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Original Article

Gauging Bankruptcy using Altman's Z-Score:Empirical Investigation from the Pharmaceutical Sector

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Abstract

This study aims to construct timely responses to escape financial distress and further losses and prevent financial crises. The main focus of the research is to present the analysis of financial distress on the performance of the five firms listed on the Pakistan Stock Exchange under the Pharmaceutical sector within ten years. If financial distress is not identified in time and inappropriate measures are taken, insolvency (bankruptcy) is likely to occur. This study sought to test the validity of Altman's Z-score and its effectiveness in identifying the financial distress on the performance of firms in the pharmaceutical sector. The sample size consists of cross-sectional time series annual data of five pharmaceutical companies listed on the Pakistan Stock Exchange (PSX). The data set has been tracked for ten years, from 2006 to 2016. The analytical model (Z-score) developed by Edward Altman is used in this study as the statistical technique. The results concluded that Abbot, Glaxo and Wyeth generally experienced stability and incline in the Z-Score values throughout the years. These companies have been fit into non-financial distress. On the other hand, Ferozsons and Highnoon have been in between a range of grey areas. The companies had a probability of experiencing the problems of financial distress. Consequently, companies have started to reach their peak and fit into non-financial distress.

Keywords: Financial performance, Altman Z-Score, Bankruptcy, financial distress, Pharmaceutical sector

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1. INTRODUCTION

Business failure is a worldwide phenomenon in emerging and established countries (Ijaz, Hunjra, Hameed, & Maqbool, 2013). The collapse of small and large businesses globally has set financial distress envisage gain reputation. Local businesses have correspondingly been exaggerated by the financial distress leading to delisting or about to closing (Kipruto, 2013). Certainly, a very small number of businesses established and grew without undergoing cash flow issues in their entire years (Sudarsanam & Lai, 2001). Financial distress is expensive because it forms a tendency for businesses to organise things that are risky to non-financial stakeholders. Furthermore, financial distress may be expensive if a business's destabilised condition brings a hostile response from the opponents to grasp the opportunity of gaining market share (Opler & Titman, 1994). Recent studies further endorse it (Anggraini & Verlandes, 2023; Hamdani et al., 2023).

The earlier the exposure, the more time is allowed to make suitable strategies. Subsequently, financial distress is not an unexpected event, so it is conceivable to envisage and avoid the situation (Natalia, 2007); (Altman, 2000). Financial analysis is a precarious method of reviewing the organisation's financial position. It provides a perfect guide to appraise and recognise the organisation's financial position. There are some methods to evaluate the organisation's financial situation: ratio analysis, cash flow analysis, decision theory, comparative statement analysis, credit analysis, etc. Financial statement analysis is the finest tool to identify the performance of the business during the year. As well as it is the easiest

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instrument for the stakeholders to analyse the business strength. (Deakin, 1972).

Financial Distress

Financial distress is when the liabilities go beyond the company's assets. Usually, it happens because of under-capitalization, insufficient cash, improper utilisation of resources, disorganised management in overall activities, declining sales volume or other hostile market situations. Financial distress is a declining state of the company's cash flow in which deadweight losses arise without insolvency (Opler & Titman, 1994). Various concerns of financial distress have come up from several perspectives and disciplines comprising management, finance, economics, accounting, political theory and legal theory (Van Gestel, et al., 2006).

Gauging the bankruptcy in the pharmaceutical sector using Altman's Z-score, Akhtar (2021) considered seven companies listed on the Bangladesh stock exchange. Only three companies fall in the grey region, whereas the rest have sound financial health. Similarly, Acharyya (2023) selected ten pharmaceutical companies listed on the Bombay Stock Exchange and found that only one company is in the grey region, whereas the rest enjoy good financial health.

