PREDICTING CORPORATE FINANCIAL DISTRESS USING ALTMAN'S Z-SCORE MODEL – A STUDYOF SELECTED PUBLICLY TRADED TEXTILE COMPANIES OF BANGLADESH

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ABSTRACT

The aim of this study is to predict the financial distress of the listed textile companies ofBangladesh using Altman's Z-score model. The data for 5 recent years from 2016-17 to 2020-21,covering the COVID-19 aggression period 2019-20 to 2020-21, have been collected from 5samples which were chosen purposively from the textile companies listed in both Dhaka Stock Exchange and Chittagong Stock Exchange Ltd. The study reveals that although most of the samples had a turned around tendency in their financial performance measured by Z-score during the COVID-19 aggression period, some poor financial ratios caused two-fifth of the samples to fall in distress zone and the remaining samples in gray zone during the study period. In this context, the study assumes that in addition to covering various key issues in a strategic plan, the samples should consider other issues like cost-cutting, optimizing operational efficiency and the like that can help manage cash flows and keep the business a-going and avoid the risk of financial distress. Eventually, both the current and potential investors are assumed to have some insights from this study as to the financial health of relatively older listed textile companies of Bangladesh and also to easily adopt the technique used in this study to predict thefinancial health of the companies under the textile industry of Bangladesh. The study also assumes that it might create scope to further research for exploring the cause(s) behind its results.

Keywords: Financial distress prediction, publicly traded textile companies, Bangladesh, Altman Z-score

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Introduction

The ultimate aim of all firms is to maximize the wealth of shareholders and the management of the companies strives in all aspects to maximize shareholders' wealth. But sometimes the firms fail to achieve this objective due to poor financial health. Poor financial health causes financial distress and thereafter threatens the survival of the firm; these eventually lead to corporate failure.

Financial distress or bankruptcy is a phenomenon where the business is not able to generate adequate revenue to meet its financial obligations (Korath and Nayak, 2022). From a balance sheet analysis, if total assets of a firm are found to fall short of total liabilities, particularly due to shortage of cash or excess debt, financial distress occurs. Financial distress can also be expressed in terms of a negative cash flow from operations (CFO) and a greater decline in return on assets (ROA) in the year prior to default (Rahman et al., 2021). Neither the Bankruptcy Act 1997 nor the Companies Act 1994 defined corporate bankruptcy in Bangladesh, but Alam and Azim (n.d.) referred corporate bankruptcy as the financial crisis of corporate entities, rather than individual businessmen.

The failure of internal support system, such as effective utilization of funds, labor, material, land, equipment, etc. and external support system, such as economic, political, and socio cultural conditions results in bankruptcy of a firm (Joshi, 2019). Lapse in management control under these conditions finally causes the collapse of firms. Giant companies like Tyco, Global Crossing, WorldCom, Enron, etc. (Anthony and Govindarajan, 2007) are the examples of global bankrupt companies in such cases, onthe other hand, Bangladesh Industrial Finance Company (Alo, 2017) is the local bankrupt company and Beximco Group, MR Group, SA Group, Ratanpur Group, and Keya Group are the top five businesses which are adjudged defaulters despite repeated loan restructure in Bangladesh (Sakib, 2017). The recent economic turmoil due to COVID-19 also caused many firms for filing bankruptcy. For example, Silicon Valley Bank and Avaya Inc. in the USA, Altera Infrastructure and Cineworld Group in the UK, Modern Land Ltd. in China, Americanas S.A. in Brazil, Endo International in Ireland, and Garuda Indonesia

(Ventura, 2023) are worth-mentioning. Bangladesh seems to have navigated the Covid- 19 pandemic better than many of its peers, but its luck won't last unless it brings in some big, meaningful reforms (Pesek, 2022) in both service and manufacturing sectors.

In Bangladesh's manufacturing sectors, among others, textile industry starting its journey in 1972 (Momen, 2007), immediately after the independence of the country on December 16, 1971, and producing woven and non-woven materials, such as cotton, jute, silk, synthetics, wool, etc. for clothing, industrial, and household applications proved as an important segment that plays a vital role in its rapidly growing economy generating more than 13% of GDP (MI (Mordor Intelligence), 2023), where, total industry contribution was 33.32% in 2021 (Business Inspection BD, 2022) and contributing over 84% of the export earnings by producing textiles and textile -related products (MI, 2023). But it faced and is still facing the negative impact of COVID -19 crisis due to shortage of labor supply and other supportive ambiences, viz. working condition, safety standards, environment pollution, etc. and closing of many local and foreign buyers. So in order to keep the growth potential, protect investors' and creditors' interest, and avoid bankruptcy, it is necessary to predict financial distress and adopt strategic plans thereof for textile companies of Bangladesh, world's second largest textile producers and exporters.

