

An Empirical Investigation about the suitable financial distress prediction methods: A Case from Pakistan's Manufacturing Sector

Muhammad Naeem Akhtar^{*}, Kashif-ur-Rehman[†], and Muhammad Irfan[‡]

Abstract

This study investigates about the most suitable financial distress prediction method for manufacturing sector companies of Pakistan. Matched paired research design is used for this purpose. Out of total 517 manufacturing units, 134 were finally matched and selected for analysis purpose. The financial statement data relating to manufacturing sector companies for the years from 1999 to 2013 was collected. Twenty-five widely used financial ratios were calculated and analyzed. Financial distress prediction methods based on MDA, Logit and Probit models were tested for the efficiency of prediction. The results of this research study indicate that Logit and Probit models are more efficient in predicting the financial distress for manufacturing sector Companies of Pakistan.

Keywords: Financial Distress; Logit Model; Probit Model; Z-Score

Introduction

Financial distress, bankruptcy, and insolvency are a global phenomenon which is taking place almost in every developing as well as developed and underdeveloped country. However, it is possible that these kinds of events take place at a lower rate in developed countries and at a higher rate in non-developed countries. The main reasons for these negative events vary across the globe due to differences in socio-economic environments, political situation, accounting practices and also due to diversity in capital structure (Argenti, 1976). Prior indications or warning signals are required to be adopted to assess or forecast the possibility of financial distress and to escape the major price of insolvency and distress. Insolvency and distress also affects all the stakeholders due to fact that directly and indirectly, costs are included in insolvency. In the absence of prior warning signals, there would not be any possibility of identification of the bankruptcy and financial distress. This scenario results in incurring huge direct and indirect cost which makes it harsh for the company to reestablish itself (E. Altman, 1993).

^{*} Muhammad Naeem Akhtar PhD Scholar, Iqra University, Islamabad. Email: muhammadnaeemakhtar@hotmail.com

[†] Dr. Kashif-ur-Rehman, Professor, Department of Management Science, Iqra University, Islamabad. Email: drkashif@iqraisb.edu.pk

[‡] Dr. Muhammad Irfan, Assistant Professor, COMSATS Institute of Information Technology, Islamabad. Email: mirfan@comsats.edu.pk

The companies facing financial distress bear two types of costs i.e., indirect and direct. The reason of indirect cost is the distraction of the top management of the company as they are focused on keeping the company on track with their dedication and full focus and also due to the fact that the company loses its critical human resources. Whereas on the other hand direct costs include cost of structuring paid to advisory services, legal and professional expenditures, professional accountants fee, legal and professional expenditures on court's filing and legal advisors and other professional charges. Another direct cost is the direct relationship for a company's time spent for liquidation or winding up charges (Altman & Hotchkiss, 2010). According to (Warner, 1977) legal fees dues, trustee's fee and other legal and professional charges are also direct expenditures and also indicate that company facing financial distress bears 4% of the firm's value as cost of financial distress. (Xie, Luo, & Yu, 2011) contended that the companies face a lot of hurdles and difficulties in getting favorable credit terms since they put cuts on research and development and marketing expenditures and they are also prone to belligerent strategies of competitors. The most important task of conducting a financial ratio analysis is to predict the future events. Most of the researchers have worked on stability and variation of financial ratios (Sayari & Mugan, 2017). One of the defining aspect of the company suffering from financial distress is the presence of financial restraints and difficulties in availability of credit facilities (López-Gutiérrez, Sanfilippo-Azofra, & Torre-Olmo, 2015).

Understanding the bankruptcy and business process failures, its causes and remedial measures, is very important for a successful manager. It is also equally important that the financial management staff and officers know their roles and responsibilities, their rights and necessary steps to be taken when their suppliers, customers and company face financial distress. The research work conducted by (Koh, Lee, Low, & Tan, 1989) stated that the analysis of accounting ratios can give a fruitful summary of the enterprise and underline the flaws of the company. The ratios also indicate the performance indicators and highlight the status of the company. The analysis of financial ratio can also be applied in cross sections/horizontally (by comparing various organizations at the same point) or vertically (by equating the same organizations at the different point of time). If we go through the various balance sheet analyses done by the financial and accounting experts at State Bank of Pakistan, various companies have been facing financial distress and many are in line to reach towards this point. The impact of these failures are not only affecting the social areas but also badly affecting the economy of Pakistan. Due to these failures many companies

have stopped their operations resulting into loss of jobs which is ultimately resulting into increase in unemployment ratio.