Financial Distress Prediction Model

Altman's (1968) Z-score model has been applied in this study to predict organisational financial distress. Edward Altman formulated the Z-Score after appraising sixty-six (66) manufacturing firms, partially of which had filed for insolvency (bankruptcy) between 1946 and 1965. He initiated with twenty-two (22) financial ratios. However, he narrowed it down into five major categories: "Liquidity, Leverage, Profitability, Solvency and Activity" and considered the most excellent combination to foresee bankruptcy (Muchlis & Jayanti, 2010).

Z-Score for Private Firms

The original Z-Score model was developed for public manufacturing firms. In 1983, Edward Altman promoted a modified Z-Score formula for private firms. The private firm version weights the factors differently and replaces market capitalisation with "book value of equity".

Z-Score for Non-manufacturing Firms

Another Z-Score model was developed for non-manufacturing firms because the original Altman model was developed for manufacturing firms. However, growing large public service firms encouraged him to expand the Z-Score model for non-manufacturing firms. The formula is the same as the previous; only the last component has been excluded, "(sales/total assets)", because Altman required reducing the effects of manufacturing rigorous asset turnover.

Research Objective

The specific research objective of the study is to establish Altman's Z-Score model validity in foreseeing financial distress in the firms.

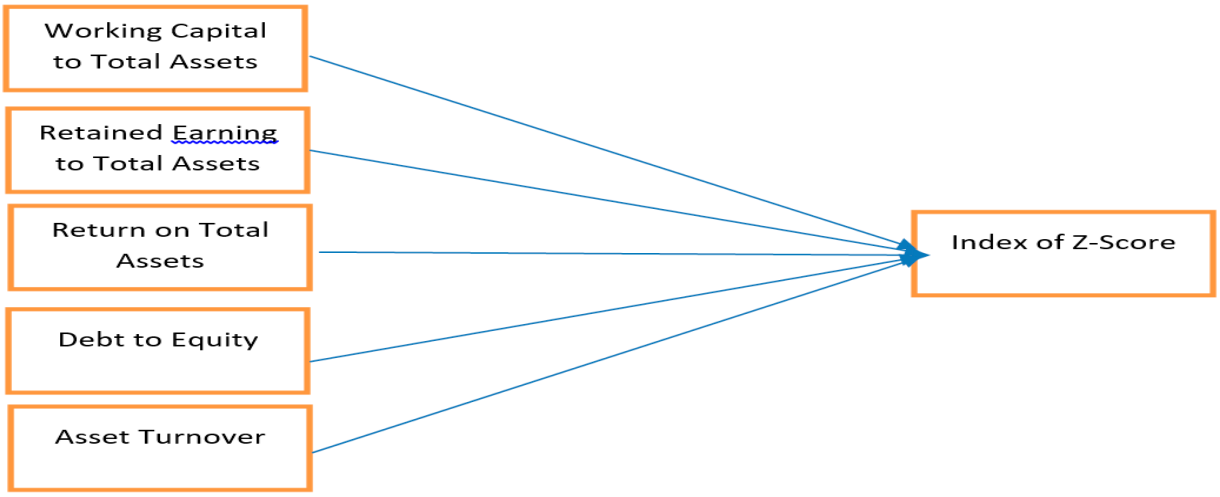
Scope

This study aims to construct timely responses to escape financial distress and further losses and prevent financial crises. The main focus of the research is to present the analysis of financial distress on the performance of the six firms listed on the Pakistan Stock Exchange under the Pharmaceutical sector within eleven years.

Statement of the problem

If financial distress is not identified in time and inappropriate measures are taken, insolvency (bankruptcy) is likely to occur. This study sought to test the validity of Altman's Z-score and its effectiveness in identifying the financial distress on the performance of firms in the pharmaceutical sector.

Theoretical Framework



The above theoretical framework has been developed to present the association of different financial ratios with an assumption that Altman's Z-Score is the well-organized method for reviewing the organization's financial distress. In this study, five classified ratios (Working Capital to Total Asset Ratio, Retained Earnings to Total Assets Ratio, Return on Total Assets, Debt to Equity Ratio and Asset Turnover Ratio)" are taken as independent variables, and the weighted average of these ratios (Z-score) is taken as dependent variable.

