Application of Altman's Z-Score Model in Predicting Financial Distress of the Ceramic Industry: Evidence from Bangladesh

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ABSTRACT

The purpose of this paper is to predict the financial position and possibility of the ceramic industry in Bangladesh. This paper uses Altman's Original Z-Score model for predicting the financial status of the companies. The study begins with a literature review of secondary data from articles, annual reports, periodicals, newspapers, and previous research papers, and the data was collected from the industry's annual reports published on their websites. It investigated a total of 60 annual reports during the twelve years of the five ceramic industries namely; RAK, Shinepukur, Monno, Standard, and Fu-Wang ceramic which are listed in the Dhaka and Chittagong Stock Exchange Limited. The results showed that RAK, Fu-Wang, and Standard ceramics had a mean score greater than 2.99(safe zone) in about (75%), (41.67%), and (25%) of the year respectively. Among them, the rest of the two companies failed to reach the safe zone. On the other hand, in the grey area, the highest rate was 66.67% with Monno, and Standard ceramics at 50%. In contrast, the lowest rate was in the RAK ceramics. The percentage in the grey area denotes the moderate financial position of a company. Interestingly, the highest score in the distress zone was 33.33% with Shinepukur. And in none of the years, has Shinepukur reached the safe zone. In the distress area, RAK had the lowest rate 16.67% among the five companies. Overall, in total, 28.33% of the year, Z-score reached the safe zone, of which 37% had in the Grey Zone, and 34.6% had in the distress zone.

Keywords: Financial position, Z-score, Safe zone, Ceramic industry, Grey zone, and Distress zone.

INTRODUCTION:

The overall performance of Bangladesh in socio-economic development is well recognized by international and regional organizations, such as the World Bank, IMF, ADB, etc. Several research institutes and economic think tanks found Bangladesh to be a potential economy in the upcoming days. Euro monitors blog (2008) observed that Bangladesh will be included in the top 11 emerging economies. Bangladesh is going to be one of the larger rising economies by 2050, and it will reach the 23rd position within 2050 and the 23rd position in 2050. Ceramics is an important industry in Bangladesh with very good growth potential. It has carved a niche in the global market. According to BCMEA, the industry earns about USD 42 million through export to more than 50 countries including the US, Canada, European Union, India, Nepal, Bhutan, UAE, and Middle East countries. In this regard, if the government raises support and provides facilities to this sector then it can be one of the best export earnings countries in the global economy. Moreover, this industry can easily face competition from ceramics-producing countries with China & India (Daily Star, 2017). The ceramics sector has become a major manufacturing sector in the national and international markets in the last couple of years. But this sector is playing a significant role at the very beginning of 1958. In the last 10 years, this sector's output stands about 200% (The Independent, 2019). Economic growth and urb-

anization helped this sector to increase continuous demand in local markets (Azim and Sharif, 2020).

The industry has been enjoying exponential growth in exports consistently, with about a 26% growth in the last 3 years. This sector provides 85% of the internal demand and also serves a major portion of the export market. This continual rising will help to place the 3rd biggest sector within 5 years (Light Castle Analytics Wing, 2020). The ceramic industry naturally offers good investment potential for now and will in the future, and, therefore, can act as a good point for testing the suitability of using Altman's Z-score model to measure the financial soundness of this sector. So, this study used this model to forecast the financial position of these industries. In light of those discussions, the study has formulated the following objectives:

1) To calculate different ratios of the industry using the model and enumerate their Z-scores.
2) To forecast the financial position of those companies using the Z-Score and make any logical and meaningful remarks about it.

So, we have organized this paper into 5 sections. Section 2 presents a Concept of Financial Distress. Section 3 presents a Literature Review. Section 4 Provides Data Sources and a Methodological Framework. The Results and Discussion are provided in section 5 and finally, the concluding remarks and policy implications are contained in section 6.