In the developed countries, the various sectors of the economy have their own failure prediction models and also performance evaluation indicators through which more accurate assessment of a particular company is possible. Even though it is presumed that the external auditors are expected to make a better assessment of a firm's show and monetary situation. The various research studies have shown that auditors only provide such report which shows only the correct picture of financial statements of a particular company. Normally banks rely on the independent assessment to measure the current situation and performance of a particular company and also its future assessment which mostly rely on the traditional ratio analyses. Financial distress, bankruptcy and insolvency are a global phenomenon which is taking place almost in every developing as well as developed and non-developed country. However, it is possible that these kinds of events take place at a lower rate in developed countries and at a higher rate in non-developed countries. The main reasons for these kinds of negative events vary across the globe due to differences in socio-economic environments, political situation, accounting practices and also due to diversity in capital structure (Argenti, 1976). In the absence of prior warning signals there would not be any possibility of identification of the bankruptcy and financial distress. This scenario results in incurring huge direct and indirect cost which makes it harsh for the company to reestablish itself (Altman, 1993).

Like all developing countries, Pakistan is also facing business failures due to various reasons. Number of manufacturing concerns has been declared as bankrupt or financially distressed and many are in line to be liquidated. Increasing interest rates, reducing demand, inadequate financial control, innovative products from competitors, no management succession, catastrophic loss caused to business, low prices, overseas competition, high turnover of workers, counter party default, lack of access to credit, financial indiscipline, lack of proper keeping of financial records, high cost structure for inefficiency, shortage of skilled manpower, policy changes of government, and poor practice of accounting standards are the foundations of corporate financial distress of an organization (Jahur & Quadir, 2012). So therefore, there is a need to keep all the stakeholders aware of the losses due to financial distress and to take such necessary steps so that the financial distress could be predicted before its occurrence. Proper warning signals is the need of the time to accurately judge the financial condition of the companies

functioning in manufacturing sector of Pakistan. This will save the huge cost of bankruptcy and will also prevent the additional corporate failures.

The outcome of this research work would be very useful for all the stakeholders of the company for the assessment of the financial strength of a manufacturing company as a result of which, the upcoming decisions relating to the debt obligations could be made. The prospective investors and stakeholders of the company would be capable to utilize the outcomes of this research work in formulating the suitable portfolio of their investments. This study would provide a greater help to the investors in the selection of companies for their investments. This will help the investors in making decision about the financially distressed and non-distressed companies. The banking industry would be able to decide about the credit worthiness of their applicants relating to the manufacturing sector of Pakistan. The results of this research study are expected to point out the best financial distress prediction model for the manufacturing sector of Pakistan and to help out the lenders in deciding the amount of risk involved in issuance of loans and advances to the industry. The results will also help the manufacturing sector companies in timely recognizing the unwanted conditions and timely taking the appropriate decisions for the financial health of the companies.

Literature Review

Financial distress prediction which is based on financial indicator dates back from the 1930s. (FitzPatrick, 1932) firstly studied a one variable bankruptcy prediction. Sample of researcher included nineteen companies and he further segregated these companies into two major groups or better to say categories and designated as bankrupt and non-bankrupt one on behalf of particularly selected financial ratio. Later he came to know that net profit/shareholders' equity and shareholders' equity/debt is indicators with highest capable of discriminating. If research work is looked back from the perspective of its past it can be easily concluded that in the beginning, there was no application and availability of statistical tools and also no support of computers was there to facilitate the researchers at that time. Thus, only wide practice for drawing of certain kind of results was comparative studies and analysis of successful and unsuccessful firms with each other. It is significantly noticeable not only from stake holder's perspective but also equally considerable for management as well as creditors of company to assess company's financial status in advance.

The researchers had shown great interest in predicting the model of bankruptcy in corporate sector since 1960s. The idea of Multiple Discriminant Analyses (MDA) is also known as Altman Z-score model. This model was developed in the year 1960 after the systematic process

made by the Edward Altman. This model is comprised of 5 accounting and financial ratio which are used for the prediction of the future business situations. The Altman Z-Score is comprised by the financial ratios divided in the categories of leverage, profitability, activity and liquidity to make a catalog of probability, which is a very useful sign of business show in predicting the insolvency and bankruptcy. The Altman Z-Score is a multivariate model which is based on the discriminant function for the corporate firms where more variables were likely to predict the business failures. Altman, (1968) has the credit of first researcher to practice an approach based on Multiple Discriminant Analysis for financial distress prediction. A Z-score bankruptcy model was generated and identified cut point of Z-score (2.675) to segregate stressed as well as healthy firms. It was reflected from results that Z-score model is sound enough from the perspective of financial distress. The Altman Z-Score models approach gained sufficient popularity by the independent auditors, accounting firms, financial institutions, source data systems and legal authorities for the processing of assessment for loan applications.

