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Research Article

Assessment of financial distress of selected pharmaceutical companies in Bangladesh by using Altman's Z-Score model

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ABSTRACT

A company's financial soundness or financial health depends on the ability to pay its current debt obligation. In the business world, several techniques are typically used to assess a company's financial stability. However, the Z-score model created by Professor Edward I. Altman in 1968 is now recognized as the most precise and reliable tool for predicting a company's financial distress or risk of bankruptcy. Here, Multiple Discriminate Analysis (MDA) is used to consolidate the effect of all ratios. In this study, the Z-Score is used to forecast the financial distress status of Bangladesh's top five pharmaceutical companies. Secondary data sources have been used to facilitate the study. The study identifies that the financial positions of Square Pharmaceutical Ltd. are far better than those of the other four selected pharmaceutical companies in Bangladesh, whereas Beximco and Beacon Pharmaceutical's Z-score values fluctuate over time. The study's findings can help investors and others who are interested in Bangladesh's pharmaceutical sector make investment decisions.

Keywords: Financial distress, Altman's Z-score, Bankruptcy, Pharmaceutical companies.

1. Introduction:

Financial performance analysis is the process of determining an appropriate link between the elements of the income statement and balance sheet to identify a company's financial strengths and weaknesses. It also aids in predicting growth in both the short and long term. Financial Performance, in a more comprehensive sense, refers to the degree to which the organization's financial goals have been attained. It is a technique for examining the relationship between the various financial statement elements to comprehend the company's financial status and performance better. It's used to evaluate companies in the same industry, as well as to assess an industry's or sector's overall financial health over time and how one company compares to others in a similar industry. The financial health of a company can be determined in a variety of ways. The Z score developed by Altman, on the other hand, has a reputation for being a trustworthy tool. This model is dedicated to predicting the likelihood of a company's insolvency. It has been proven that it accurately forecasts the bankruptcy of the underlying sample with a 76.9% accuracy rate. (Beaver, 1966; Joy, Ming, & Susan, 1996) . (Altman, 1968) identifies five anticipated

variables that might be used to evaluate the correctness of a multivariate model. Financial ratios provide the basis of the model. (Chen & Shimerda, Spring, 1981) discovered that financial ratios could predict bankruptcy with 90% accuracy.

2. Literature review:

"Beaver was the first to look at the usefulness of accounting data in forecasting bankruptcy, and the earliest research on financial distress and bankruptcy projections dates back to the 1960s. (Beaver, 1966)". Beaver described corporate financial distress as an organization's "inability to meet its financial obligations when they become due." He focused on several types of financial distress, including bankruptcy, overdrawn bank accounts, bond defaults, and preferred stock defaults.

"By Andrade and Kaplan Andrade and Kaplan (Andrade & Kaplan, 1998) the incidence of corporate financial difficulty distinguishes between two time periods of a company's operations: financial health and financial disease. Financial trouble can take two different forms: failing to make debt payments and debt restructuring. When a company's management believes that financial adversity is imminent, it considers debt restructuring."

"Bankruptcies can be predicted by Z-score models up to three years in advance, according to Gerantonis Vergos and Christopoulos (Gerantonis, Vergos, & Christopoulos, 2009). The Altman model did well in forecasting failures, according to the findings. They discovered that the findings may be applied by company management in making financial decisions, by regulatory bodies in selecting stocks, and by portfolio managers in selecting stocks."

Anup & Suborna, (2009) implemented the Z scoring model to determine the financial distress risk of each Z category stock traded on the DSE. They calculated the Z-score using statistics from 53 firms from the years 2000 to 2005. They argued that while Altman's Z-score approach isn't always entirely applicable to businesses in Bangladesh, it nevertheless shows significant validity and accuracy in forecasting the distress of Z-category businesses.

The Z score model was used to evaluate the financial stability of the Indian steel industry (Ramaratnam, Jayaraman, Enathur, & Nadu, 2010).The research used data from five steel companies over five years (2006–2010). During the course of their research, they discovered that all of the companies they chose were financially healthy.

Tyagi, (2014) employed Z score analysis to assess the financial status of the logistics industry in India. It demonstrates that the Indian logistics sector was doing well. When the Indian economy was struck by the global recession in 2006, the average Z score increased from 2.54 to 3.01, which is a good thing. This means that the logistics sector in India performed well overall.