According to Muller et al., early prediction of financial distress is necessary for investors and other lending institutions (Muller et al., 2009). Ascertaining the probable insolvency in the earlier stage may help avoid the worse cases in the near future and protect the firm from going bankruptcy (Sajjan, 2016). Altman's multivariate discriminate analysis (MDA) model, commonly known as Altman's Z-score model, has been popularly using worldwide for the prediction of corporate financial distress of publicly traded companies with high level of accuracy since 1968, when Professor E. Altman introduced this model first in his article, Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy, published in the journal named Journal of Finance 22, September 1968, pp. 589-609. Later on in 1983, he incorporated a new model in his book, Corporate Financial Distress (New York: John Wiley, 1983), pp. 120 -124, revising the earlier one with no measurable effect on prediction performance applicable for both publicly traded and non-publicly traded companies (Wild et al., 2007). As a matter of fact, this study attempts to predict the financial distress of selected listed textile companies of Bangladesh using Altman's earlier Z-score model.

Under the above circumstances, the study aims to examine whether the publicly traded textile companies of Bangladesh have a healthy financial position or not during the study

period covering the period of COVID-19 aggression. To this, the study also calculates and analyzes relevant financial ratios used to determine Altman's Z -score. Finally, the study tries to highlight its implications based on findings.

In fact, there are some generalized limitations of Altman Z-score, such as dependency only on database, not working well for new or emerging companies, failing to incorporate the benefits of good cash flow management, working on garbage in garbage out (GIGO) method, etc. This study also is not free from some limitations as to sample selection, sample database, and data analysis techniques. The study also could have considered using other financial distress prediction models, viz. Grover model, Taffler model, Zmijewski model, etc. with high level of accuracy (Indriyanti, 2019). Moreover, a number of studies, viz. Korath and Nayak (2022), Pranav et al. (2020), Adriatico (2019), Joshi (2019), Panigrahi (2019), Wesa and Otinga (2018), Akhtar et al. (2017), Mohammed (2016), Sajjan (2016), and Oyedokun et al. (2015), Muller et al. (2009), etc. have already been conducted so far focusing on financial distress prediction of different manufacturing industries in several countries outside Bangladesh using Altman's earlier Z-score model. However, this study claims to be different from them in several reasons, for example, the study has been conducted in Bangladesh context, exclusively on t extile industry of Bangladesh, there has been no such study conducted so far in Bangladesh specially in the textile industry, the textile companies used as samples in the study are 100% export oriented, data used in the study were taken from very recent ye ars including the years of severe COVID-19 attack, the samples are enlisted in both Dhaka Stock Exchange (DSE) and Chittagong Stock Exchange (CSE), and the samples have been selected purposively from those whose establishments and enlistments were taken

place at least twelve and five years respectively before the beginning of the study period. The study also assumes that further research can be taken place to explore the cause(s) behind its results.

The organization of this paper is structured by placing introduction in the first, followed by its scope, literature review, methods, data analysis and findings, and conclusion in the end.

Scope of the Study

The study takes textile industry of Bangladesh as its area of research. Total 5 textile companies listed in DSE and CSE have been selected as sample to conduct this study. This selection processwas purposive and it has been made after considering the span of time the companies have passed since

their establishment as well as enlistments till the beginning of the study period. The study period consists of 5 consecutive years from 2016-17 to 2020-21, covering the period of frightening effect of COVID-19 aggression, 2019-20 to 2020-21. A short profile of the sampleshas been presented in Table 1.

Table No 1: Profile of the samples

Samples	Establi-shing Year	Listing Year*	Product	Location	Financial Performance**
Envoy Textiles Ltd.	1995	2012	100% export oriented denim fabrics	Mymen-shingh	EPS = 2.05, 2.01, 3.31, 1.63, 0.56 P/E = 19.26, 17.29, --, 12.97, 52.04 D/Y (%) = 1.77, 2.88, 4.27, 2.36, 1.70
Malek Spinning Mills Ltd.	1991	2010	Yarns for local and international markets	Gazipur, Dhaka	EPS = --, 1.17, 0.76, - 1.68, 3.36 P/E = --, 14.64, 21.73, --, 9.28 D/Y (%) = --, 5.85, 6.02, --, 3.21
Argon Denims Ltd.	2006	2013	100% export oriented denim fabrics	Gazipur, Dhaka	EPS = --, 3.18, 3.06, 1.53, 0.71 P/E = --, 8.21, 8.25, 12.57, 38.15 D/Y (%) = --, 5.75, 3.97, 2.60, 3.69
Prime Textile Spinning Mills Ltd.	1989	1995	100% export oriented cotton yarn	Narayan-Ganj	EPS = --, 1.05, 0.54, - 2.67, 0.62 P/E = --, --, 63.42, --, 36.40 D/Y (%) = --, 2.84, 1.45, 0.63, 0.89
Square Textile Ltd.	1997	2002	Cotton yarns for local and international markets	Gazipur, Dhaka	EPS = --, 2.43, 2.18, 0.27, 3.41 P/E = --, 20.84, 20.95, 107.26, 13.95 D/Y (%) = --, 3.94, 4.38, 3.45, 4.21

Source. Samples' websites and DSE website.