Concept of the Financial Distress

The ability to forecast financial distress is a very powerful tool that can help both corporations and investors in making wise and prudent investment decisions. It helps managers to take preventive measures to save the firm from falling into distress. They can improve the situation and can try to find out solutions before the condition worsens. The early studies on financial distress and bankruptcy predicttions can be traced back to the 1960s and the usefulness of accounting information to predict bankruptcy was first studied by Beaver in 1966. (Beaver, 1966) defined financial distress as the inability of a firm to pay its obligation within a maturing period. (Andrade & Kaplan, 1998) mentioned the two forms of financial distress; one is debt payment failure and the other is debt restructuring. (Deakin, 1972) stated that companies must try to guess the failure of their business operations when firms disappear from the marketplace due to economic downturns and that

might cause substantial losses to creditors and stockholders. The economic cost of business failures is relatively large that affects all stakeholders (E. I. Altman, 1983; Opler & Titman, 1994; Gilbert *et al.,* 1990) mentioned the three key reasons for financial distress; asset mix, financial structure, & corporate governance. (John,1993) mentioned that liquid assets such as cash and marketable securities constitute a considerable portion of total assets, say 6.3% to 9.6% in manufacturing firms. Financial managers pay a lot of attention to the management of corporate liquidity. (E.I. Altman, 2000) pointed out that bankruptcy in firms with large asset sizes was quite rare before 1966, but that became more common in the 1970s. Another study (E. Altman & Hotchkiss, 2006) defined insolvency as "one being unable to service its current debts due to the lack of liquidity and often culminates in a declaration of bankruptcy." (Ooghe & De Prijcker, 2008) identified the causes of corporate failures or bankruptcy to be the characteristics of management, for example, inadequate management qualities and skills, and poor corporate policy and strategies. It is the responsibility of a financial manager to measure the financial performance and also to predict the financial situation of the company (Levratto, 2013) has revealed that the circumstances of the business's internal and external factors have a significant impact on business failure. (Ijaz *et al.,* 2013) stated that financial failure happens when companies fail to pay their obligations or when the fair value of their assets falls shorter than obligations.

Review of Literature
Where Altman's model was found more effective
After 1960, several studies were done by accountants and finance people in different countries of the world trying to find a business failure prediction model that would serve as the sole predictor of corporate bankruptcy. Thus, an attempt is made in this study to examine whether Altman's Z-score model can predict the bankruptcy position or the financial soundness of the ceramic industry in Bangladesh. Beaver's univariate analysis led the way to a multivariate analysis by Edward Altman, who used multiple discriminant analyses (MDA) in his effort to find a bankruptcy prediction model in 1968 with a high degree of accuracy. The result showed 95% accuracy one year prior and 72% two years before failure (E.I. Altman, 1968). Interestingly, the beauty of this model is that it shows a calculated measure based on

past data rather than personal opinion. One of the pioneers in predicting business failures using financial ratios was Beaver, who paved the way for multi-variate attempts, which was later adopted by Altman and other researchers (E. I. Altman, 2000). The model developed by Altman (1968) has been used extensively by both academics and practitioners as a standard of comparison for subsequent insolvency classification studies (Wilson & Sharda, 1994; Coats & Fant, 1993). Although this model was developed more than 50 years ago and many alternative failure prediction models were existed, it is continuously being used worldwide as a main or supporting tool for measuring the financial performance of a company. (Collins, 1980) applied different models for assessing bankruptcy in his study, but he found that Altman's 1968 proved as a good model than the other models. The multiple discriminant analysis and in particular the Z-score model being applied in distress and bankruptcy studies showed satisfactory results (Scott, 1981; Jones, 1987; Aziz & Dar, 2006; Bellovary *et al.,* 2007). At the time of the financial crisis, the significance of bankruptcy or financial distress is extremely felt by the stakeholders (Taffler, 1983). Multiple discriminant analysis (MDA) is considered the best appropriate model for detecting bankruptcy as it included a variety of financial ratios (Frydman *et al.,* 1985). (Gerantonis *et al.,* 2008) used this model on the companies that are listed in the Athens Exchange. It examined the predictability of this model to measure the bankruptcy position of those companies before the 3 years and reached in conclusion that it has the predictive power of it. Subsequently, (Hayes *et al.,* 2010) applied this model to a sample of US 17 retail industries. The study revealed that the model correctly predicts bankruptcy at a level of 94%.