To continue his further research experience, Altman (1993) used linear discriminant analysis for examining the twenty one bankruptcies in rail road during the years from 1939-70. The precision rate prior to first year bankruptcy was 95.24% for bankrupt category and hundred percent for non-bankrupt category. Statistical analysis of ratios was primarily practiced by (Beaver, 1968) for financial distress prediction. His study contained thirty most appearing and repeatedly occurring ratios and grouped into six groups of ratios.(Beaver, 1968) suggested that financial ratios are more powerful than market price changes in assessing the solvency positions of companies. He however found that this is not always the case as he also discovered that time-series analysis may forecast failure sooner than the financial ratios.(Edmister, 1972) carried out a study in which an adequate model was developed to predict small business failures. The results of this study indicated that one-year analysis is not sufficient for predicting distress of small organizations. At least three-year statements were required to get significant results. In this study it was found that Multiple Discriminant Analysis is best predictor of financial distress for small business while using the financial data of the company. The model showed an overall accuracy of 93% for predicting the distress. The results showed that if Z value is less than 0.520 then the firm is insolvent while z value seems higher than 0.520 then it will be considered as non-bankrupt.

The analyses of the disaster happened to the company by (Deakin, 1972) showed that the whole debt burden of the company is

extremely instable. Entire debt, Cash flow, and net profits have relatively steady whereabouts in two samples of financially distressed and non-distressed companies. His study recommended that MDA practice is a beneficial tool to estimate bankruptcy with advanced precision even three year's formerly concrete failure. (Argenti, 1976) pointed out that the quantitative models displaying accounting ratio with coefficients which differentiate between failing and non-failing companies and further these can eventually be utilized to point out the firms which display the structures of formerly failing firms. These models fall under the category of univariate and multiple discriminant analyses. (Ohlson, 1980) is the pioneer to design a model utilizing the multivariate logistic regression (Logit) to build a probabilistic bankruptcy prediction model. He stated that his research work had an advantage i.e., his study considered the timing matter. The model presents reports at a point of time the annual financial statements were issued to general public and one could thus examine whether the firm entered into the phase of bankruptcy before or after the date of issuance of the annual financial statements. The model developed by (Ohlson, 1980) gained major popularity which was developed by utilizing the Logit analysis to predict the financial failure since it has removed the deficiencies pinpointed in MDA and has not the same assumptions as in MDA. The Probit model developed by (Zmijewski, 1984) was operationally used for the prediction of corporate failure. Previously, it was least utilized in the econometric models. The research done by (Lennox, 1999) and (Menard, 1995) also used logistic and probit models to predict the financial distress.

A lot of research studies had been carried out in the field of corporate financial distress in the mixed sectors of Malaysia. Most of the researchers focused on Multivariate discriminant analysis. Along the mixed sector financial distress analyses, some of the research studies were carried in the manufacturing sector using MDA (Low, Nor, & Yatim, 2001); (Fantazzini & Figini, 2009) found that better out of sample forecasts relating to simple logit models over more sophisticated and advanced models is possible in credit risk default for Small industries. Multivariate discriminant analyses operate with the assumption that the equality of variances is equal for distressed and non-distressed companies and the sample population is distributed in multivariate fashion. (Karels & Prakash, 1987) stated that it had been found that most of the time these assumptions are not followed by the gathered information. They inferred that this type of analyses normally doesn't provide efficient results if the used accounting and financial ratios depart from the assumptions of normality.

Abdullah et al, (2008) linked three approaches for categorizing fiscally distressed companies including the first one as MDA and secondly as regression (logistic) and thirdly as Probit model. This was found to be the highest accuracy rate among the sample of 52 financially distressed as well as financially non-distressed companies with 94.9 % accurate prediction rate and this was a noticeably higher accuracy rate. Ecaterina, Ionut, & Marin, (2009) used Logit Model, Hazard Model, CHAID Decision Tree Model, Artificial Neural Network, and Principal Component Analysis to predict the financial distress. Muller et al, (2009) tested the effectiveness of four different techniques used to predict financial distress through the usage of information data relating to South African companies' data available on the Johannesburg Stock Exchange. They inferred that MDA and recursive partitioning methods have the highest precision and accuracy in results for the prediction of distressed and non-distressed companies. According to their research Logit, Probit and neural networks also found to have the best accuracy of the predictive ability.