** Since the CSE has started its functioning in 1995, much later than the functioning of the DSE in 1964, the listing year means here the year of enlistment of the samples in DSE.*

*** Financial performances have been reported showing earning per share (EPS), price-earning (P/E) ratio, and dividend yield (D/Y) on the basis of data available for the study period of 2016-17, 2017-18, 2018-19, 2019-20, and 2020-21.*

'--' indicates empty due to unavailability of data.

Literature Review

Financial distress analysis of different types of companies using Altman's Z-score model is a well-studied topic in different countries in the world. But research in Bangladesh on the same issue has not been found so far coming out any significant way either in the same pace with theresearch abroad or at a lower rate. However, a review of some of those researches is made herein on the basis of their availability.

Korath and Nayak (2022) studied on financial distress prediction using Altman's Z-score in the case of Indian listed manufacturing companies. Using a sample of 5 unhealthy companies and 5 healthy companies which were admitted for bankruptcy under the Insolvency and Bankruptcy Board of India (IBBI) covering a period of 5 years from 2017 to 2021 for data, the study revealedthat all the 5 unhealthy companies showed a low Z-score which proved that they were distressed and 4 out of 5 healthy companies showed a high Z-score which was an indication of their financial soundness.

Rahman et al. (2021) studied on predicting financial distress of American listed firms using F- score model and its components instead of Altman's Z-score model. Extracting 81 financially distressed firms from the Florida UCLA-LoPucki Bankruptcy Research Database during 2009– 2017, the study found that firms which were at risk of distress tended to record a negative cash flow from operations (CFO) and showed a greater decline in return on assets (ROA) in the year prior to default.

Adriatico (2019)'s study sought to predict companies that were listed on the Philippine Stock Exchange and potential to corporate financial distress using the Altman's Z-score model and current ratio. The study revealed that 35 randomly selected companies out of 45 companies had been chosen potential for becoming financially distressed based on Altman's Z-score modelanalysis, and 12 companies were also found experiencing financial difficulties based on current ratio analysis.

As to the prediction power of models, Indriyanti (2019)'s study showed that among 7 financial distress prediction models, namely Altman, Grover, Taffler, Zmijewski, Springate, Ohlson, and Fulmer, Grover (96%) and Altman (86.6%) models were two top graded models of accuracy in predicting financial distress of global 25 biggest Tech Companies in 2015–2016 Forbes's version.

As to the prediction power of Altman's Z-score model, **Joshi (2019)** made a case study of a communication company in India, which has filed for bankruptcy in the month of February 2019. By analyzing the financial statement and the market data of the sample, the study found that the model was successful in predicting the upcoming financial distress of the sample, and concluded that the sample was making losses since long and was under the gray area (i.e. distress zone) 3 years before they filed for bankruptcy.

Panigrahi (2019) in his study took selected 4 pharmaceutical companies in India to test their financial distress using Altman's Z-score Model covering a period of 5 years from 2012-2013 to 2016-2017, and after analyzing the secondary data, he commented based on his findings that the industry had a healthy financial position because of a strong Z-score of 5.9 on an average which was much above the cut-off score of 1.8 (as per the standard of measurement used by the author).

Mohammed (2016) also made a case study about the prediction of bankruptcy using the same model, i.e. Altman's Z-score model, of an Omani cement company and its subsidiaries. Using annual report's data for the period from 2007 to 2014, the study revealed that the samples were financially sound as measured by a Z-score higher than the benchmark of 2.99 during almost the entire period of the study.

Sajjan (2016)'s study covered 3 listed manufacturing and 3 listed service companies in India to predict the likelihood of bankruptcy of those firms for a period of 5 years from 2011 to 2015. The study revealed that most of the firms were in distress zone with a Z-score below 1.81 for manufacturing firms and below 1.1 for service firms (as per the standard of measurement used by the author).

Mahmud (1987) in an article titled 'Ratios as indicators of financial health' asserted that Altman's Z-score and related ratios are powerful tools to predict financial health of a firm.

Under the above background, it is seen that most of the studies conducted outside Bangladesh have used Altman's Z-score to predict financial distress of different manufacturing and service sector enterprises, of which some were listed and some were unlisted firms, taking several study periods. In Bangladesh, except for a very few, no such remarkable studies have been found so far that have been conducted using Altman's MDA model either in manufacturing or service sector enterprises. This almost unaddressed task in Bangladesh thus seen to be aresearch gap which has led the authors to conduct this study of predicting financial distress of Bangladesh's listed textile companies. The period covering COVID-19 attack was also seemed tobe an important point of study.

Methods of the Study

This is a predictive research study based on entirely secondary data collected from the annual reports of the sample. The sample consists of 5 listed textile companies (100% export oriented) selected from a total of 58 companies of said categories (as of 30 June 2021) in Bangladesh. Before this selection, an eliminating process is applied on total number on the basis of the date of establishment and enlistment of the samples. Further, it takes samples having comparatively older age of operations assuming that the Altman's model will not work properly on newly established and enlisted companies. As such, the companies which have been established at least 12 years (i.e. an era)

before and at the same time enlisted at least 5 years before the year of the beginning of the study period (i.e. 2016-17) are chosen purposively as samples (see Table1). The study takes into account a period of 5 consecutive years from 2016-17 to 2020-21 (5- year period in many prior studies found to consider as reasonable period for study) specially covering the period of frightening effect of COVID-19 aggression, 2019-20 to 2020-21.