Where Alman's model was found less effective

Altman's Z-score model has been criticized and revised by both Altman himself and other researchers such as (Ohlson, 1980; Begley *et al.,* 1996; Grice & Ingram, 2001; Shumway, 2001; Begley *et al.,* 1996) argued that the forecasting power of the original model was going to be reduced due to using current data. As a result, this model was introducing measurement errors and biased results. (Agarwal & Taffler, 2008) added that Altman's 1968 Z-Score model suffered from high misclassification rates. The common criticism of this model is the decline of the accuracy rate over time (Joy & Tollefson, 1975;

Dimitras *et al.,* 1999). But, (Eisenbeis, 1977; and Jones, 1987) criticized Altman´s approach regarding its assumptions of normality and group distribution. (Shumway, 2001) opposed Altman's model from different angles. Firstly, the model dropped observations on firms that will be bankrupt in two or three years. Secondly, it neglected firms that have low values of this ratio (WC/TA), in a particular, which went to default in the following year. Lastly, the sample firms were not chosen randomly. (Grice & Ingram, 2001) found that in 1968 Altman compiled a list of 22 financial ratios, and the ratios were not selected on a theoretical basis but based on their popularity in the literature and belief about their potential relevancy to bankruptcy. (Chava & Jarrow, 2004) applied hazard models on the USA public limited companies from 1962 to 1999. The objectives were to validate the superiority of Shumway's model over Altman's model. But Shumway's model significantly outperformed Altman's model. (Abdullah *et al.,* 2008) criticized Altman's model due to the equal distribution of sample size between distressed and non-distressed companies. (Wu *et al.,* 2010) undertook a study on the U.S.A listed firms and they compared the most relevant accounting-based and market-based bankruptcy models with each other. They found Altman model performed poorly compared with the other models. (Alareeni & Branson, 2012) tested the relevance of this model in the context of Jordan to identify failed industrial companies. But, Altman's Z-score model could not provide strong evidence to differentiate between failed and non-failed companies. (Hernandez Tinoco & Wilson, 2013) used this model as a benchmark to assess the performance of the U.K. listed firms. They found out that Altman's model has very good predicttive power in distressed firms but less predictive power for non-distressed firms.

METHODOLOGY:

Research methods

This paper used quantitative analysis. Inferential statistics for the exogenous variables (X_1, X_2, X_3, X_4, X_5) and the coefficients 0.012, 0.014, 0.033, 0.006, & 0.99 have been used for the exogenous variables. And then Z-score is calculated by combining all the explanatory variables.

Data collection

The data was collected from the industry's annual reports published on their websites. This paper inve-

stigated a total of 60 annual reports from the period 2010 to 2021. The industries are Rak Ceramics, Shinepukur Ceramics, Monno Ceramics, Standard Ceramics, and Fu-Wang Ceramics listed on the Dhaka and Chittagong Stock Exchange Limited.

Table 1: Ratios used in the analysis.

Variables	Description
X_1	Working capital/Total assets
X_2	Retained earnings/Total assets
X_3	Earnings before interest and taxes/Total assets
X_4	Market value of equity/Book value of total debt
X_5	Sales/Total assets

The Z-score model has zones of discrimination that classify whether a company is in danger of going bankrupt or not. Companies classified in the "Safe" zone generally demonstrate a minimal chance of bankruptcy, while those in the "Grey" zone have a moderate chance of going bankrupt but are not in as much danger as firms in the "Distress" zone. The "Distress" zone is in danger of falling into bankruptcy. The zones of discrimination for the Z-score model are as follows:

Z-score above 2.99> "Safe" Zone

Z-score below < 2.99 but up to 1.82 "Grey" Zones

Z-score less than < 1.81 - "Distress" Zones

The higher Z-score of this model indicates companies are adopting more actions at a fast pace, while the lower score implies that fewer actions are initiated by the company and respond accordingly (Ferrier *et al.,* 2002). Precisely, a score below 1.81 sends the message to the stakeholders that companies are operating activities in a poor situation.