Alkhatib & Al Bzour, (2011) examined the role of financial ratios using the Altman and Kida models in predicting insolvency in Jordanian publicly traded enterprises. The study sample covered the years 1990 to 2006 and included industrial and non-financial service companies. With an average accuracy of 93.8 percent in the five years before the liquidation occurrence, Altman's model outperforms Kida's model in terms of corporate bankruptcy prediction. They recommended that Jordanian publicly traded companies use at least one of these high-credibility models to anticipate corporate bankruptcy.

 Mizan, Amin, & Rahman, (2011) "conducted a study in Bangladesh to forecast the insolvency of the pharmaceutical industry. For this, they used the Altman Z-score Model, with a sample size of six major corporations in the industry. Their research uncovered some interesting facts, including the fact that two companies were deemed to be financially healthy, with no imminent risk of bankruptcy, while the other companies were revealed to be unsatisfactory, with a high risk of financial disaster in the upcoming future".

"Research was done to analyze the financial health of Bangladesh's cement sector (Mizan & Hossain, 2014). Two of the five companies are financially sound, according to the findings, as their Z scores exceed the reference (2.99). Another firm is in the grey area in that it is financially solid but requires managerial care to improve the organization's financial health".

"As described by Hamid, Akter, & Rab, (2016), this study use Altman's Z Score Model (1965) to forecast the financial standing of 15 NBFIs listed on Bangladeshi stock markets during five years between 2011 and 2015. The findings reveal that the majority of the sampled NBFIs are in the "distress" zone. Some of the NBFIs in the sample received awards on a national and international level for their remarkable achievements and contributions made to the country's economic and industrial growth, however, they did not achieve the required score".

"Following Shariq, (2016) showed that Raysut Cement Company SAOG and its affiliates are financially stable since they consistently score better than the benchmark (2.99), except for a few research years. The study's conclusions may be helpful to managers when making financial decisions, shareholders when selecting investments, and others when protecting their interests about the nation's concerned cement makers".

Moreover, a study by Ansari *et al*., (2023) conducted on five pharmaceutical companies on the Pakistan Stock Exchange revealed that Abbot, Wyeth, and Glaxo are more financially stable firms than Highnoon and Ferozsons.

There is a direct correlation between corporate governance and financial crisis (Begum *et al*., 2023). Ownership structure, audit committee, and board of directors define corporate governance, while Altman Z-scores indicate financial distress. In the study, financial difficulties are influenced by company-level characteristics (sales growth, performance, liquidity, firm size) and corporate governance elements (board independence, auditor independence, auditor opinion, sponsor directors' ownership, and foreign shareholders).

3.   Research Gap:

To predict a company's financial issues, the Altman Z-score model is used in several research undertaken globally, including in Bangladesh. The majority of studies on financial challenges in Bangladesh is centered on PCBS, with very few studies focusing on pharmaceutical businesses. One review of the literature on seven pharmaceutical companies in Bangladesh claims that two of the companies are moving toward good ratings, while three pharmaceutical companies are found to be financially healthy with a higher Z-score. It was also discovered that two more pharmaceutical companies may file for bankruptcy shortly due to their unsound financial standing (Akter, 2021).

4.   Altman's Model for Predicting Financial Distress:

Edward Altman created the Altman Z Score Model (Altman, 1968) to anticipate financial difficulty, and it is widely utilized in a variety of industries. Auditors and management accountants approved it in the 1980s. The Z-Score formula, developed by Altman, is a multivariate method that examines a company's financial performance using basic financial ratios. It involves an examination of a company going bankrupt in the next two years. According to certain studies, the model can predict bankruptcy up to two years ahead of time with an accuracy of 72 to 80%. A sample of 66 manufacturing enterprises was used to develop the original formula. In the early 2000s, Altman changed the formula to allow it to be applied to scenarios that were not included in the initial sample set. The Z-Score employs a variety of accounting ratios to forecast a company's financial difficulty and potential insolvency. Altman used five popular business ratios and systematically weighted them in his calculations to come up with the formula. Working capital to total assets, retained earnings to total assets, EBIT to total assets, market value of equity to book value of total liabilities, and total assets turnover were the five financial ratios he discovered. These five financial ratios, he discovered, can distinguish between organizations that are bankrupt and those that are not. The original formula for the Z-Score was:

$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$

Where, Z = Discriminate function score of a firm, X_1 = Working Capital/Total Assets (WA/TA), X_2 = Retained Earnings/Total Assets (RE/TA), X_3 = Earnings before Interest and Taxes/Total Assets (EBIT/TA), X_4 = Market Value of Equity/Book Value of Total Liabilities (MVE/BVTL), X_5 = Sales/Total Assets (S/TA)

3.1 'Z'-score ingredients:

The Z-score is computed by multiplying the accounting ratios shown below, and it is effective in forecasting bankruptcy.