Research Question

How much a firm is financially sound?

2. LITERATURE REVIEW

Theoretical Background

Altman's z-score model is a direct combination of five common financial ratios weighted by coefficients (Beaver, 1966). A financial ratio is a proportion of two figures comprising both numbers of financial statements (Altman, 2000).

Although Altman formulated the Z-score in the 1960s, the concept of trying to envisage which firms would not succeed was far away from the new firms at that era. Consequently, Altman appended the statistical technique with high intensity of accuracy, named "Multiple Discriminant Analysis (MDA)", with the combination of the conventional ratio analysis techniques. This combination permitted him to consider the impacts of various ratios on the "Predictiveness" of the bankruptcy model and how those ratios distressed each other's effectiveness in the model (Muchlis & Jayanti, 2010).

Determinants of Financial Distress

Various instances are mixed on determinants of financial distress, which are interconnected and evaluated in all-time complexity. The consequence of financial distress draws from the declining financial performance of the firms and can have many other reasons. Such as poor supervision, unwise extension, severe competition, excess debt, massive legal actions, and adverse contracts are some of the feasible causes (Natalia, 2007).

Two major components are causing financial distress: internal and external components. "Poor financial management, excess of debt, fraud or corruption, ineffectual management" is considered an internal component. "Severe competition, unnecessary expansion, political volatility, declining prices and change in demand of customers" are considered external components (Njogo, 2011); (Zmijewski, 1984). The most considerable cause of financial distress is "poor management" (Whitaker, 1999), high intensity of leverage causes a firm's financial distress (Andrade & Kaplan).

Empirical Studies

The study was conducted by (Makini, 2015), aiming for Altman's Z-score failure prediction model to forecast the financial distress of the companies registered on the Nairobi Securities Exchange. Secondary data was taken for five years, from 2010 to 2014 and analysed using SPSS. The variables included "working

capital, retained earnings, EBIT, total equity, sales, total assets and liabilities". Altman (1968) adopted it as a statistical technique for analysis. The results concluded that the Z-score model used was suitable for predicting the financial distress of the companies registered on the Nairobi Securities Exchange. Furthermore, the study suggested that stockholders and stakeholders adopt Altman's prediction model. (Emre & Serdar, 2023; Ahmad, Ali & Usman, 2018).

The impact of financial distress was gauged concerning the Pakistani corporate sector, where a sample size of fifteen companies from the Energy and fuel sector was selected with a period of six years, from 2007 to 2012. Altman's Z-score model was proposed to analyse the financial health of the firms and measure the effect of financial distress on the financial performance of the companies. The outcome showed that financial distress and performance significantly correlate with each other. Furthermore, results revealed that an increase in Z-score values will increase the financial performance and reduce the financial distress of the companies in the Energy and fuel sector. (Shaukat & Affandi, 2015)

A study was conducted to forecast the risks of bankruptcy and the financial health of manufacturing firms using Altman's Z-score. Raysut Cement Company SAOG and its subsidiaries in Oman were the firms under consideration. The data was extracted from the companies' annual financial reports from 2007 to 2014 for eight years. The study illustrated that manufacturing firms and their subsidiaries have a greater Z-score in all years than the benchmark (2.99), except for a few years. (Mohammed, 2016). Reschiwati et al. (2020) have considered five pharmaceutical companies' sub-sectors. This research uses descriptive analysis techniques and multiple linear regression analysis with Random Effect Model (REM) methods. They found that Liquidity (Cash Ratio) had a significant positive effect, Solvency (DAR) and inflation had a significant negative effect on Financial Distress, whereas profitability (ROE) does not affect Financial Distress.