The model

This paper used Altman's (1968) model to analyze the results. It is presented as a linear equation form which is as follows:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.99X_5$$

RESULTS AND DISCUSSION:

The financial health or distress position of the ceramic sector had been measured by Altman's Z-score model. The data starting from 2010 to 2021 for each of the industries were collected from their annual reports and their Z-scores were calculated accordingly. The Z-score of those ratios had been shown in the following (2-6) tables.

Table 2: Z-Scores on the working capital /total assets ratio.

Year	RAK	SPC	MC	SC	FWC
2010	0.350	0.040	-0.034	-0.175	-0.136
2011	0.418	0.004	-0.037	-0.138	0.403
2012	0.358	0.007	0.014	-0.144	1.118
2013	0.413	-0.007	0.002	-0.144	0.210
2014	0.452	-0.134	0.007	-0.101	0.258
2015	0.268	-0.277	0.007	-0.055	0.263
2016	0.293	-0.127	0.066	-0.056	0.383
2017	0.274	-0.122	0.034	-0.048	0.314
2018	0.320	-0.121	0.061	-0.048	0.029
2019	0.344	-0.100	0.079	-0.834	0.260
2020	0.003	-0.001	0.001	-0.003	0.001
2021	0.004	0.000	0.001	-0.003	0.001
mean	0.291	-0.070	0.018	-0.141	0.259
Industry avg.	0.071				

The given **Table 2** illustrates the data about the industry average of the working capital to total assets. The industry average is 0.071 which means 7.1% of their total assets. Shinepukur shows a negative working capital ratio throughout the period. The highest average by the RAK ceramics. It is concluded that RAK ceramics had been maintaining its assets more accurately as compared to other industries.

The given below **Table 3** compares the mean and the industry average of the retained earnings to the ratio of the total assets. The industry average of this ratio stands at 6%. The Shinepukur & Standard Ceramics have retained less than the industry average. The RAK, Monno, and Fu-Wang ceramics have a relatively more percentage above the industry average. The other two companies show a negative ratio.

Table 3: Z-Scores on the Retained earnings/total assets ratio.

Year	RAK	SPC	MC	SC	FWC
2010	0.228	0.113	0.006	0.041	0.059
2011	0.239	0.085	0.046	0.053	0.106
2012	0.220	0.071	0.055	0.078	0.108
2013	0.307	0.031	0.944	0.092	0.116
2014	0.199	-0.017	0.031	-0.053	0.104
2015	0.161	-0.043	0.043	-0.118	0.059
2016	0.160	-0.041	0.046	0.039	0.130
2017	0.175	-0.143	0.053	0.000	0.085
2018	0.188	-0.147	0.078	0.000	0.057
2019	0.175	-0.120	-0.008	-0.587	0.073
2020	0.001	-0.001	0.000	-0.002	0.001
2021	0.002	0.000	0.000	-0.002	0.001
mean	0.171	-0.018	0.108	-0.038	0.075
Industry avg.	0.060				

Table 4: Z-Scores on the Earnings before interest and taxes/total assets ratio.

Year	RAK	SPC	MC	SC	FWC
2010	0.386	0.482	0.663	0.135	0.125
2011	0.409	0.102	0.558	0.172	0.274
2012	0.343	0.083	0.010	0.307	0.356
2013	0.422	-0.013	0.010	0.152	0.185
2014	0.158	0.010	0.320	0.188	0.122
2015	0.337	-0.030	0.003	0.307	0.092
2016	0.376	-0.030	0.030	0.175	0.274
2017	0.386	0.010	0.003	0.185	0.172
2018	0.333	0.040	0.073	0.185	0.172
2019	0.271	0.043	0.096	-1.109	0.142
2020	0.001	0.000	0.000	0.001	0.004
2021	0.000	0.000	0.000	0.001	0.004
mean	0.285	0.058	0.147	0.058	0.160
Industry avg.	0.142				

The above **Table 4** compares the changes to mean and collective mean in their financial position on the earnings before interest and taxes to the ratio of the total assets over the period. According to the results, in terms of mean score, RAK ceramics tops among the five companies, with 28.5% showing satisfactory results. The industry average ratio of the Z-score on the earnings before interest and taxes to total assets ratio is 14.2%. Turning to other companies, 16%, and 14.7%, were Fu-Wang and Monno ceramics respectively.