Jiming & Weiwei,(2011) developed the financial distress prediction model with the help of Logistic Regression in which two models were used, one with financial indicators and the other one with financial and non-financial indicators. The study led by Abdullah et al., (2008) identified the ratios which are useful in the prediction of corporate distress of non-financial sector of Pakistan. The ratios having four significant financial characteristics each company five year prior to bankruptcy was analyzed. The results showed that the companies having Z- Score less than zero will be categorized as "Bankrupt" whereas those having Z-value more than 0 will be categorized as "Non-Bankrupt." The overall accuracy of the model was calculated as 76.9%.(Xie et al., 2011) industrialized SVM and MDA mockups to estimate the financial distress of industrial corporations. Financial ratios counting the ratio of profitability along with solvency, operationality and also the rate of sustainable development and cash flow ratios were castoff to develop the model. The outcomes of this study indicated that the accurateness of SVM is more than 80% for the period three years before the occurrence of financial distress showing that SVM model gives greater accuracy than MDA models. Al-khatib & Al-Horani, (2012) investigated the ratios by using Logit Regression and Discriminant Analysis. According to the research conducted by Kristanti, Rahayu, & Huda, (2016) firm that survives financial distress is the one that is capable to present better performance which is evident from the results of the financial ratios. Li, Crook, & Andreeva, (2017) argued that lenders are interested in not only predictive accuracy but also taking into account the risk driven factors

shaking financial distress. Mselmi, Lahiani, & Hamza, (2017) conducted the research study to measure the ability of financial ratios to predict financial distress in the French perspective.

After the detailed evaluation of the literature, it is evident that an extensive research work was done to avoid the future collapse and destruction. The research in this area is still going on and they are still advancing to new techniques. Due to changing business dynamics throughout the world and advancement of the technology the challenge to cope with the changing business environment it has become a challenge to come up with new ideas to predict the business failures so that the business world become a Heaven for the investors and other stakeholders. In this situation, the most suitable and effective forewarning alarm could be of greater help in preventing the financial distress and bankruptcy.

Based on the literature review, the study developed following hypothesis:

- H₁: MDA predicts the financial distress based on published financial information
- H₂: Logit Model predicts the financial distress based on published financial information and:
- H₃: Probit Model predicts the financial distress based on published financial information.

Theoretical Framework and Methodology

The sensitivity of financial distress prediction models raises the question that whether the model is sufficient enough to evaluate the financial condition of the company in different industries or not. In other words, the financial distress prediction models use the specific set of financial ratios, of companies in different industries, lose the predictive capability. The models based on information theory reveals that financial ratios provide sufficient information even uncertainty prevails in the industry (Sayari & Mungan, 2017), whereas the accounting theory allows the researchers to develop a generalized prediction model for a distinct time frame (Oz & Yelkenci, 2017). Both the information and accounting theories are based on the conviction that specific financial and accounting ratios are capable enough to predict the financial condition of the company. The investigation of the different variables reflects the various aspect of the company such as profitability, solvency, leverage and capital structure etc.

The current study aims to bridge the gap by identifying the most suitable industry specific financial distress prediction model using the financial ratios and accounting information to develop a prediction models that enable us to classify the listed firm as distress and non-distress firms.

Considering the research title of the current study and the previous research works on bankruptcy and corporate distress prediction models, the criteria for the selection of a particular company as distressed and non-distressed was finalized. A company selected as financially distressed, if it failed to declare dividend/bonus for 5 years from the date of last declaration, quoted below 50% of face value for continuous period of 3 years, companies dissolved or delisted due to court orders or in liquidation process due to Karachi Stock Exchange listing regulation violations or under liquidation process as per the Security and Exchange Commission of Pakistan. Non-distressed companies were also selected from the same industries from where distressed companies were selected. At the same time matching of companies was based on asset size. A company selected as financially non-distressed if it is running a profitable business and has a positive book value of equity, it is from the same year as of the company in the group I, it belongs to same sector of the Industry as in the group I, equity or asset size of the company is equal to the equity or asset size of the companies in the group I.

Keeping in mind the above-mentioned criteria, a comprehensive list of delisted companies was obtained from the KSE website from 1999 to 2013 which were delisted as well as declared as in process of liquidation. A second list was obtained from the Securities and Exchange Corporation of Pakistan which has been wound up under the provisions of Companies Ordinance, 1984 or which are under the process of being wound up and a final list of companies was obtained from the Balance Sheet Analyses reports done by State Bank of Pakistan. A final list of distressed and non-distressed companies was prepared from the above mentioned three lists. Afterwards, various companies were excluded from the list due to non-availability of complete data and information required to carry out the financial analyses.

Table 1: Number of Companies in each group i.e., Distressed & Non-Distressed

Industry	No. of Companies in each group	Industry	No. of Companies in each group
Cement	2	Paper & Board	3
Chemical & Pharmaceuticals	3	Sugar	4
Engineering & Autos	5	Textile	43
Fuel & Energy	3	Tobacco	1
Information, Transport & Communication	1	Vanaspaty & Allied Industries	2
Total	67		

Table 1 shows the industry wise number of sixty-seven companies for each category of financially distressed and non-distressed

Emerging Issues in Economics and Finance

companies. After the selection of distressed and non-distressed manufacturing companies, the data relating to balance sheet and income statement has been gathered. Comprehensive review of literature identified a lot of financial variables which were significantly contributing towards the financial distress prediction.