The main focus of the study is to predict the financial distress of the selected samples during the study period. There are various models in practice to predict firms' financial distress. However, many studies proved that Altman's Z-score is a powerful model of prediction of financial distress. In fact, for the purpose of financial distress prediction irrespective of publicly traded and nonpublicly traded manufacturing and non-manufacturing firms, this model is seen to have a first level of accuracy rate (over 80%) over the world. Against such backdrop, this study also chooses Altman's Z-score model to predict corporate financial distress of the sample firms.

Altman's Z-score model, developed by Professor E. Altman, has two dimensions using the same (5 in numbers) financial ratios, viz. 1) liquidity, 2) age of firm and cumulative profitability, 3) profitability, 4) financial structure, and 5) capital turnover rate (Wild et al., 2007). First, in 1968, the model has been suggested to use for the prediction of corporate financial distress of publicly traded companies only. Next, in 1983, modifying the coefficient values only and having no measurable effect on prediction performance, the model has been suggested to use to generalized way for all sorts of firms, both publicly traded and non-publicly traded companies. Since the samples are manufacturing publicly traded companies, this study uses first model (Wild et al., 2007) to serve its purpose. The model is as follows.

$Z = 1.2\ X1 + 1.4\ X2 + 3.3X3 + 0.6X4 + 1.0\ X5$

Five financial ratios included in the above Z-score model are shown in Table 2.

Table No : Description of the financial ratios used in Altman's Z-score model

Symbols used for the ratios	Name of the ratios	Formula of the ratios
X1	Liquidity	Working capital ÷ Total assets
Age of firm and cumulative	profitability	Retained earnings ÷ Total assets

Profitability	Earnings before interest and taxes (EBIT) ÷Total assets
Financial structure	Market value of preferred and common equity ÷ Total liabilities

In Table 2, the liquidity ratio comparing working capital to total assets used in the model will measure the samples' ability to meet short-term obligations; the age of firm and cumulative profitability ratio comparing retained earnings to total assets will measure the long-term profitability of the samples and also will give the samples an idea of how much they rely on debt for the funding of their total assets; the profitability ratio comparing EBIT to total assets will the long-term profitability of the samples; the financial structure ratio comparing the market value of preferred and common equity to total liabilities will measure long-term solvency of the samples; and the capital turnover rate comparing sales to total assets will measure the capacity of the samples' assets to generate sales and the capacity of their managements' to deal with competitive conditions as well.

Based on the above discussion and taking the model into consideration, the collected data wereused to calculate the said financial ratios included in the Z-score model and combine the values in a specific way of the model to produce a single number (i.e. an overall index), and then predict and analyze the financial health of the sample companies as per the guidelines provided by Professor Altman. The guidelines are shown in Table 3. Moreover, Microsoft Excel Spreadsheet Software (MESS) was used to do all sorts of relevant calculations in this respect.

Table No 3: Altman's guidelines to classify firms as either financially sound or bankrupt

Situations	Zone of Discriminations	Results
$Z < 1.20$	Distress or bankruptcy zone	High probability of bankruptcy or failure
$1.20 < Z < 2.90$	Gray or ambiguous zone	May or may not fail
$Z > 2.90$	Safe or healthy zone	Low probability of bankruptcy or failure

Source. Wild et al. (2007), Joshi (2019), and Panigrahi (2019)

Table 3 indicates Altman's guidelines to measure the corporate firms as to their financial health based on an overall index of Z-score. A Z-score of less than 1.20 suggests that the samples will fall in a distress zone and will have a high probability of bankruptcy, while Z-scores above 2.90 imply that the samples will be in a safe or healthy zone and will have a low probability of bankruptcy. Scores between 1.20 and 2.90 will be the indication of the samples staying in the gray or ambiguous zone and they may or may not fail.

Further, in analyzing the data (i.e. Z values) over the study period, some descriptive statistics tools, viz. mean, standard deviation, and coefficient of variation along with a graphical presentation

are used.

Data Analysis and Findings

At the very outset of this section, data relating to Altman's Z-score of the sample listed textile companies for the study period are analyzed using average, standard deviation, and coefficient of variation. Table 4 contains these positions.

Table No 4: Analysis of Z-score data by sample during the period from 2016-17 to 2020-21

Name of the Companies	2020-21	2019-20	2018-19	2017-18	2016-17	Mean	Standard Deviation	Coefficient of Variation
Envoy Textiles Ltd.	0.95	0.89	1.13	0.89	0.53	0.88	0.22	0.25
Malek Spinning Mills Ltd.	2.18	1.32	1.92	2.49	3.19	2.22	0.70	0.31
Argon Denims Ltd.	1.98	2.05	2.42	2.61	2.85	2.38	0.37	0.16
Prime Textiles Ltd.	0.79	0.44	0.95	0.93	0.91	0.80	0.21	0.26
Square Textile Ltd.	2.37	1.66	2.39	2.80	5.28	2.90	1.39	0.48

Source. Appendices 6-10. Calculations have been done by the authors.

