07	-0.01	0.03	-0.12
	(0.92)	(0.75)	(0.74)	(0.49)	(0.33)	(0.67)
Liquid assets to current liabilities	-0.28	-0.04	(0.01)	0.04	0.06	-0.06
	(1.39)	(0.28)	(0.32)	(0.28)	(0.19)	(0.52)
Net liquid assets to current liabilities	-0.99	-0.52	-7.04	-0.89	-0.84	-1.76
	(0.79)	(2.19)	(31.19)	(0.42)	(0.31)	(6.67)
Working capital to total asset	-1.41	-0.71	-0.52	-0.31	-0.24	-0.64
	(5.06)	(2.54)	(1.67)	(1.01)	(0.87)	(2.23)

Table 4.2c: Means and Standard Deviations of Profitability Ratios for Non-bankrupt Companies

Profitability ratios	Years prior Bankruptcy					Average
	1	2	3	4	5	
EBIT to current liabilities	-1.32	-0.71	-0.48	-0.25	-0.2	-0.5
	(5.15)	(2.58)	(1.73)	(0.98)	(0.97)	(1.99)
EBIT to sales	7.63	-10.2	12.39	9.44	18.1	10.06
	(22.24)	(107.95)	(38.81)	(20.75)	(35.35)	(54.88)
EBIT to total assets	0.14	0.11	0.16	0.13	0.16	0.23
	(0.41)	(0.28)	(0.45)	(0.33)	(0.31)	(0.53)
Net income to sales	2.04	1.17	1.5	0.99	0.93	22.97
	(5.13)	(2.31)	(2.03)	(0.94)	(0.91)	(104.18)
Net income to total asset	0.46	0.2	0.21	0.19	0.17	0.20
	(1.34)	(0.21)	(0.21)	(0.20)	(0.18)	(0.76)
Retained earnings to total assets	0.96	0.45	1.01	1.03	1.19	0.67
	(0.84)	(2.78)	(0.79)	(0.80)	(1.05)	(1.42)

Table 4.2d: Means and Standard Deviations of Turnover Ratios for Non-bankrupt Companies

Turnover ratios	Years prior Bankruptcy					Average
	1	2	3	4	5	
Expenses to sales	-0.26	-0.35	-0.2	-0.08	0.09	0.07
	(1.52)	(1.76)	(1.63	(1.07)	(0.71)	(3.15)
Sales to fixed assets	31.62	70.44	196.47	187.97	300.73	131.24
	(592.45)	(143.09)	(853.4)	(948.96)	(1143.88)	(613.76)
Sales to total assets	-0.58	-0.49	-0.52	-0.35	-0.29	-0.34
	(1.71)	(1.16)	(0.96)	(0.58)	(0.47)	(0.91)
Working capital to sales	-0.15	-2.95	0.18	0.12	0.16	1.24
	(1.49)	(15.44)	(0.55)	(0.56)	(0.44)	(12.23)

Table 4.3a: Testing Equality of Means of Leverage Ratios for Bankrupt *versus* Non-Bankrupt

Leverage Ratios	Years prior Bankruptcy				
	1	2	3	4	5
Cash flow ratio	0.09	-1.61	-2.9	-2.68	-1.05
	(0.47)	(0.06)	(0.00)	(0.01)	(0.15)
Cash flow to total debt	0.05	0.96	-2.49	-1.46	-2.88
	(0.48)	(0.17)	(0.01)	(0.08)	(0.00)
Current liabilities to total assets	-1.89	0.97	-1.84	-1.62	-1.73
	(0.04)	(0.17)	(0.04)	(0.06)	(0.05)
EBIT to fixed assets at cost	0.78	0.38	0.27	0.4	0.87
	(0.22)	(0.16)	(0.40)	(0.35)	(0.20)
EBIT to total liabilities	-0.67	-1.77	-1.08	-0.97	0.17
	(0.26)	(0.04)	(0.14)	(0.17)	(0.44)
Equity to long term debt	-3.17	-4.03	-1.92	-1.95	-2.75
	(0.00)	(0.00)	(0.03)	(0.03)	(0.01)
Market value of equity to book value of debt	-2.57	-2.54	-3.89	-2.09	-3.39
	(0.01)	(0.01)	(0.00)	(0.02)	(0.00)
Net income to fixed assets at cost	1.04	1.30	0.72	1.38	1.27
	(0.15)	(0.10)	(0.24)	(0.09)	(0.11)
Net income to total debt	0.63	-0.69	-1.15	-0.78	-0.94
	(0.27)	(0.25)	(0.13)	(0.22)	(0.18)
Total debt to total asset	-2.55	-2.29	-0.70	-0.11	-1.14
	(0.01)	(0.02)	(0.25)	(0.46)	(0.13)