X_1 (Working Capital/Total Assets)	This ratio reflects the company's liquidity status in relation to its total capitalization. Working capital is the sum of current assets minus current liabilities.
X_2 (Retained Earnings / Total Assets)	It reflects the amount of the company's leverage by indicating the amount reinvested, as well as earnings and losses. In other words, the amount of assets that have been paid out of corporate profits.
X_3 (Earnings before Interest and Taxes / Total Assets)	It is a measure used to assess a company's operating efficiency as well as its earning potential. Furthermore, this is a measure of the firm's asset productivity that is independent of any tax on advantage factors.
X_4 (Market Value of Equity / Book Value of Total liabilities)	It is an indicator of a company's long-term viability. The market value of all shares is used to determine equity. While debt comprises both current and long-term liabilities, this measure demonstrates how much an enterprise's assets can depreciate in value before the liabilities surpass the assets and the company goes bankrupt.
X_5 (Sales / Total Assets)	This is a common method of calculating turnover. Regrettably, it differs significantly by industry. It will also disclose the assets' ability to generate revenue and a measure of management's ability to deal with competitive situations.

3.2 Altman's guidelines for health zone:

Situation	Z-Score	Zone	Remarks
I.	Below 1.8	"Distress" Zone	There is a significant likelihood that the company may experience financial difficulties in the near future, and it may be forced to take drastic measures to stay afloat in the market.
II.	Between 1.8 and 2.99	"Gray" Zone	The company is in the gray region, which indicates that it is less likely to suffer financial difficulties in the near future.
III.	3.0 and above	"Safe" Zone	The company is financially stable, with little chance of going bankrupt.

5.   Objectives of the study:

The study is designed to achieve the following objectives:
  i.   To evaluate the financial stability of the selected pharmaceutical companies through using Z-score model.
  ii. To find out the financial stability and profitability of the pharmaceutical companies that have been chosen.

6. Methodology:

The research is based on secondary data gathered from published annual reports of selected pharmaceutical companies in Bangladesh. Five pharmaceutical companies in Bangladesh have been included in the study's sample size using convenience sampling techniques. The current investigation takes place during a ten-year period between 2013 and 2022. To examine financial performance, Altman's Z-score model has been used. The assertion of each of Altman's Z score model's components with respect to their sample unit has also been tested using the One-way ANOVA test.

6.1 Hypothesis of the Study:

H_{o1}: Working capital to total assets ratio is equal in the sample units.
H_{o2}: Retained earnings to total assets ratio is equal in the sample units.
H_{o3}: EBIT to total assets ratio is equal in the sample units.
H_{o4}: Market value of equity to book value of total liabilities ratio is equal in the sample units.
H_{o5}: Sales to total assets ratio is equal in the sample units.
H_{o6}: Z-score value is equal in the sample units.

7. Results and Discussion:

Table-1: The ratio of WC/TA of the selected companies

Year	Pharmaceuticals							
	Beximco	Square	Renata	IBN Sina	Beacon	Mean	S.D.	Std. Error
2013	0.1646	0.0940	-0.0888	0.0543	0.1938	0.0836	0.1111	0.0497
2014	0.1262	0.1332	0.0057	0.0098	0.2386	0.1027	0.0975	0.0436
2015	0.1145	0.1644	0.0518	-0.0619	0.3006	0.1139	0.1343	0.0601
2016	0.1780	0.2041	0.1148	-0.0770	0.2817	0.1403	0.1354	0.0606
2017	0.1680	0.3244	0.1832	-0.0385	0.2520	0.1778	0.1359	0.0608
2018	0.0532	0.4061	0.2617	-0.0830	0.2175	0.1711	0.1898	0.0849
2019	0.0105	0.5430	0.3192	-0.0637	0.2774	0.2173	0.2459	0.11
2020	0.0337	0.5872	0.3185	-0.0717	0.2413	0.2218	0.2573	0.1151
2021	0.0846	0.5986	0.2831	0.0596	0.2839	0.262	0.216	0.0966
2022	0.0859	0.6090	0.1025	0.1176	0.1637	0.2157	0.2217	0.0992
Mean	**0.1019**	**0.3664**	**0.1552**	**-0.0155**	**0.2451**			
S. D	**0.0585**	**0.2086**	**0.1410**	**0.0710**	**0.0436**			
Std. Error	**0.0185**	**0.066**	**0.0446**	**0.0225**	**0.0138**			