Table 4 shows the year-wise as well as average position of Z-score of the samples during the study period 2016-17 to 2020-21. After putting the respective values of suggested financial ratios (see Appendices 1-5) in the equation of the Z-score model (see the Section 4: Methods of this study), the values of Z-score have been estimated. The average values of Z-score of the samples were 0.88 (Envoy Textiles Ltd.), 2.22 (Malek Spinning Mills Ltd.), 2.38 (Argon Denims Ltd.), 0.80 (Prime Textiles Ltd.), and 2.90 (Square Textile Ltd.) and the coefficient of variations oftheir Z-score were 25%, 31%, 16%, 26% (the lowest), and 48% (the highest) respectively [here the low Z-score of Envoy and Prime were likely to be the results of poor working capital, earnings before interest and taxes (EBIT), and debt management (see Appendices 1, 3, and 4)]. As per Altman's guidelines to classify firms as either financially sound or bankrupt (see Table 3), the average values of Z-score of the samples indicate that the financial health of Malek, Argon, and Square remained in gray/ambiguous zone, on the other hand, the financial health of Envoy and Prime remained in distress/bankruptcy zone. However, using the calculated values ofAltman's Z-score associated with the sample textile firms during study periods, a classificationof the firms has been made in Table 5 showing their financial soundness according to the zone of discriminations suggested by Altan (See Table 3).

Table No 5: Firms' classification based on Altman's Z-score

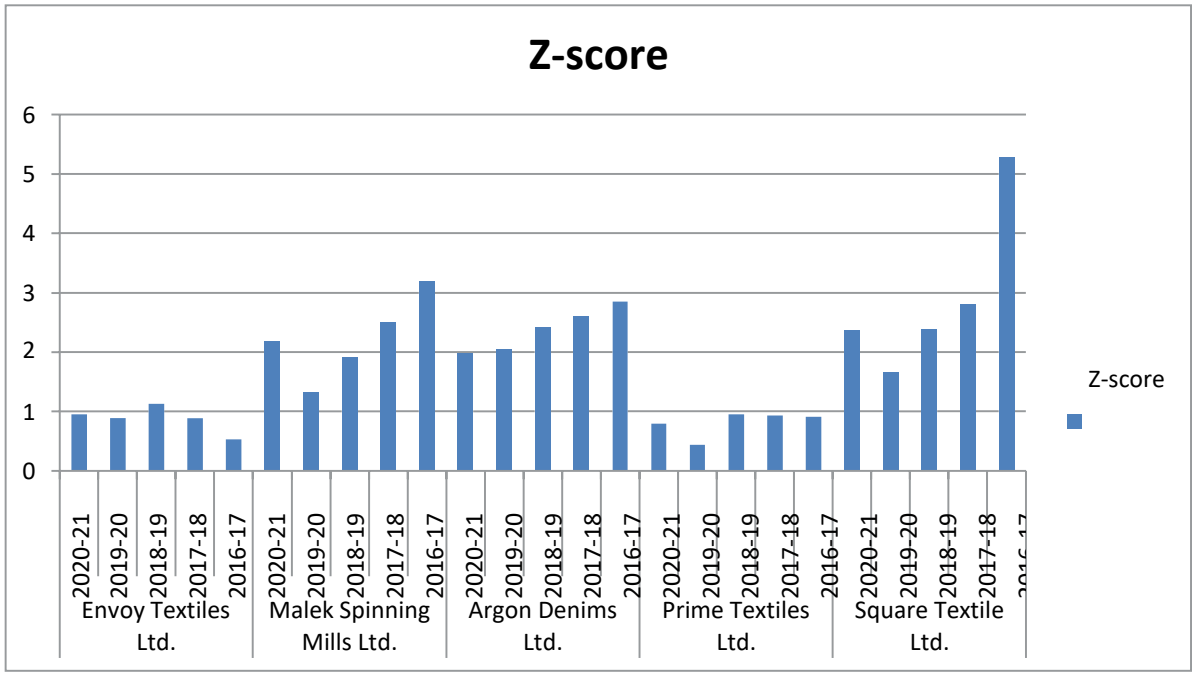
Name of the Company	Period	Z-score	Zone of Discrimination
Envoy Textiles Ltd.	2020-21	0.95	Distress zone
	2019-20	0.89	Distress zone
	2018-19	1.13	Distress zone
	2017-18	0.89	Distress zone
	2016-17	0.53	Distress zone
Malek Spinning Mills Ltd.	2020-21	2.18	Gray zone
	2019-20	1.32	Gray zone
	2018-19	1.92	Gray zone
	2017-18	2.49	Gray zone
	2016-17	3.19	Safe zone
Argon Denims Ltd.	2020-21	1.98	Gray zone
	2019-20	2.05	Gray zone
	2018-19	2.42	Gray zone
	2017-18	2.61	Gray zone
	2016-17	2.85	Gray zone
Prime Textiles Ltd.	2020-21	0.79	Distress zone
	2019-20	0.44	Distress zone
	2018-19	0.95	Distress zone
	2017-18	0.93	Distress zone
	2016-17	0.91	Distress zone
Square Textile Ltd.	2020-21	2.37	Gray zone
	2019-20	1.66	Gray zone
	2018-19	2.39	Gray zone
	2017-18	2.80	Gray zone
	2016-17	5.28	Safe zone