Table 4.3b: Testing Equality of Means of Liquidity Ratios for Bankrupt *versus* Non-Bankrupt

Liquidity Ratios	Years prior Bankruptcy				
	1	2	3	4	5
Current assets to current liabilities	-0.02	0.15	0.09	-0.17	-0.88
	(0.49)	(0.44)	(0.46)	(0.43)	(0.19)
Liquid assets to current liabilities	-0.85	-1.68	-3.22	-2.41	-1.07
	(0.20)	(0.05)	(0.00)	(0.01)	(0.15)
Net liquid assets to current liabilities	-1.02	-1.16	1.00	-0.74	-1.01
	(0.16)	(0.13)	(0.16)	(0.23)	(0.16)
Working capital to total asset	0.68	0.58	2.8	0.63	0.69
	(0.24)	(0.28)	(0.00)	(0.27)	(0.25)

Table 4.3b: Testing Equality of Means of Profitability Ratios for Bankrupt *versus* Non-Bankrupt

Profitability Ratios	Years prior Bankruptcy				
	1	2	3	4	5
EBIT to current liabilities	0.39	0.3	0.17	-0.01	0.27
	(0.35)	(0.38)	(0.43)	(0.49)	(0.39)
EBIT to sales	0.88	1.03	0.71	-0.21	-1.43
	(0.19)	(0.16)	(0.24)	(0.42)	(0.08)
EBIT to total assets	-1.59	-1.48	-1.45	-1.4	-1.71
	(0.06)	(0.08)	(0.08)	(0.09)	(0.05)
Net income to sales	-0.08	0.01	-1.05	-0.68	-0.24
	(0.47)	(0.50)	(0.15)	(0.25)	(0.40)
Net income to total asset	-0.08	1.55	2.06	1.64	1.03
	(0.47)	(0.07)	(0.02)	(0.06)	(0.16)
Retained earnings to total assets	-2.35	0.77	-1.43	5.95	-1.18
	(0.01)	(0.22)	(0.08)	(0.00)	(0.02)

Table 4.3d: Testing Equality of Means of Turnover Ratios for Bankrupt *versus* Non-Bankrupt

Turnover Ratios	Years prior Bankruptcy				
	1	2	3	4	5
Expenses to sales	0.30	0.63	0.67	1.04	0.14
	(0.38)	(0.27)	(0.25)	(0.15)	(0.44)
Sales to fixed assets	0.13	-1.1	-0.41	-0.53	-1.03
	(0.45)	(0.14)	(0.34)	(0.30)	(0.16)
Sales to total assets	0.60	0.75	1.27	1.26	0.97
	(0.28)	(0.23)	(0.11)	(0.11)	(0.17)
Working capital to sales	0.04	0.94	-2.88	-1.92	-2.32
	(0.48)	(0.18)	(0.00)	(0.03)	(0.01)

Table 4.4a: Testing Equality of Variance of Leverage Ratios for Bankrupt *versus* Non-Bankrupt