The industry average of the market value of equity to the book value of total debt **Table 5** of the company is 1.396 times which indicates a comfortable position of the industry as whole. RAK ceramic is in most comfortable position and then followed by FCI, SPC, and MCI. The lowest mean Z-Score is presented by SCL.

Table 5: Z-Scores on the Market value of equity/Book value of debt ratio.

Year	RAK	SPC	MC	SC	FWC
2010	2.186	0.926	0.740	0.815	0.672
2011	5.303	1.268	1.136	0.814	2.701
2012	3.655	1.355	1.207	0.823	2.047
2013	3.669	1.497	0.761	0.766	1.870
2014	3.874	1.418	1.724	0.818	2.341
2015	3.013	1.783	1.759	0.670	1.463
2016	2.480	1.807	1.437	0.712	2.441
2017	2.495	0.883	1.427	0.608	2.652
2018	1.847	1.873	1.724	0.625	1.235
2019	1.456	1.810	1.311	0.398	0.922
2020	0.008	0.013	0.012	0.002	0.240
2021	0.007	0.016	0.012	0.001	0.203
mean	2.499	1.221	1.104	0.588	1.566
Industry avg.	1.396				

Table 6: Z-Scores on the Sales/total assets ratio.

Year	RAK	SPC	MC	SC	FWC
2010	0.568	0.375	0.881	1.667	0.393
2011	0.591	0.266	0.815	2.017	0.547
2012	0.594	0.272	0.256	1.961	0.566
2013	0.505	0.287	0.240	2.072	0.520
2014	0.546	0.256	0.228	2.215	0.494
2015	0.475	0.317	0.248	2.661	0.446
2016	0.506	0.386	0.255	1.391	0.531
2017	0.592	0.223	0.267	1.341	0.249
2018	0.525	0.237	0.296	1.301	0.265
2019	0.412	0.238	0.347	2.217	0.234
2020	0.418	0.210	0.216	1.032	0.240
2021	0.431	0.330	0.351	1.064	0.391
mean	0.522	0.283	0.367	1.745	0.406
Industry avg.	0.665				

The given **Table 6** presents the ratio of the market value of equity to the book value of the total debt. Overall, the industry average of this ratio is 0.665. Most of these companies except Standard ceramics show relatively low scores. This low ratio indicates that the industry has idle capacity and there is scope for further improvement. Concerning RAK ceramics, the other company's mean figure went down by 23.9.1%, 15.5%, and 11.6% to the SPC, MC, and the FWC ceramics industry respectively.

Table 7: Year-wise, Z-scores, mean, and the industry average of the selected industries.

Year	RAK	SPC	MC	SC	FWC
2010	3.719	1.936	2.257	2.483	1.113
2011	6.960	1.725	2.518	2.917	4.032
2012	5.170	1.785	1.542	3.080	4.196
2013	5.316	1.794	1.976	2.938	2.901
2014	5.230	1.533	2.310	3.067	3.318
2015	4.253	1.750	2.061	3.466	2.322
2016	3.815	1.995	1.834	2.261	3.760
2017	3.922	0.850	1.784	2.086	3.472
2018	3.214	1.881	2.232	2.063	1.758
2019	2.658	1.871	1.824	0.086	1.630
2020	0.431	0.222	0.229	1.025	0.250
2021	0.497	0.285	0.183	0.962	0.209
mean	3.765	1.469	1.729	2.203	2.413
Industry avg.	2.316				