Source. Appendices 6-10 and Table 3.

Table 5 reveals the status of the sample companies with regard to their financial health during the study period including the period of pandemic caused by COVID-19. Both Envoy Textiles Ltd. and Prime Textiles Ltd. fell in financial distress zone over the entire study period from 2016-17 to

2020-21 indicating a high probability of bankruptcy or failure of these two firms. On the contrary, Argon Denims Ltd. for entire study period and Malek Spinning Mills Ltd. and Square Textile Ltd. for the last four years from 2017-18 to 2020-21 stayed in gray zone indicating their moderate position in terms of financial soundness that brings a meaning that they may or may not fail financially. Among them only Malek Spinning Mills Ltd. and Square Textile Ltd. showed their financial soundness staying in safe zone which indicates a low probability of bankruptcy or failure at the very outset of the study period, i.e. in 2016-17. Although after 2016-17, none of the sample companies were able to change their position from the prevailing zone of discriminations, it is observed that most of them were able to improve their financial performance measured by Z-score during the period of COVID-19, i.e. from 2019-20 to 2020-21.Figure 1 shows the trend of Z-score of the sample companies during study period including the COVID-19 aggression period.

Figure No 1: Distribution of Z-score of the sample companies by years



Source. Appendices 6-10.

Figure 1 provides a clear picture of Z-score calculated for the sample companies for the period from 2016-17 to 2020-21. Revealing the significant variations, as calculated in Table 4, in year- wise Z-score of the samples, Figure 1 exhibits that Z-score of Malek Spinning Mills Ltd., Argon Denims Ltd., and Square Textile Ltd. exceeded 2-point line, but that of Envoy Textiles Ltd. and Prime Textiles Ltd. did not exceed 1-point line, except for Envoy's Z-score in 2018-19. This is also an explicit revelation of Professor Altman's guidelines about the firm's classification as to either it is financially

sound or bankrupt. Under the circumstances, it is also seen that except forArgon denims, the Z-score of all other samples uplifted during the COVID-19 aggression period, i.e. from 2019-20 to 2020-21. Under the above backdrop, the findings of this study can be summarized as per below.

- In terms of average Z-score during the study period, the majority samples, viz. Malek Spinning Mills Ltd. (2.22), Argon Denims Ltd. (2.38), and Square Textile Ltd. (2.90), were found to be performed above the distress zone and the other samples, viz. Envoy Textiles Ltd. (0.88) and Prime Textiles Ltd. (0.80), within the distress zone.
- Although Envoy Textiles Ltd. and Prime Textiles Ltd. were in high risk of being bankrupt, their Z-score tended to have an increasing tendency at the end of the study period, particularly in The period of COVID-19 aggression (i.e. 2019-20 to 2020-21). Among other samples, Malek SpinningMills Ltd. and Square Textile Ltd. also had their Z-score increased during the same period.
- Having comparatively a high rate of coefficient of variation in Z-score and staying at safe zone in 2016-17 and then at gray zone from 2017-18 to 2020-21, Malek Spinning Mills Ltd. and Square Textile Ltd. began to descend from 2017-18 to 2019-20 and thereafter started moving up from 2019-20 to 2020-21, the period of COVID-19 aggression.
- Despite staying at gray zone, the Z-score of Argon Denims Ltd. showed a tendency to decrease consistently over the study period along with the lowest rate of coefficient of variation.

Implications and Concluding Remarks

Any business firm usually has an inherent tendency to grow. But different key success factors, both financial and nonfinancial or controllable and uncontrollable, influence its smooth growing. Although many past researches used Altman's Z-score model as a better means of predicting financial distress, Wild et al. (2007) suggest that it should not be blindly applied without informed and critical analysis of a company's fundamentals. However, in the context of Altman's Z-score model, this study finds that the sample textile companies were not satisfactorily performing over the study period. Some of the samples (viz. Malek Spinning Mills Ltd. and Square Textile Ltd.) with high degree of coefficient of variation in their financialperformance, measured by selected ratios in Altman's Z-score, were found to be gone down from safe zone to gray/ambiguous zone; some others (viz. Envoy Textiles Ltd. and Prime Textiles Ltd.), on the other hand, with comparatively less variations in their Z-score were found to be improved slowly, though staying in distress zone. Moreover, almost all of the samples, except only for Argon Denims Ltd., showed a turned around in Z-score, irrespective of their zone of discriminations, in the second year of COVID-19 aggression (i.e. 2020-21).