Leverage Ratios	Years prior Bankruptcy				
	1	2	3	4	5
Cash flow ratio	0.23	140.33	5.77	5.13	201.45
	0.00	0.00	0.00	0.00	0.00
Cash flow to total debt	0.01	0.00	0.03	0.21	0.47
	0.00	0.00	0.00	0.00	0.03
Current liabilities to total assets	0.02	0.00	0.36	0.92	0.19
	0.00	0.00	0.01	0.42	0.00
EBIT to fixed assets at cost	0.00	0.00	0.28	0.61	0.35
	0.00	0.00	0.00	0.11	0.01
EBIT to total liabilities	1.94	165.61	175.23	149.15	165.84
	0.05	0.00	0.00	0.00	0.00
Equity to long term debt	1.34	0.75	0.16	0.96	0.30
	0.24	0.24	0.00	0.46	0.00
Market value of equity to book value of debt	2.49	0.23	0.49	0.23	0.54
	0.01	0.00	0.04	0.00	0.06
Net income to fixed assets at cost	0.02	0.01	0.14	0.24	0.15
	0.00	0.00	0.00	0.00	0.00
Net income to total debt	0.12	0.07	0.07	0.19	0.14
	0.00	0.00	0.00	0.00	0.00
Total debt to total asset	0.16	0.05	1.05	2.87	0.32
	0.00	0.00	0.45	0.01	0.00

Table 4.4b: Testing Equality of Variance of Liquidity Ratios for Bankrupt *versus* Non-Bankrupt

Liquidity Ratios	Years prior Bankruptcy				
	1	2	3	4	5
Current assets to current liabilities	0.08	0.05	0.10	0.18	0.34
	0.00	0.00	0.00	0.00	0.00
Liquid assets to current liabilities	0.33	81.84	3.48	2.14	77.13
	0.00	0.00	0.00	0.03	0.00
Net liquid assets to current liabilities	0.02	0.02	0.00	0.02	0.41
	0.00	0.00	0.00	0.00	0.02
Working capital to total asset	0.04	0.10	0.29	0.26	0.22
	0.00	0.00	0.00	0.00	0.00

Table 4.4c: Testing Equality of Variance of Profitability Ratios for Bankrupt *versus* Non-Bankrupt

Profitability Ratios	Years prior Bankruptcy				
	1	2	3	4	5
EBIT to current liabilities	0.13	0.15	0.28	0.55	0.38
	0.00	0.00	0.00	0.07	0.01
EBIT to sales	37.63	14.45	26.28	1.18	0.27
	0.00	0.00	0.00	0.34	0.00
EBIT to total assets	0.44	0.98	0.44	0.79	0.97
	0.02	0.48	0.02	0.28	0.47
Net income to sales	0.41	0.08	0.07	0.16	0.17
	0.02	0.00	0.00	0.00	0.00
Net income to total asset	0.09	58.62	2.48	1.12	22.28
	0.00	0.00	0.01	0.39	0.00
Retained earnings to total assets	1.09	0.09	0.31	0.38	0.12
	0.42	0.00	0.00	0.01	0.00

Table 4.4d: Testing Equality of Variance of Turnover Ratios for Bankrupt *versus* Non-Bankrupt

Turnover Ratios	Years prior Bankruptcy				
	1	2	3	4	5
Expenses to sales	0.02	0.01	0.05	1.72	0.52
	0.00	0.00	0.00	0.09	0.05
Sales to fixed assets	0.75	8.86	0.98	0.39	0.25
	0.23	0.00	0.48	0.01	0.00
Sales to total assets	0.08	0.07	0.05	0.12	0.17
	0.00	0.00	0.00	0.00	0.00
Working capital to sales	0.01	0.00	0.27	0.29	0.30
	0.00	0.00	0.00	0.00	0.00