Source: Authors' calculation based on the annual reports of the selected pharmaceutical companies

The ratio of working capital (WA) to total assets (TA) is displayed in **Table 1**. Maintaining a specific amount of money as liquid assets is crucial for carrying out day-to-day business operations efficiently. Because unproductive money from maintaining a high WC/TA ratio impairs profitability, every business organization should pay close attention to managing working capital as well as balancing the firm's profitability. Square outperformed all other sample units' pharmaceutical firms in Bangladesh in terms of this ratio. In addition, the aggregate ratio has dramatically risen over time, indicating that everyone except IBN Sina Pharmaceuticals is particularly concerned about maintaining the high level of liquidity.

Table 2: One-way ANOVA of the WA/TA ratio

ANOVA Summary						
Source of variation	**df**	**SS**	**MS**	**F-Stat**	**P-Value**	**F crit**
Between Groups	4	0.8348	0.2087	14.147	1.507e-7	2.5787
Within Groups	45	0.6638	0.0148			
Total	49	1.4986				

Results of a one-way ANOVA test on the WA/TA ratio for five selected at random pharmaceutical businesses in Bangladesh are shown in **Table 2.** The one-way ANOVA table reveals the convincing outcomes is that the calculated value (F_{cal}=14.147) is far more than the F critical value (F_{tab} = 2.5787). The null hypothesis is rejected because the estimated value of F falls inside the rejection zone with df (4, 45) at a 5% level of significance. As a result, there is a statistically significant difference between the working capital to total assets ratio in the sample units.

Table 3: The ratio of RE/TA of the selected companies

Year	Pharmaceuticals					Mean	S.D.	Std. Error
	Beximco	**Square**	**Renata**	**IBN Sina**	**Beacon**	**Mean**	**S.D.**	**Std. Error**
2013	0.2791	0.5415	0.4350	0.1784	0.0298	0.2928	0.2028	0.0907
2014	0.2995	0.5814	0.4721	0.2133	0.0520	0.3237	0.2092	0.0935
2015	0.3276	0.6095	0.5199	0.2216	0.0618	0.3481	0.2215	0.0991
2016	0.3440	0.6577	0.5876	0.2200	0.0737	0.3766	0.2454	0.1097
2017	0.3688	0.7130	0.6449	0.2566	0.0738	0.4114	0.267	0.1194
2018	0.3340	0.6925	0.6846	0.3845	0.0828	0.4357	0.2576	0.1152
2019	0.3484	0.8529	0.7149	0.4107	0.0830	0.482	0.3058	0.1367
2020	0.4002	0.8740	0.7074	0.4259	0.1022	0.5019	0.2986	0.1335
2021	0.4628	0.9093	0.7079	0.4780	0.1913	0.5499	0.2718	0.1215
2022	0.4195	0.9392	0.6650	0.5357	0.2223	0.5563	0.2689	0.1202
Mean	**0.3584**	**0.7371**	**0.6139**	**0.3325**	**0.0973**			
S. D	**0.0559**	**0.1454**	**0.1043**	**0.1285**	**0.0614**			
Std. Error	**0.0177**	**0.046**	**0.033**	**0.0406**	**0.0194**			

Source: Authors' calculation based on the annual reports of the selected pharmaceutical companies

The profitability ratio of a business entity is shown in **Table 3** as the ratio of retained earnings to total assets. All sorts of company enterprises regard their capacity to generate revenue utilizing their whole assets to be their source of life. According to the data analysis (**table 3**), Square Pharmaceuticals has the highest profits performance (0.7371) while Beacon has the lowest (0.0973).