Table 2: List of Independent Variables

Group	Ratio	Description	Authors
Liquidity	CA/CL	Current Assets/Current Liabilities	(Low et al., 2001))
Liquidity	QA/CL	Quick Assets/Current Liabilities	(Ko, Blocher, & Lin, 2001)
Liquidity	C/TA	Cash & Cash Equivalents/Total Assets	(Moro et al, 2011)
Liquidity	QA/TA	Quick Assets/Total Assets	(Ecaterina et al., 2009)
Liquidity	C/CL	Cash/Current Liabilities	(Moro et al, 2011)
Liquidity	WC/TA	Working Capital/Total Assets	(Ohlson, 1980)
Liquidity	CL/TL	Current Liabilities/Total Liabilities	(Moro et al, 2011)
Activity	TA/S	Total Assets/Sales	(Jiming & Weiwei, 2011)
Activity	Inv./S	Inventory/Sales	(Moro et al, 2011)
Activity	AR/S	Accounts Receivables/Sales	(Jiming & Weiwei, 2011)
Activity	AP/CS	Accounts Payable/Cost of Sales	(Moro et al, 2011)
Profitability	EBIT/TA	Earnings Before Interest & Taxes/Total Assets	(Moro et al, 2011)
Profitability	NP/S	Net Profit/Sales	(Ecaterina et al., 2009)
Profitability	NI/TA	Net Income/Total Assets	(Ohlson, 1980)
Profitability	EBIT/S	Earnings Before Interest & Taxes/Sales	(Moro et al, 2011)
Leverage	D/E	Debt/Equity	(Ecaterina et al., 2009)
Leverage	RE/TA	Retained Earnings/Total Assets	(Tirapat & Nittayagasetwat, 1999)
Leverage	OK/TA	Own Capital/Total Assets	(Tirapat & Nittayagasetwat, 1999)
Leverage	CL/TA	Current Liabilities/Total Assets	(Moro et al, 2011)
Leverage	TD/TA	Total Debt/Total Assets	(Ecaterina et al., 2009)
Leverage	LTL/TA	Long Term Liabilities/Total Assets	(Ko et al., 2001)
Size	Ln(TA)	Log (Total Assets)	(Low et al., 2001)
Size	Ln(TS)	Log (Total Sales)	(Moro et al, 2011)
Growth	Sales Growth	$(Sales_{(n)} - Sales_{(n-1)})/Sales_{(n-1)}$	(Moro et al, 2011)
Growth	Net Income Growth	$[Net\ Income_{(n)} - Net\ Income_{(n-1)}]/Net\ Income_{(n-1)}$	(Ecaterina et al., 2009)

Table 2 shows 25 ratios, which are selected as potentially helpful variables, for research and evaluation purposes. All these variables have further classified into six categories. The ratios are chosen on the basis of

reputation of ratio in the literature, high relevancy to the study, observance of statistical significance, assessment of inter-correlation among the ratios and scrutiny of the accuracy of projection. Ratios are calculated for each of distressed and non-distressed firms for five years prior to distress or non-distress. For the calculations, when denominators have zero values, they were replaced with the mean value of that there value was replaced with the mean value of that ratio of other companies in the same year as suggested by (Michala, Grammatikos, & Filipe, 2013). These ratios are divided into six groups namely; Liquidity, Activity, Profitability, Leverage, Size, and Growth.

Results and Discussion

Descriptive analysis is done for all the ratios which are discussed in table 3. Mean and standard Deviation of the accounting ratios are presented in each group and overall.

Table 3: Descriptive Statistics of two groups (Distressed and Non-Distressed) and the whole sample