Eventually, it can be noted that although the Altman's Z-score is not only the measure of

predicting financial distress, the results obtained by using this model cannot be totally ignored. That is the model can be used as an early warning to determine the financial status of a textile company. Therefore, despite a glim of improving financial performance of the majority sample listed textile companies is revealed by their increased Z-score amidst the COVID-19 aggression period, they must have a strategic plan covering various key issues like bank loan, trade credit, invoice financing, long-term borrowings, etc. that can help manage cash flows and keep the business afloat and avoid the risk of financial distress. In fact, along with strategic planning, some other measures, such as cost-cutting, optimizing operational efficiency, exploring new revenue streams, etc. are worth consideration to strengthen the financial position of the textile companies in Bangladesh. Taking all these facts into consideration, it is assumed that this study might carry some insights to the users as to the financial health of relatively older listed textile companies of Bangladesh during a critical period, when the corona pandemic has destroyed theglobal economy drastically. Moreover, both current investors in particular and potential investors in general associated with the textile industry in Bangladesh also may be able to choose and decide their investment options after reviewing the financial performance of the concern as applied in this study.

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Samples' Annual Reports:

Argon Denim Textile Ltd., 2016-17 to 2020-21

Envoy Textile Ltd., 2016-17 to 2020-21

Malek Spinning Mill Ltd., 2016-17 to 2020-21

Prime Spinning Mill Ltd., 2016-17 to 2020-21

Square Textile Ltd., 2016-17 to 2020-21

Websites:

Argon Denim Ltd.,

http://www.argondenims.com/Envoy Textile

Ltd., https://envoytextiles.com/

Malek Spinning Mill Ltd., https://www.newasiabd.com/malekspinni

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http://primegroup.com.bd/index.php?menu_id=57•Square Textile Ltd.,

https://textile.squaregroup.com/

Appendices

Appendix 1. X_1 = Working capital ÷ Total assets

Name of the Company	2020-21	2019-20	2018-19	2017-18	2016-17
Envoy Textiles Ltd.	0.043342321	0.038214967	0.026511314	-0.025652132	-0.058351616
Malek Spinning Mills Ltd.	0.206246275	0.207418595	0.23266575	0.263102471	0.259096296
Argon Denims Ltd.	0.322119728	0.333577881	0.310269096	0.35205955	0.335685861
Prime Textiles Ltd.	0.100156539	0.064156617	0.022019065	0.004541985	-0.005333188
Square Textile Ltd.	0.215072244	0.01259757	0.069659844	0.055161726	0.222273168

Source. Calculations have been done by the authors using data from the annual reports of the samplefirms.

Appendix 2. X_2 = Retained earnings ÷ Total assets

Name of the Company	2020-21	2019-20	2018-19	2017-18	2016-17
Envoy Textiles Ltd.	0.099677626	0.10860007	0.108669763	0.082778136	0.08049107
Malek Spinning Mills Ltd.	0.064695237	0.031040405	0.052926163	0.06984283	0.075222093
Argon Denims Ltd.	0.192803796	0.2188758	0.2217734	0.199809366	0.1764472
Prime Textiles Ltd.	0.020873041	0.008898676	0.032691743	0.025459747	0.014287193
Square Textile Ltd.	0.345883468	0.345930001	0.405409901	0.372123547	0.487771808

Source. Calculations have been done by the authors using data from the annual reports of the samplefirms.

Appendix 3. X_3 = Earnings before interest and taxes (EBIT) ÷ Total assets

Name of the Company	2020-21	2019-20	2018-19	2017-18	2016-17
Envoy Textiles Ltd.	0.015548245	0.015937366	0.036690372	0.020461654	0.021864803
Malek Spinning Mills Ltd.	0.037641698	-0.008606411	0.010862352	0.021840949	0.021637349
Argon Denims Ltd.	0.016133451	0.041852713	0.081612853	0.086088619	0.087552004
Prime Textiles Ltd.	0.006682857	-0.019515857	0.007897721	0.012570297	0.013739704
Square Textile Ltd.	0.047545421	0.006352342	0.033649234	0.036925971	0.039619108

Source. Calculations have been done by the authors using data from the annual reports of the samplefirms.

Appendix 4. X_4 = Market value of preferred and common equity ÷ Total liabilities

Name of the Company	2020-21	2019-20	2018-19	2017-18	2016-17
Envoy Textiles Ltd.	0.399203299	0.307479457	0.51833983	0.508860071	0.060898604
Malek Spinning Mills Ltd.	2.235222851	1.139346947	1.862926878	2.571193488	3.848988381
Argon Denims Ltd.	1.293886848	1.056415248	1.375945365	1.573262024	2.156394485
Prime Textiles Ltd.	0.354521613	0.255534601	0.668766503	0.663342436	0.620293409
Square Textile Ltd.	1.154837601	0.782664852	1.573161986	2.3578608	5.88445362

Source. Calculations have been done by the authors using data from the annual reports of the samplefirms.