Table 4.5.6: In Sample Model Classification Results

No.	Company	Actual Group	Predicted Group	Z-Score	Prob. of group 1	Prob. of group2
1	Lafayette Industries Synthetics Ltd	1	1	-0.037	0.513	0.487
2	Sunshine Cotton Mills Ltd	1	1	-0.659	0.722	0.278
3	Pearl Fabrics Ltd	1	1	-1.501	0.898	0.102
4	Sunrise Textiles Ltd	1	1	-0.516	0.678	0.322
5	Nusrat Textile Mills Ltd.	1	1	-1.240	0.858	0.142
6	Crown Textile Mills Ltd	1	1	-1.534	0.902	0.098
7	Marr Fabrics Ltd	1	1	-2.228	0.962	0.038
8	Amazai Textile Mills Ltd	1	1	-1.723	0.924	0.076
9	Alif textile industries Ltd	1	1	-1.027	0.815	0.185
10	Apex Fabrics Ltd	1	1	-1.489	0.896	0.104
11	Tawakl Garments industries Ltd	1	2**	0.656	0.279	0.721
12	Schon textiles Ltd	1	1	-0.417	0.646	0.354
13	Adil Polypropylene Ltd	1	1	-0.495	0.672	0.328
14	Pak Fibre industries Ltd	1	1	-1.095	0.830	0.170
15	Modern Textile Mills Ltd	1	2**	0.058	0.479	0.521
16	Tawakl Ltd	1	2**	0.078	0.472	0.528
17	Pakistan dairies Ltd	1	2**	0.474	0.335	0.665
18	Regal ceramics Ltd	1	1	-0.071	0.526	0.474
19	Uqab Breeding Farms Ltd	1	1	-0.962	0.801	0.199
20	Mediglass Ltd	1	1	-3.693	0.995	0.005
21	Ghulam M dadabhoy Ltd	1	1	-0.144	0.552	0.448
22	Sarhad Ghee Mills Ltd	1	2**	1.084	0.172	0.828
23	Muslim Ghee mills Ltd	1	1	-0.637	0.715	0.285
24	Fazl Vegetable Ghee Mills Ltd	1	1	-0.902	0.787	0.213
25	Kausr paints Ltd	1	1	-0.922	0.791	0.209
26	Sind Alkalis Ltd	1	2**	0.126	0.454	0.546
27	Premium Textile Mills Ltd	2	2	1.424	0.887	0.113
28	Ahmad Hassan Textile Mills Ltd	2	2	0.959	0.800	0.200
29	J.K Spinning Mills Ltd	2	2	0.470	0.664	0.336
30	Ishaq Textile Mills Ltd	2	2	0.298	0.606	0.394
31	Fawad Textile Mills Ltd	2	1**	-0.897	0.214	0.786
32	Data Textiles Ltd	2	2	0.102	0.537	0.463
33	Salman Noman Enterprise Ltd	2	2	0.514	0.678	0.322
34	Babri Cotton Mills Ltd	2	2	2.757	0.982	0.018
35	The National Silk and Ryon Ltd	2	2	1.046	0.820	0.180
36	Crescot Mills Ltd	2	2	0.964	0.801	0.199
37	Olympia Textile Mills Ltd	2	1**	-0.536	0.315	0.685
38	Zaman Textile Mills Ltd	2	2	0.513	0.677	0.323
39	Sana industries Ltd	2	2	1.193	0.849	0.151
40	Ideal Spinning Mills Ltd	2	2	0.723	0.740	0.260
41	Globe Textile Mill Ltd	2	2	0.919	0.791	0.209
42	Universal leather and Footwear industries	2	1**	-0.042	0.485	0.515
43	Pak German Prefabs Ltd	2	1**	-1.232	0.144	0.856
44	Michells Fruit Farms Ltd	2	2	2.534	0.975	0.025
45	Pakistan House international Ltd	2	2	0.865	0.778	0.222
46	Grays of Cambridge Pak Ltd	2	2	3.007	0.987	0.013
47	Good luck industries Ltd	2	1**	-0.268	0.404	0.596
48	Kohinoor Oil Mills Ltd	2	2	1.257	0.860	0.140
49	Punjab Oil Mills Ltd	2	2	1.167	0.844	0.156
50	Burma Oil Mills Ltd	2	2	0.960	0.800	0.200
51	RRP Ltd	2	1**	-0.136	0.451	0.549
52	Dyno Pakistan Ltd	2	2	0.254	0.591	0.409

Annexure 1: List of Bankrupt and Non-bankrupt Companies[1] (Assets in Rs. Millions)