Ratios	All		Distressed		Non-Distressed	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
CA/CL	0.97061	1.429096	0.64739	0.654987	1.29383	1.863991
QA/CL	0.619036	1.177248	0.439601	0.55205	0.798471	1.556501
C/TA	0.406325	0.224289	0.366954	0.241488	0.445695	0.199773
QA/TA	0.04861	0.123443	0.054036	0.154726	0.043183	0.081897
C/CL	0.043331	0.095127	0.0305	0.067568	0.056163	0.11548
WC/TA	-17.6238	172.9458	-35.2052	244.2253	-0.04245	0.239083
CL/TL	0.759499	0.234856	0.767471	0.243172	0.751526	0.227791
TA/S	6.471754	55.82417	11.76732	78.88089	1.176182	0.872878
Inv./S	0.250748	0.52519	0.259634	0.704162	0.241863	0.244588
AR/S	10.48333	18.76279	9.214965	19.97506	11.7517	17.52567
AP/CS	7.140152	71.25675	13.75659	100.7123	0.523718	0.352714
EBIT/TA	-0.02623	0.42979	-0.07069	0.594951	0.018218	0.119409
NP/S	-0.22854	2.716785	-0.48176	3.834677	0.024679	0.196852
NI/TA	-0.02623	0.42979	-0.07069	0.594951	0.018218	0.119409
EBIT/S	-0.21871	2.723125	-0.47665	3.836247	0.039218	0.302167
D/E	209.3994	426.9924	230.4704	578.2919	188.3284	179.1216
RE/TA	-74.445	819.0083	-149.089	1157.756	0.198851	0.2898
OK/TA	26.92551	341.6758	53.52685	483.546	0.324171	0.283699
CL/TA	18.03016	172.9957	35.57217	244.3024	0.488145	0.241584
TD/TA	44.80033	479.148	88.96893	677.2616	0.631717	0.308803
LTL/TA	26.7718	307.6935	53.39676	435.1388	0.146839	0.142657
Ln(TA)	13.182	3.319975	12.75063	3.163913	13.61337	3.438506
Ln(TS)	11.53833	5.23877	10.01737	5.861763	13.05928	4.030915
SalesGrowth	0.145807	0.856303	0.099956	1.105921	0.191658	0.50029
NI Growth	0.439054	17.7222	1.823787	24.71902	-0.94568	4.241271

The descriptive analyses of the figures in table 3 show statistically significant differences in distressed and non-distressed groups. It is evident from the descriptive results that, those

Emerging Issues in Economics and Finance

manufacturing firms going through distressed phase has a low or negative profitability, lack of quality of products, activities are low and also has declining growth level and are small in size and vice versa. The companies which are not in distressed phase or are out of it has a positive productivity, efficient process, quality products and a positive leverage etc.

Table 4: Comparison of Results (MDA, Logit & Probit Analysis)

		MDA / Z-Score		Logit		Probit		
		Correct Prediction	Incorrect Prediction	Correct Prediction	Incorrect Prediction	Correct Prediction	Incorrect Prediction	
Year 1	Non-Distressed	Count	58	9	57	10	57	10
		%	87%	13%	85%	15%	85%	15%
	Distressed	Count	43	24	50	17	49	18
		%	64%	36%	75%	25%	73%	27%
	Overall	Count	101	33	107	27	106	28
		%	75%	25%	80%	20%	79%	21%
Year 2	Non-Distressed	Count	58	9	58	9	59	8
		%	87%	13%	87%	13%	88%	12%
	Distressed	Count	44	23	44	23	44	23
		%	66%	34%	66%	34%	66%	34%
	Overall	Count	102	32	102	32	103	31
		%	76%	24%	76%	24%	77%	23%
Year 3	Non-Distressed	Count	60	7	61	6	61	6
		%	90%	10%	91%	9%	91%	9%
	Distressed	Count	35	32	44	23	44	23
		%	52%	48%	66%	34%	66%	34%
	Overall	Count	95	39	105	29	105	29
		%	71%	29%	78%	22%	78%	22%
Year 4	Non-Distressed	Count	60	7	58	9	60	7
		%	90%	10%	87%	13%	90%	10%
	Distressed	Count	32	35	45	22	45	22
		%	48%	52%	67%	33%	67%	33%
	Overall	Count	92	42	103	31	105	29
		%	69%	31%	77%	23%	78%	22%
Year 5	Non-Distressed	Count	63	4	53	14	53	14
		%	94%	6%	79%	21%	79%	21%
	Distressed	Count	29	38	45	22	45	22
		%	43%	57%	67%	33%	67%	33%
	Overall	Count	92	42	98	36	98	36
		%	69%	31%	73%	27%	73%	27%

The Table 4 summarizes the results of the three financial distress prediction models relating to the Pakistan manufacturing sector financially distressed and non-distressed companies for five years prior to distress.

According to the results of the first year prior to distress, out of 134 financial and non-financial distressed companies, MDA correctly predicted for 101 companies, Logit correctly predicted for 107 companies whereas, Probit correctly predicted for 106 companies. Overall 80% of the companies were correctly predicted by Logit Analysis.

According to the results of the second year prior to distress, out of 134 financial and non-financial distressed companies, MDA correctly predicted for 102 companies, Logit correctly predicted for 102

companies whereas, Probit correctly predicted for 103 companies. Overall 77% of the companies were correctly predicted by Probit Analysis.

As per results of the third year prior to distress, out of 134 financial and non-financial distressed companies, MDA correctly predicted for 95 companies, Logit correctly predicted for 105 companies whereas, Probit correctly predicted for 105 companies. Overall 78% of the companies were correctly predicted by Probit Analysis.