Table 4: One-way ANOVA of the RE/TA ratio

ANOVA Summary						
Source of variation	**df**	**SS**	**MS**	**F-Stat**	**P-Value**	**F-crit**
Between Groups	4	2.5343	0.6336	57.154	0.000	2.5787
Within Groups	45	0.4988	0.0111			
Total	49	3.0331				

The information displayed in **Table 4** stems from an ANOVA test examination of retained profits to total assets. It is examined that $F_{cal} = 57.154$ is much higher compared to $F_{tab} = 2.5787$ demonstrating that the alternative hypothesis is significantly accepted and the null hypothesis is rejected at the 5% level of significance in a two-tailed test with df (4, 45). The p-value is 1.5073e-7, where p (x ≤ F) = 1. It also indicates that there is little possibility of a type 1 mistake, which rejects a valid H0: 0.000015%, or 1.507e-7, The higher the support for H1 is, the smaller the p-value. Furthermore, the retained profits to total assets ratio is significantly different in the sample units.

Table 5: The ratio of EBIT/TA of the selected companies

Year	Pharmaceuticals							
	Beximco	**Square**	**Renata**	**IBN Sina**	**Beacon**	**Mean**	**S.D.**	**Std. Error**
2013	0.1032	0.1911	0.1910	0.1166	0.0034	0.1211	0.0774	0.0346
2014	0.1014	0.1894	0.2008	0.1539	0.0081	0.1307	0.0787	0.0352
2015	0.1026	0.2001	0.1952	0.1549	0.0108	0.1327	0.0786	0.0351
2016	0.0548	0.2087	0.2168	0.1736	0.0136	0.1335	0.0932	0.0417
2017	0.0848	0.2584	0.2249	0.1496	0.0227	0.1481	0.0972	0.0435
2018	0.0769	0.2030	0.2082	0.2299	0.0257	0.1487	0.0913	0.0408
2019	0.0802	0.2407	0.2154	0.1599	0.0335	0.1459	0.088	0.0393
2020	0.0928	0.2286	0.2063	0.1657	0.0257	0.1438	0.0839	0.0375
2021	0.1221	0.2166	0.1958	0.1700	0.1404	0.169	0.0387	0.0173
2022	0.1011	0.2156	0.1457	0.1726	0.1195	0.1509	0.0451	0.0202
Mean	**0.092**	**0.2152**	**0.2000**	**0.1647**	**0.0403**			
S. D	**0.0186**	**0.022**	**0.0219**	**0.0283**	**0.0484**			
Std. Error	**0.0059**	**0.007**	**0.0069**	**0.0089**	**0.0153**			

Source: Authors' calculation based on the annual reports of the selected pharmaceutical companies

The ratio of EBIT to total assets, which is summarized in **Table 5** for a recent ten-year period, reflects the operational efficiency of any sort of commercial entity. This efficiency ratio is a crucial business statistic to consider when judging a company's soundness. This statistic, which additionally applies Altman's Z-score to selected firms, builds Square Pharmaceuticals at the top. Interestingly, it has been seen that this operational efficiency ratio has greatly grown throughout the period under observation.

Table 6: One-way ANOVA of the EBIT/TA ratio

ANOVA Summary						
Source of variation	**df**	**SS**	**MS**	**F-Stat**	**P-Value**	**F-crit**
Between Groups	4	0.2208	0.0552	61.9789	0.000	2.5787
Within Groups	45	0.0401	0.0009			
Total	49	0.2609				

Table 6 highlights an ANOVA summary of the EBIT/TA ratio. Since, $F_{cal} > F_{tab}$, This signifies that a two-tailed test would reject the computed value of F. According to statistical deductive reasoning, the alternative hypothesis

is accepted with a (4, 45) df when the null hypothesis is rejected at the 5% level of significance or with a 95% confidence level. As consequence, the sample units do not have an identical EBIT to total asset ratio.