Furthermore, (Ilahi, Jamil, Kazmi, Ilahi, & Lodhi, 2015), presented research on the topic "Financial Performance Analysis of Pakistan Banking Sector Using the Altman Z-Score Model of Corporate Bankruptcy". The objective of the research was to explore the financial difficulties faced by commercial banks in Pakistan. The sample data was collected from the commercial banks registered on the Karachi Stock Exchange (KSE) for the period of five years from 2009 to 2013. The findings concluded that all the commercial banks selected in the model faced financial difficulties, including those functioning well. Therefore, the results suggested that Altman's Z-score cannot forecast commercial banks' bankruptcy or financial performance.

In addition, a paper by (Khaliq, Motawe Altarturi, Thaker, Harun, & Nahar, 2014), presented to address the financial distress measurement amongst thirty Government Linked Companies (GLC) registered on Bursa Malaysia for the period of five years starting from 2008 to 2012. Liquidity ratio was taken as an independent variable (measured by current ratio and debt ratio), whereas financial distress was taken as a dependent variable (measured by Altman's Z-score). The conclusion is that both determinants, namely, current and debt ratios, significantly correlate with the financial distress measured by the Z-score.

Stock investment is always uncertain, and financiers are unwilling to invest in the stock market. Investors will assertively put their money in stocks if they get the true factors influencing the stock prices. The research presented by (Ahmad & Raza, 2016), detects "the effect of the financial health of the companies, financial leverage, liquidity and profitability on stock returns whereas, for controlling for the size of firm and book value to market equity". Altman's Z-Score model for predicting insolvency was taken as a measure to distinguish the companies restrain distress (financial and non-financial). The data set of seven years from 2007 to 2013 was gathered from the companies registered on the Pakistan Stock Exchange (under the cement, Pharmaceutical, and chemical sectors) and from the financial statements analysis performed by the State Bank of Pakistan.Multiple Regression model was used as a statistical technique to identify the association. The findings concluded that a significant association was found between financial health and stock returns, while financial distress affects stock returns and has a significant association. Furthermore, stock returns positively correlate with firm size and ROA, whereas financial leverage and returns have an inversely significant association. An insignificant association was found between liquidity and market equity. (Pratiwi, 2022; Milašinović, Knežević & Mitrović 2019).

Nayem (2022) empirically investigated the impact of each component on the overall z-score of the selected pharmaceutical companies listed on the Dhaka Stock Exchange (DSE), where nine companies were considered, and six years of data were obtained from 2015 to 2020. This study used Altman's Z score model to categorise the companies into the "Distress", "Grey", and "Safe" categories to predict the bankruptcy risk of the company. A one-sample t-test found that the pharmaceutical industry is at

a significant risk of bankruptcy. Similarly, Verma (2022) attempted to predict the default occurrence of selected pharmaceutical sector firms using MDA – Multiple Discriminant Analysis, Logit function, structural model, Altman's model and calibrated model. The findings show that the structural model performed quite well for classifying defaulted cases than non-defaulted cases. Out of 53 defaulted cases, the structural model correctly classified 45 cases with up to 85% accuracy.

3. METHODOLOGY

Data

Only a single source of data has been used in this study, which was gathered from different official websites, including:

- State Bank of Pakistan
- Pakistan Stock Exchange
- Companies' websites (Financial reports)

Variables

There are different types of financial ratios are used in the model. Details are given below:

Working Capital to Total Asset Ratio:

The Liquidity Ratio measures net liquid assets over total capital and shows whether a company has adequate assets to cover its debt in the short-term.

Retained Earnings to Total Assets Ratio:

The Leverage Ratio used to measure the company's leverage and specifies the extent to which the company relies on debt financing.

Return on Total Assets:

The Profitability Ratio is used to measure the true productivity of the company and is considered to be an indicator of how profitable a company is compared to its assets.

Debt to Equity Ratio:

The Solvency Ratio measures a company's financial leverage and specifies the comparative proportion of debt and shareholders' equity used for financing a company's assets.

Asset Turnover Ratio:

The Activity Ratio measures the company's efficiency and ability to generate sales revenue from its assets.