According to the results of the fourth year prior to distress, out of 134 financial and non-financial distressed companies, MDA correctly predicted for 92 companies, Logit correctly predicted for 103 companies whereas, Probit correctly predicted for 105 companies. Overall 78% of the companies were correctly predicted by Probit Analysis.

As per results of the fifth year prior to distress, out of 134 financial and non-financial distressed companies, MDA correctly predicted for 92 companies, Logit correctly predicted for 98 companies whereas, Probit correctly predicted for 98 companies. Overall 73% of the companies were correctly predicted by Probit Analysis.

Overall Probit analysis produced better results throughout the five years prior to distress as compared to Logit and MDA Analysis. It is also evident from the results that all the prediction models more efficiently calculated the results in initial four years prior to distress. The efficiency of the results in all three financial distress prediction models relatively decreased in fifth year prior to distress.

The results of this research study are consistent with (Rashid & Abbas, 2011) where they applied the discriminant model on 52 companies from the textile sector of Pakistan. The Probit model developed through their study had efficient predictive ability in forecasting the distressed companies. The results of this research study are also consistent with (Lee & Choi, 2013) where they examined the different sets of independent variables to predict the bankruptcy in construction, retail and manufacturing companies.

Conclusion

Both financial and non-financial sectors of the economy play a substantial role for the growth and development of the county. This research study focuses only on the manufacturing sector companies of the Pakistan. The balance sheets and income statements of all the manufacturing sector companies were analyzed and after this analysis one hundred thirty-four companies were selected and divided equally in to two groups of financially distressed and non-distressed group. This paper identifies the most suitable financial prediction model which is

significantly contributing towards the identification of financial distress in manufacturing sector companies of Pakistan.

After detailed analyses and testing of financial distress prediction models, this study infers that the manufacturing companies facing financial distress are having low or negative profitability, low asset efficiency, low level of liquidity, higher leverage, decline growth trend and having size and vice versa for the non-financial distressed companies, the financially non-distressed companies stay alive due to their strong and positive trends of the financial ratios. This study finds that those manufacturing firms going through distressed phase has a low or negative profitability, lack of quality of products, activities are low and having declining growth level and are small in size and vice versa. The companies which are not in distressed phase or are out of it has a positive productivity, efficient process, quality products and a positive leverage etc. Furthermore, to have a comprehensive comparison of the financial distress prediction models, MDA model, Logit Model and Probit Models were tested upon the companies operating in manufacturing sector companies of Pakistan. This research study suggests that the Logit and Probit models show better efficiency in predicting the financial distress hence are recommended for their use in analyzing the company's health and prospects.

It is suggested that regulatory bodies like Securities and Exchange Commission of Pakistan and State Bank of Pakistan should incorporate the Probit and Logit models of financial distress prediction for assessing the credit health of the corporate clients for issuance of loans. This will ensure the decline in non-performing loans and will ultimately lead towards economic growth. The predicted ability becomes more accurate for the industry specific models of distress prediction, due to the fact that, the independent variables are specifically selected for each industry. It is therefore left for future research to develop industry specific predictive models to provide more accurate results. A further extension can also be made by incorporating financial distress prediction models in sub groups of the manufacturing sector companies of Pakistan.

References:

- Abdullah, N. A. H., Halim, A., Ahmad, H., & Rus, R. M. (2008). Predicting corporate failure of Malaysia's listed companies: comparing multiple discriminant analysis, logistic regression and the hazard model. *International Research Journal of Finance and Economics*, 15, 201–217.
- Al-khatib, H. B., & Al-Horani, A. (2012). Predicting financial distress of public companies listed in Amman Stock Exchange. *European Scientific Journal, ESJ*, 8(15).
- Altman, E. (1993). *Corporate Financial Distress and Bankruptcy: A Complete Guide to Predicting and Avoiding Distress and Profiting from Bankruptcy*, 2nd edition. John Wiley & Sons.
- Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589–609.
- Altman, E. I., & Hotchkiss, E. (2010). *Corporate financial distress and bankruptcy: Predict and avoid bankruptcy, analyze and invest in distressed debt* (Vol. 289). John Wiley & Sons.
- Argenti, J. (1976). Corporate planning and corporate collapse. *Long Range Planning*, 9(6), 12–17.
- Beaver, W. H. (1968). The information content of annual earnings announcements. *Journal of Accounting Research*, 67–92.
- Deakin, E. B. (1972). A discriminant analysis of predictors of business failure. *Journal of Accounting Research*, 167–179.
- Ecaterina, A. M., Ionut, A. M., & Marin, A. (2009). Using financial ratios to identify Romanian distressed companies. *Economia. Seria Management*, 12(1 Special), 46–55.
- Edmister, R. O. (1972). An empirical test of financial ratio analysis for small business failure prediction. *Journal of Financial and Quantitative Analysis*, 7(2), 1477–1493.
- Fantazzini, D., & Figini, S. (2009). Random survival forests models for SME credit risk measurement. *Methodology and Computing in Applied Probability*, 11(1), 29–45.
- FitzPatrick, P. J. (1932). *A comparison of the ratios of successful industrial enterprises with those of failed companies*.
- Jahur, M. S., & Quadir, S. M. N. (2012). Financial distress in small and medium enterprises (SMES) of Bangladesh: Determinants and remedial measures. *Economia. Seria Management*, 15(1), 46–61.
- Jiming, L., & Weiwei, D. (2011). An empirical study on the corporate financial distress prediction based on logistic model: evidence from china's manufacturing industry. *International Journal of Digital Content Technology and Its Applications*, 5(6).