Bankrupt Company[2]	Year[3]	Total Assets	Non-bankrupt Company	Total Assets
Adil Polypropylene Products Ltd	1998	208.7	Sana industries Ltd	248.4
Alif Textile industries Ltd	1996	30.1	The National Silk and Ryon Ltd	52.9
Amazai Textile Mills Ltd	1998	119.9	Babri Cotton Mills Ltd	176.2
Apex Fabrics Ltd	1996	101.4	Crescot Mills Ltd	108.4
Crown Textile Mills Ltd	1997	114.1	Data Textiles Ltd	138.2
Fazl vegetable Ghee Mills Ltd	1998	83.7	Burma Oil Mills Ltd	70.7
Ghulam M dadabhoy Ltd	1997	7.4	Good Luck industries Ltd	2.4
Kausr paints Ltd	1998	35.6	RRP Ltd	34.5
Lafayette Industries Synthetics Ltd	2006	457.7	Premium Textile Mills Ltd	467.4
Marr Fabrics Ltd	1998	116.5	Salman Noman Enterprises Ltd	125.1
Mediglass Ltd	1998	126.5	Grays of Cambridge Pak Ltd	166.2
Modern Textile Mills Ltd	1998	103	Globe Textile Mills Ltd	142.4
Muslim Ghee Mills Ltd	1996	53.1	Punjab Oil Mills Ltd	81.8
Nusrat Textile Mills Ltd.	1997	378.7	Fawad Textile Mills Ltd	376
Pakistan Dairies Ltd	1996	26.7	Pak German Prefabs Ltd	33.3
Pak Fibre industries Ltd	1998	250.5	Ideal Spinning Mills Ltd	270.8
Pearl Fabrics Ltd	1996	461.8	J.K Spinning Mills Ltd	479.9
Regal Ceramics Ltd	1998	197.5	Michells Fruit Farms Ltd	207
Sarhad Ghee Mills Ltd	1997	58.6	Kohinoor Oil Mills Ltd	51.3
Schon Textiles Ltd	1996	260.5	Zaman Textile Mills Ltd	286.3
Sind Alkalis Ltd	1998	322.9	Dyno Pakistan Ltd	330.6
Sunrise Textiles Ltd	1996	716.5	Ishaq Textile Mills Ltd	716.3
Sunshine Cotton Mills Ltd	1998	233.1	Ahmad Hassan Textile Mills Ltd	238.4
Tawakl Garments industries Ltd	1996	461.8	Olympia Textile Mills Ltd	465.1
Tawakl Ltd	1996	797.7	Universal Leather and Footwear industries Ltd	720.8
Uqab Breeding Farms Ltd	1998	46.5	Pakistan House International Ltd	64.6

[1]Note: 15 companies are from textile, 6 from vanaspati and allied, 4 from chemical and 12 from miscellaneous sector. As the companies consist of mixed industry, therefore following Beaver (1968) paired sampling technique was used in which bankrupt companies were paired/matched with the non-bankrupt companies having same industry and closest total assets 1 year prior to bankruptcy.

[2]Bankrupt companies consist of (1) liquidation / winding up of a company under court order i.e. violation of KSE listing regulation no. 32 (1) (d). Or (2) winding up of a company by SECP. Sources:

[3]This is the year which has been taken as 'year of bankrupt' for a company based on the data availability of 5 years prior bankruptcy.

Annexure 2: List of Financial variables

Financial ratios	#	Calculation
1-Leverage ratios		
	i.	Cash flow ratio = Net profit after tax plus depreciation for the year divided by depreciation for the year plus changes in capital employed
	ii.	Cash flow to total debt [3]
	iii.	Current liabilities to total assets [3]
	iv.	EBIT to fixed assets at cost [3]
	v.	EBIT to total liabilities [2]
	vi.	Equity to long term debt [2]
	vii.	Market value of equity to book value of debt [1]
	viii.	Net income to fixed assets at cost [3]
	ix.	Net income to total debt [3]
	x.	Total debt to total asset [2]
2-Liquidity ratios		
	xi.	Current assets to current liabilities [2]
	xii.	Liquid assets to current liabilities [2]
	xiii.	Net liquid assets to current liabilities [3]
	xiv.	Working capital to total assets [1]
3-Profitability ratios		
	xv.	EBIT to current liabilities [2]
	xvi.	EBIT to sales [3]
	xvii.	EBIT to total assets [1]
	xviii.	Net income to sales [3]
	xix.	Net income to total assets [1]
	xx.	Retained earnings to total assets [1]
4-Turn over ratios		
	xxi.	Expenses to sales [3]
	xxii.	Sales to fixed assets [2]
	xxiii.	Sales to total assets [1]
	xxiv.	Working capital to sales [3]

[1] Variables from Altman (1968)
[2] Variables from Gu (2002)
[3] Variables from Eljelly et.al (2001)