Table-7: The ratio of MVE/BVTL of the selected companies

Year	Pharmaceuticals							
	Beximco	**Square**	**Renata**	**IBN Sina**	**Beacon**	**Mean**	**S.D.**	**Std. Error**
2013	2.2563	14.3864	3.9703	5.0269	2.2032	5.5686	5.072	2.2682
2014	2.6723	29.8520	6.4397	4.1662	1.9849	9.023	11.7683	5.263
2015	4.0522	37.5418	9.6988	4.3453	1.8530	11.4982	14.842	6.6376
2016	4.1862	40.4161	10.0945	7.3430	1.9857	12.8051	15.7392	7.0388
2017	5.0854	57.0961	12.4718	7.3047	2.5234	16.8963	22.7688	10.1825
2018	2.3239	32.4205	15.9724	6.0196	2.1554	11.7784	12.8339	5.7395
2019	1.7501	48.8895	16.3128	6.1114	2.4543	15.1036	19.7619	8.8378
2020	1.6202	32.2600	12.1131	4.2196	5.5061	11.1438	12.4224	5.5555
2021	5.3151	43.5664	14.3965	4.5459	8.9773	15.3602	16.2413	7.2633
2022	3.2061	42.4251	11.4446	5.5048	12.2469	14.9655	15.8241	7.0767
Mean	**3.2468**	**37.8854**	**11.2915**	**5.4587**	**4.189**			
S. D	**1.3433**	**11.68**	**3.9436**	**1.2095**	**3.6305**			
Std. Error	**0.4248**	**3.6935**	**1.2471**	**0.3825**	**1.1481**			

Source: Authors' calculation based on the annual reports of the selected pharmaceutical companies

The market value of equity to book value of total liabilities ratio, which is a measure of a company's long-term solvency, is examined in **Table 7**. Square Pharmaceuticals found the greatest average and standard deviation among all the firms, with scores of 37.8854 and 11.68, respectively. Therefore, both the mean and variance are large. The standard deviation and the industry average value were 16.8963 and 22.7688, respectively, in 2017. Beximco, however, accomplished the lowest mean and standard deviation.

Table 8: One-way ANOVA of the MVE/BVTL ratio

ANOVA Summary						
Source of variation	**df**	**SS**	**MS**	**F-Stat**	**P-Value**	**F-crit**
Between Groups	4	8501.166	2125.2915	63.0941	0.000	2.5787
Within Groups	45	1515.8003	33.6845			
Total	49	10016.9663				

The findings and executive summary of the MVE/BVTL ratio's one-way ANOVA are shown in the following table **(table 8).** When p (x ≤ F) = 1, the p-value is equivalent to 0. Accordingly, there is little possibility of a type 1 mistake, which would reject a valid H0: 0 (%) H1 is more strongly supported by a lower p-value. Stated otherwise, there exists a considerable statistical discrepancy between the sample averages of certain groups. However, among the sample units, there is a significantly notable difference in the market value of equity to book value of total liabilities ratio.

Table-9: The ratio of S/TA of the selected companies

Year	Pharmaceuticals							
	Beximco	**Square**	**Renata**	**IBN Sina**	**Beacon**	**Mean**	**S.D.**	**Std. Error**
2013	0.3819	0.88464	0.6888	2.0145	0.2886	0.8517	0.6924	0.3096
2014	0.3864	0.73324	0.7664	2.2414	0.3683	0.8991	0.7732	0.3458
2015	0.4205	0.74948	0.7982	1.9573	0.4332	0.8717	0.6314	0.2824
2016	0.2269	0.75827	0.8473	2.0167	0.4969	0.8692	0.6857	0.3067
2017	0.4550	0.74652	0.8852	1.8605	0.5775	0.9049	0.5586	0.2498
2018	0.4051	0.56264	0.8939	1.9074	0.7662	0.9070	0.5898	0.2638
2019	0.4636	0.59460	0.9182	1.8611	0.9540	0.9583	0.5463	0.2443
2020	0.5110	0.61703	0.8320	1.7990	0.7790	0.9076	0.5144	0.2301
2021	0.5645	0.58547	0.8507	1.6751	0.8343	0.902	0.4525	0.2024
2022	0.5241	0.59053	0.7395	1.7268	0.7418	0.8645	0.4912	0.2197
Mean	**0.4339**	**0.6822**	**0.822**	**1.906**	**0.624**			
S. D	**0.095**	**0.1065**	**0.0732**	**0.1633**	**0.2221**			
Std. Error	**0.0301**	**0.0337**	**0.0231**	**0.0517**	**0.0702**			

Source: Authors' calculation based on the annual reports of the selected pharmaceutical companies

Table 9 conveys the S/TA ratios for the chosen pharmaceutical companies. The sales-to-total-assets ratio gauges how well a company is using its assets for selling its goods. The rate exhibits how well the company uses its assets to generate sales revenues. The findings indicate that IBN Sina has an average asset turnover (1.906) that is larger than its assets, with a standard deviation of 0.1633. With a standard deviation of 0.5463, the industry average for 2019 is 0.9583, which is the highest of all the periods. The whole picture of the combined sample units in this ratio is significantly more permissible.