- Karels, G. V, & Prakash, A. J. (1987). Multivariate normality and forecasting of business bankruptcy. *Journal of Business Finance & Accounting*, 14(4), 573–593.
- Ko, L.-J., Blocher, E. J., & Lin, P. P. (2001). Prediction of corporate financial distress: An application of the composite rule induction system.
- Koh, H. C., LEE, M. H., LOW, A. M., & TAN, T. M. (1989). What Do Your Financial Statements Tell About Your Company's Position and Performance?
- Kristanti, F. T., Rahayu, S., & Huda, A. N. (2016). The Determinant of Financial Distress on Indonesian Family Firm. *Procedia-Social and Behavioral Sciences*, 219, 440–447.
- Lee, S., & Choi, W. S. (2013). A multi-industry bankruptcy prediction model using back-propagation neural network and multivariate discriminant analysis. *Expert Systems with Applications*, 40(8), 2941–2946.
- Lennox, C. (1999). Identifying failing companies: a re-evaluation of the logit, probit and DA approaches. *Journal of Economics and Business*, 51(4), 347–364.
- Li, Z., Crook, J., & Andreeva, G. (2017). Dynamic prediction of financial distress using Malmquist DEA. *Expert Systems with Applications*, 80, 94–106.
- López-Gutiérrez, C., Sanfilippo-Azofra, S., & Torre-Olmo, B. (2015). Investment decisions of companies in financial distress. *BRQ Business Research Quarterly*, 18(3), 174–187.
- Low, S.-W., Nor, F. M., & Yatim, P. (2001). Predicting corporate financial distress using the logit model: The case of Malaysia. *Asian Academy of Management Journal*, 6(1), 49–61.
- Menard, S. (1995). *Applied logistic regression analysis: Sage university series on quantitative applications in the social sciences*. Thousand Oaks, CA: Sage.
- Michala, D., Grammatikos, T., & Filipe, S. F. (2013). *Forecasting distress in European SME portfolios*. Luxembourg School of Finance, University of Luxembourg.
- Moro, R., Härdle, W. K., Aliakbari, S., & Hoffman, L. (2011). *Forecasting Corporate Distress in the Asian and Pacific Region*.
- Mselmi, N., Lahiani, A., & Hamza, T. (2017). Financial distress prediction: The case of French small and medium-sized firms. *International Review of Financial Analysis*, 50, 67–80.
- Muller, G. H., Steyn-Bruwer, B. W., & Hamman, W. D. (2009). Predicting financial distress of companies listed on the JSE-A comparison of techniques. *South African Journal of Business*

- Management*, 40(1), 21–32.
- Ohlson, J. A. (1980). Financial ratios and the probabilistic prediction of bankruptcy. *Journal of Accounting Research*, 109–131.
- Oz, I. O., & Yelkenci, T. (2017). A theoretical approach to financial distress prediction modeling. *Managerial Finance*, 43(2), 212–230.
- Rashid, A., & Abbas, Q. (2011). Predicting Bankruptcy in Pakistan. *Theoretical & Applied Economics*, 18(9).
- Sayari, N., & Mugan, C. S. (2017). Industry specific financial distress modeling. *BRQ Business Research Quarterly*, 20(1), 45–62.
- Tirapat, S., & Nittayagasetwat, A. (1999). An investigation of Thai listed firms' financial distress using macro and micro variables. *Multinational Finance Journal*, 3(2), 103.
- Warner, J. B. (1977). Bankruptcy, absolute priority, and the pricing of risky debt claims. *Journal of Financial Economics*, 4(3), 239–276.
- Xie, C., Luo, C., & Yu, X. (2011). Financial distress prediction based on SVM and MDA methods: the case of Chinese listed companies. *Quality & Quantity*, 45(3), 671–686.
- Zmijewski, M. E. (1984). Methodological issues related to the estimation of financial distress prediction models. *Journal of Accounting Research*, 59–82.