Appendix 5. X5 = Sales ÷ Total assets

Name of the Company	2020-21	2019-20	2018-19	2017-18	2016-17
Envoy Textiles Ltd.	0.464637478	0.45400553	0.512517547	0.432784955	0.378493769
Malek Spinning Mills Ltd.	0.380712185	0.367052171	0.410748931	0.464473513	0.396729638
Argon Denims Ltd.	0.497289256	0.566013988	0.645224027	0.678805263	0.616623672
Prime Textiles Ltd.	0.408750403	0.26395248	0.447360199	0.445277624	0.47993514
Square Textile Ltd.	0.773382443	0.66985912	0.686727479	0.675522626	0.668380745

Source. Calculations have been done by the authors using data from the annual reports of the sample firms.

Appendix 6. Calculation of Z-score: Envoy Textiles Ltd.

	2020-21	2019-20	2018-19	2017-18	2016-17
X1*1.2	0.052010786	0.045857961	0.031813577	-0.030782558	-0.070021939
X2*1.4	0.139548676	0.152040097	0.152137668	0.115889391	0.112687498
X3*3.3	0.051309209	0.052593307	0.121078228	0.067523458	0.072153851
X4*0.6	0.239521979	0.184487674	0.311003898	0.305316043	0.036539162
X5*1	0.464637478	0.45400553	0.512517547	0.432784955	0.378493769
Z-score	0.947028128	0.88898457	1.128550918	0.890731288	0.529852342
Z-score (0.00 places)	0.95	0.89	1.13	0.89	0.53

Source. Appendices 1-5. Calculations have been done by the authors.

Appendix 7. Calculation of Z-score: Malek Spinning Mills Ltd.

	2020-21	2019-20	2018-19	2017-18	2016-17
X1*1.2	0.24749553	0.248902314	0.2791989	0.315722965	0.310915555
X2*1.4	0.090573332	0.043456567	0.074096629	0.097779962	0.105310931
X3*3.3	0.124217604	-0.028401155	0.035845761	0.072075131	0.071403252
X4*0.6	1.341133711	0.683608168	1.117756127	1.542716093	2.309393029
X5*1	0.380712185	0.367052171	0.410748931	0.464473513	0.396729638
Z-score	2.184132363	1.314618065	1.917646348	2.492767664	3.193752404
Z-score (0.00 places)	2.18	1.32	1.92	2.49	3.19

Source. Appendices 1-5. Calculations have been done by the authors.

Appendix 8. Calculation of Z-score: Argon Denims Ltd.

	2020-21	2019-20	2018-19	2017-18	2016-17
X1*1.2	0.386543674	0.400293457	0.372322915	0.42247146	0.402823034
X2*1.4	0.269925314	0.306426119	0.31048276	0.279733112	0.24702608
X3*3.3	0.053240388	0.138113954	0.269322416	0.284092443	0.288921613
X4*0.6	0.776332109	0.633849149	0.825567219	0.943957215	1.293836691
X5*1	0.497289256	0.566013988	0.645224027	0.678805263	0.616623672
Z-score	1.983330741	2.044696667	2.422919338	2.609059493	2.849231089
Z-score (0.00 places)	1.98	2.05	2.42	2.61	2.85

Source. Appendices 1-5. Calculations have been done by the authors.

Appendix 9. Calculation of Z-score: Prime Textiles Ltd.

	2020-21	2019-20	2018-19	2017-18	2016-17
X1*1.2	0.120187847	0.07698794	0.026422878	0.005450382	-0.006399825
X2*1.4	0.029222257	0.012458146	0.04576844	0.035643646	0.02000207
X3*3.3	0.022053428	-0.064402328	0.026062479	0.041481982	0.045341024
X4*0.6	0.212712968	0.153320761	0.401259902	0.398005462	0.372176045
X5*1	0.408750403	0.26395248	0.447360199	0.445277624	0.47993514
Z-score	0.792926904	0.442316999	0.946873899	0.925859095	0.911054454
Z-score (0.00 places)	0.79	0.44	0.95	0.93	0.91

Source. Appendices 1-5. Calculations have been done by the authors.

Appendix 10. Calculation of Z-score: Square Textile Ltd.

	2020-21	2019-20	2018-19	2017-18	2016-17
X1*1.2	0.258086693	0.015117084	0.083591813	0.066194072	0.266727801
X2*1.4	0.484236855	0.484302002	0.567573862	0.520972966	0.682880531
X3*3.3	0.15689989	0.020962727	0.111042471	0.121855704	0.130743058
X4*0.6	0.692902561	0.469598911	0.943897192	1.41471648	3.530672172
X5*1	0.773382443	0.66985912	0.686727479	0.675522626	0.668380745
Z-score	2.365508442	1.659839845	2.392832817	2.799261847	5.279404307
Z-score (0.00 places)	2.37	1.66	2.39	2.80	5.28

Source. Appendices 1-5. Calculations have been done by the authors.