Table 10: One-way ANOVA of the S/TA ratio

ANOVA Summary						
Source of variation	**df**	**SS**	**MS**	**F-Stat**	**P-Value**	**F-crit**
Between Groups	4	13.5878	3.3969	166.974	0.000	2.5787
Within Groups	45	0.9155	0.0203			
Total:	49	14.5033				

Table 10 shows the ANOVA summary of the sales-to-total-assets ratio. This time, it goes beyond the A two-tailed F test with df (4, 45) rejects the null hypothesis at the 5% level of significance since the p-value is less than α. It is believed that some groups' averages are not equal. Put another way, there is a statistically significant discrepancy in the sample averages of some groups. The sample units' sales-to-total-assets ratio is inconsistent since the alternative hypothesis was accepted.

Table-11: The Z- score of the selected companies

Year	Pharmaceuticals									
	Beximco	Square	Renata	IBN Sina	Beacon	Mean	S.D.	C.V.	Std. Error	Financial Position
2013	2.6644	11.0181	4.2039	5.7302	1.8961	5.1025	3.6201	0.6346	1.619	**Safe**
2014	2.8950	20.2434	5.9608	5.5594	1.9451	7.3207	7.4235	0.9070	3.3199	**Safe**
2015	3.7864	24.9856	8.0517	5.3117	2.0281	8.8327	9.2964	0.9414	4.1575	**Safe**
2016	3.6149	26.8622	8.5799	7.2109	2.1745	9.6885	9.9455	0.9182	4.4478	**Safe**
2017	4.5040	37.2443	10.2330	7.0502	2.5721	12.3207	14.2255	1.0327	6.3618	**Safe**
2018	2.5844	22.1416	12.4368	6.7166	2.5210	9.2801	8.2534	0.7955	3.691	**Safe**
2019	2.2786	32.5684	12.8006	6.5540	2.9864	11.4376	12.5253	0.9795	5.6015	**Safe**
2020	2.3904	22.6557	10.1531	5.3878	4.6002	9.0374	8.1224	0.8039	3.6324	**Safe**
2021	4.9059	29.4313	11.4658	5.7045	7.2925	11.76	10.1976	0.7756	4.5605	**Safe**
2022	3.4717	28.8027	9.1412	6.4903	8.9920	11.3796	10.0089	0.7867	4.4761	**Safe**
Mean	**3.3096**	**25.5953**	**9.3027**	**6.1716**	**3.7008**					
S.D	**0.9033**	**7.2496**	**2.7407**	**0.7101**	**2.5022**					
C.V.	**0.2589**	**0.2653**	**0.2795**	**0.1092**	**0.6414**					
Std. Error	**0.2856**	**2.2925**	**0.8667**	**0.2246**	**0.7913**					
Financial Position	**Safe**	**Safe**	**Safe**	**Safe**	**Safe**					

Source: Authors' calculation based on the annual reports of the selected pharmaceutical companies

The following table **(table 11)** outlines how the Z score outcomes for some Bangladeshi pharmaceutical businesses were generated. According to a thorough investigation, the square's average Z score values between 2013 and 2022 are 25.5953, with a coefficient of variation of 0.2653. The average Z score for Beximco, Reneta, IBN Sina, and Beacon is 3.3096, 9.3027, 6.1716, and 3.7008, with respective CVs of 0.2589, 0.2795, 0.1092, and 0.6414. The industry's Z score value and Square's Z score value was both at their highest in 2017, which implies that the majority of businesses performed exceptionally well in this year (37.2443). In terms of their financial soundness, all sample units fall inside the "safe zone," under Altman's standards. None of the companies involved are in a distressed or gray area. The same conclusion is also supported by the industry average. After conducting an empirical investigation, it emerged that Square has adopted a stand-up strategy and has little to no possibility of experiencing short-term financial hardship. Without taking variance into account, Reneta, IBN Sina, Beacon, and Beximco occupy the second, third, fourth, and fifth places, respectively. It has been noted that Beximco's average Z score value is extremely insignificant, and in 2013, 2014, 2018, 2019, and 2020, their scores went into the gray area, suggesting they might experience financial issues soon. Comparable to Beximco, Beacon Pharmaceutical additionally possesses an average Z score above 3, but for the most of the year, their Z values are under 3, which show they have previously had financial troubles. Their Z score values were not higher than 2.9864 between 2013 and 2019. In order to ensure financial stability, management at Beximco and Beacon should focus on their operating performance as well as examine all of the other components of the Z score model. They steadily improve their financial situation, but they must focus to keep moving in this direction. Additionally, they have a significant degree of variance, which suggests that their values are chaotic. They ought to emphasize long-term financial viability.