Statistical model

The analytical model (Altman's Z-score) is used in this study for testing the financial soundness of a firm, which are given as follows:

"Z = 0.717*X1+0.847*X2+3.107*X3+0.420*X4+0.998*X5"

Where;

"Z=Weighted average of five separate ratios"

"X1=Working Capital/Total Assets (WC/TA)"

"X2=Retained earnings /Total Assets (RE/TA)"

"X3=Earnings before Interest and Taxes/Total Assets (EBIT/TA)"

"X4=Book Value of Equity/Book Value of Total Liabilities"

"X5=Sales/Total Assets (S/TA)"

The cutoff rate for the calculated value of the inventive Z-score:"

Z-Score Range	Interpretation	Decision
Z-Score ≥ 2.99	Good Sign	No Financial Distress
1.23< Z-Score <2.99	Warning Sign	Grey Area
Z-Score ≤ 1.23	Bad Sign	Financial Distress

Source: Altman (2000)

No Financial Distress:

It indicates that the firm does not experience any difficulty; it is in good financial position and safe from financial distress.

Grey Area:

It indicates that the firm has a chance to experience the problems of financial distress.

Financial Distress:

It indicates that the firm experienced a severe threat of financial distress.

Sample & Sampling technique

The sample size consists of cross-sectional time series annual data of six pharmaceutical companies listed on the Pakistan Stock Exchange (PSX). The data set has been tracked for ten years, from 2006 to 2016 and was obtained via secondary sources.

Inclusion Criteria

The study mainly focuses on the data composed at the particular time duration of eleven years, which can illustrate the firms' financial position while keeping in mind cost-effective conditions, challenges and threats affecting the activities of the firms.

Statistical Technique

The analytical model (Z-score) developed by Edward Altman is used in this study as the statistical technique because this model contains a high level of effectiveness and accuracy in evaluating the firm financial distress. Despite all these concerns, this model is still among the well-known and broadly used measures of financial distress.

4. RESULTS AND FINDINGS

The values are obtained from the financial ratios of each pharmaceutical company to calculate the Altman Z-Score and evaluate the results which have been presented. The table below presents the Z-Score values of each company under the pharmaceutical sector and its tendency, whether it has a propensity to rise, stabilise or fluctuate and decline for 11 years (2006 to 2016). The trend value Altman Z-Score can be used to analyse the financial condition of the companies belonging to the pharmaceutical sector that will experience financial distress and are situated in a grey area condition.

Abbot Laboratories

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
4.962	4.648	3.209	3.536	4.134	4.26	4.345	4.861	4.842	4.576	5.130

The table above presents the Z-Score of Abbot Laboratories. The values for this company have been greater than 2.99, which is a good sign throughout the 11 years from 2006 to 2016. It indicates that the firm does not experience any difficulty; it is in a good financial position and safe from financial distress.

Ferozsons Laboratories Limited

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.522	2.511	2.382	2.294	2.695	2.669	3.151	3.299	3.397	3.141	5.068

The chart above presented the Z-Score of Ferozsons Laborites Limited. The values for this company have been in between a range of grey areas (1.23 - 2.99), demonstrating the warning sign and specifying

that the company had a probability of experiencing problems of financial distress from 2006 to 2011. Consequently, from 2012 to 2016, the Z-Score for this company have been greater than 2.99, which is a good sign throughout the 5 years. It indicates that the firm has started to reach its peak in the subsequent years from 2012 to 2016 and does not experience any complexity; it is in good financial position and safe from financial distress."

GlaxoSmithKline Pakistan

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
4.206	4.094	4.280	3.522	3.205	3.328	3.229	2.786	2.912	2.901	3.043

The table above presents the Z-Score of GlaxoSmithKline Pakistan. The values for this company have been greater than 2.99 which is a good sign throughout the 11 years from 2006 to 2016. In 2013, the company struck an all-time low and started to reach its level in the subsequent years from 2014 to 2016. It indicates that the firm has the potential to lift and does not experience complexity; it is in good financial position and safe from financial distress."