The given above **Table 7** compares the yearly Z-score, mean, and industry mean of the sample companies. The industry man score of the ceramic company was 2.316 over the period. Overall, the ratio was different among these companies each year. Regarding the range of the ratio, the response of RAK ceramics was above the industry average of the sales to total assets ratio. The average Z-score of the sample firms was 3.765, 1.469, 1.729, 2.203, and 2.413 in RAK, SPC, MC, SC, and FWC respectively. When about asked the Z-score, RAK ceramics, among these companies, had the highest average ratio of 3.765 which means the cut-off score (2.99) over the Safe Zone. Although, the mean score of Fu-Wang and Standard ceramics were below the industry average, both of the companies reach the Grey Zone. Whereas this ratio was almost similar to the Shine-pukur and the Monno ceramics (1.469, and 1.729) rated as poor or both of the companies lie in the distress zone and indicating the weak financial position of these companies.

Table 8: Year-wise Z-scores under/above the industry average of the selected industries.

Z-score (industry average)	Name of the Industry				
	RAK	SPC	MC	SC	FWC
Yearly Z-Score>Industry avg.	10(83.33%)	0(0%)	1(8.33%)	6(50%)	7(58.33%
Yearly Z-Score <Industry avg.	2(16.67)	12(100%)	11(91.67%)	6(50%)	5(41.67%)
	12(100%)	12(100%)	12(100%)	12(100%)	12(100%)

The above **Table 8** compares the percentage of the Z-score above and below the industry average in five industries. RAK, in terms of the yearly Z-score, had the highest 83.33% of the cases above the industry average among five companies. The percentage in all the other sectors was 58.33%, 50%, and 18. 33% with FWC, SC, and MC respectively. FWC took 2nd place in Z-score over the industry average.

CONCLUSION:

The study used Altman's Z-Score model as a tool to assess the financial position of the ceramic industries in Bangladesh. The data was collected from the industry's annual reports published on their websites. The study investigated a total of 60 annual reports from 2010 to 2021. Subsequently, Z-scores were calculated under the areas namely; Safe, Grey, and Distress Zone. The results showed that RAK, FWC, and SC ceramics reached the safe zone at (75%), (41.67%), and (25%) of year respectively. Among them, none of the years, the rest of the two companies had been able to reach the grey zone. On the other hand, in the grey area, the highest percentage was 66.67% with MC, and SC at 50%. The lowest rate was in the RAK ceramics. It is clear that for most of the years, RAK had a score that helped them reach the safe zone. Interestingly, the highest score in the distress zone was SPC. Specifically, the score for the distress area for the SPC was 33.33% and in none of the years, it reached the Safe Zone. The higher percentage in the distress area is not a good sign for a company. By contrast, the highest percentage in the safe zone denotes the good financial performance of a company. In the distress area, RAK had the lowest rate 16.67% among the five companies. In total, 28.33% of the year, Z-score reached the safe zone, of which 37% had in the grey zone, and 34.6% had in the distress zone. Lastly, this paper will help investors, and stakeholders make appropriate investment decisions to predict the financial position of a company. These, on contrary, will help identify business potentiality. Moreover, this paper viewed the concept of bankruptcy as the financial status of an enterprise rather than an event bankruptcy. It implies that the Z-score and its impact factors will help management to improve and change financial scenario of an enterprise in a better way.

Abbreviations
SPC: Shiepukur Ceramics; MC: Monno Ceramic; SC: Standard Ceramics; FWC: Fu-Wang Ceramics.

CONFLICTS OF INTEREST:
The author(s) declare no potential conflict of interest.

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APPENDIX

Table 9: Z-score in the different areas.

Name of the companies	Zone classification		
	Z-Score>2.99 (Safe)	**Z-Score>1.80 (Grey)**	**Z-Score<1.80 (Distress)**
RAK	9(75%)	1(8.33%)	2(16.67%)
SPC	0(0%)	4(33.33%)	8(66.67%)
MC	0(0%)	8(66.67%)	4(33.33%)
SC	3(25%)	6(60%)	3(25%)
FWC	5(41.67%)	2(16.67%)	5(41.67%)