Based on the circumstances of Bangladesh's pharmaceutical enterprises as a sample, which are represented as an industry average, it was calculated that the likelihood of bankruptcy for each sample unit between 2013 and 2022 was minimal. Despite occasional differences over time, the industry average Z score value typically displays an increasing tendency. Therefore, the pharmaceutical business is financially sound at the moment, even though the average scores of certain companies are just above the threshold.

Table 12: One-way ANOVA of the Z- Z-score

ANOVA Summary						
Source of variation	df	SS	MS	F-Stat	P-Value	F-crit
Between Groups	4	3420.6035	855.1509	63.2047	0.000	2.5787
Within Groups	45	608.844	13.5299			
Total:	49	4029.4475				

Table 12 articulates the computation summary of the ANOVA of Z score values. The null hypothesis is located in the region of the normal curve known as the rejection zone because the calculated value of the F test ($F_{stat} = 63.2047$) is significantly higher than the critical value of the F test ($F_{crit} = 2.5787$). The null hypothesis is thus invalidated at the 5% level of significance in a two-tailed test with a df (4, 45). As a consequence of this, the Z-score value varied amongst the sample units.

Table 13: Ranking of Pharmaceuticals

Name of the Pharmaceuticals	Ranking based on Altman's Model Variables					
	Liquidity	Profitability	Operating Efficiency	Solvency	Asset Turnover	Z-score
Beximco	4	3	4	5	5	5
Square	1	1	1	1	3	1
Renata	3	2	2	2	2	2
IBN Sina	5	4	3	3	1	3
Beacon	2	5	5	4	4	4

Table 13 lists the ranking of a few pharmaceutical companies based on their asset turnover, liquidity, profitability, operating efficiency, and long-term solvency. Based on long-term solvency, asset turnover, and Z score values, Beximco grabbed the last position from the sample unit. According to the firm's profitability, its greatest ranking is third. The other two elements of Beximco hold down the fourth spot.

Contrarily, Square placed top across the board except asset turnover ratio, which came in third. Similar to this, Reneta was in second place for all components other than liquidity, which was in third place. IBN Sina is now at positions 5, 4, 3, 1, and 3, respectively. Finally, Beacon came in at positions 2, 5, 5, 4, 4, and 3. Square Pharmaceuticals won the top ranking whereas Beximco is in last place according to the Z score.

8. Conclusion and Recommendations:

Pharmaceutical companies contribute to the advancement of both medicine and the global economy by conducting research, developing, and introducing breakthrough pharmaceuticals that improve patient health and quality of life around the globe. Hospitals and other healthcare facilities are the most important social systems for

providing these services. People in Bangladesh are reportedly growing more concerned about access to healthcare (Islam *et al*., 2021).

For its stakeholders, including patients, business management, governmental regulatory agencies, and the WHO, the financial stability of any type of pharmaceutical enterprise is extremely important. All stakeholder decisions are built upon the organization's financial soundness. The Altman Z-score methodology is the most accurate way to assess a company's financial stability. The goal of the current study is to evaluate the financial stability of a few Bangladeshi pharmaceutical enterprises that are seen as the forerunners of the country's fast healthcare services.

The study also shows that the Z-score values for Beximco and Beacon Pharmaceutical fluctuate over time. In contrast, the other three pharmaceutical companies ran smoothly and kept their Z-scores high between 2013 and 2022. To ensure financial stability, management at Beximco and Beacon should focus on their operating performance in addition to reviewing all of the other Z-score model components.

9. Conflict of Interest:
This research project's authors all state that they have no conflicts of interest.

10. Authors Contributions:
The concept for this investigation was created by Moshiuddullah, A. B. M. Data collecting involved the participation of all writers. After that, with the assistance of all contributors, the updated information was arranged and assessed. After careful reading, Moshiuddullah, A. B. M., and the other writers approved the final draft of the article.

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