Searle Pakistan Pvt. Limited

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.726	1.580	1.877	2.494	2.782	2.746	2.180	2.412	2.388	2.805	3.065

The table above presents the Z-Score of Searle Pakistan Pvt. Limited. The values for this company have been in between a range of grey areas (1.23 - 2.99) throughout the years. It demonstrates the warning sign and specifies that the firm had the probability of experiencing problems of financial distress in the following years. The values also indicate that the firm is likely to lift and can face the challenges with continuous improvement.

Highnoon Laboratories

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1.980	2.121	1.953	2.021	2.254	2.836	2.393	3.136	3.397	3.882	3.833

The chart above presents the Z-Score of Highnoon Laborites Limited. The values for this company have been in between a range of grey areas (1.23 - 2.99), demonstrating the warning sign and specifying that the firm had the possibility of experiencing problems of financial distress from 2006 to 2011. Consequently, from 2013 to 2016, the Z-Score for this company have been greater than 2.99, which is a good sign throughout the 5 years. It indicates that the firm has started to reach its peak in the subsequent years from 2013 to 2016 and does not practice any complexity; it is in a good financial position and safe from financial distress.

Wyeth Pakistan Limited

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
3.936	3.958	3.964	2.948	2.931	3.841	4.611	3.731	3.261	3.141	2.285

The chart above presents the Z-Score of Wyeth Pakistan Limited. The values for this company have been greater than 2.99, which is a good sign throughout the 10 years from 2006 to 2015. It indicates that the firm does not experience any difficulty; it is in a good financial position and safe from financial distress. In 2016, the company struck an all-time low in the year 2016; still, the firm has the potential to lift again and will start to reach its level in the subsequent years."

Discussion

The results of Z-Score have been used to analyse which pharmaceutical company is experiencing financial issues. Hence, Abbot, GlaxoSmithKline and Wyeth generally experienced stability and incline in the Z-Score values throughout the years. These companies have been fit into non-financial distress, do not experience any difficulty and are in a sound financial position."

On the other hand, Ferozsons and Highnoon have been between a range of grey areas. The companies had the probability of experiencing problems of financial distress for six to seven years. Consequently, from 2012 and 2013 onwards, the companies have started to reach their peak in the subsequent years and do not practice any complexity, are in good financial position and fit into non-financial distress. Furthermore, Searle has been fit into financial distress; the values for this company have been in between the range of grey areas throughout the years, but it has a significant rise in value, especially in 2016."

5. CONCLUSION

This study concludes that an increase in Z-score values will lead to an increase in financial performance and reduce the financial distress of the companies belonging to the pharmaceutical sector, as the results of the study succeeding with the research papers previously presented by Shaukat & Affandi, (2015). Furthermore, a study conducted by Makini, (2015) suggested that not only stockholders but also the other stakeholders adopt Altman's prediction model. The results, also supporting the study presented by Mohammed (2016), illustrated that the manufacturing firm and its subsidiaries have greater Z-scores in all years as compared to the benchmark (2.99), except for a few years."

It has been clear that the key purpose of most of the preceding research concerned with the distress prediction models is to recognise the accuracy and validity of Altman's Z-score model to determine failure."

Limitations and Recommendations

This study has been limited to the pharmaceutical companies and focused on one type of industry. However, data from six companies have been taken to examine the analysis, but it can also be examined by including the remaining companies under the pharmaceutical sector. This study covered ten years because of time limitations, and as such, outcomes may be dissimilar if the period covered can be expanded. There could be a difference in the outcomes if this research has to cover other companies listed on the Pakistan Stock Exchange under different sectors.

Regarding recommendations, it is clear that a greater sample size increases the accuracy ratio. Moreover, using more than one model for anticipating failure may increase the chance of analysing the greatest and the most accurate model. The alternative models, such as the Logit Regression Model and Artificial Neural Networks Model (ANN)."

Competing Interests

The authors did not declare any competing interest.

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