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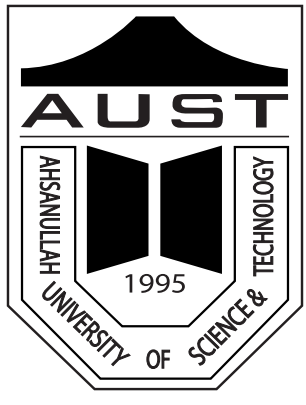

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Analysing the potential of Altman's Z-score for prediction of market performance and share returns – A case study of the cement industry in Bangladesh

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Abstract : *Altman's Z-score model has been proven to be an accurate and useful tool in predicting the financial distress of firms by numerous studies over time. Literature reveals that the model can have strong impact on share prices and can be extended as an indicator for market performance and share returns. But not much work has been done to test this potential in the context of Bangladesh. This article takes up a case of the cement industry in Bangladesh and tries to investigate the relationship between Z-scores and share returns. The results show that the correlation and regression model between these two variables are extremely weak. Companies with both weak and strong Z-scores outperform the market about 50% of the times and underperform the rest 50% of the times. The mean returns of the two groups are also not significantly different. Hence, the report concludes that Altman's Z-score bear no relevance or relationship with share returns in the cement industry of Bangladesh. So, the research output clearly shows that the Altman Z-score model cannot play any meaningful role in assessing and predicting the market performance of companies and in decision making by the investors, at least in the context of the cement industry in Bangladesh.*

1. Introduction

The Altman Z-Score is a quantitative method to determine a company's financial health by using five weighted business ratios that are mainly extracted from its balance sheet. The method was first developed in 1968 by Edward I. Altman. He devised this score as a quantitative measure of the bankruptcy risk of firms for investors. According to this theory, a Z-score can be calculated for all non-financial companies, and the lower the score, the greater the risk of the company falling into financial distress(Croft, 2011).

Now, in the context of a country like Bangladesh, where the stock market is really volatile and investors are exposed to high degrees of risk, this model can prove to be a handy tool for assessing and predicting the financial health and performance of companies. This can help investors make better investment decisions and earn better returns on their stock market investments. However, not much work has been done in this area to test the applicability of this model in the context of Bangladesh. This research aims to investigate whether the Altman's z-score can give any indication of a company's financial soundness and performance in terms of excess returns over market average so that shareholders can use it as a meaningful tool for assessing prospective investment.

For the purpose of this analysis, the paper has selected the case of one particular industry – the cement industry, in Bangladesh. Cement is an important industry in Bangladesh with very good growth potential, averaging around at least 20-25% per year (Nahar, 2011). Bangladesh cement industry is already the 40th largest in the world and, given the expanding nature of our economy, the prospects of this industry can only be expected to grow brighter with time (Nahar, 2011). So, the cement industry naturally offers a good investment potential for now and the future, and, therefore, can act as a good starting point for testing the suitability of the Altman's z-score model in the context of Bangladesh.

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2. Objectives of the Study

Altman's Z-Score model has been an important tool for predicting the financial distress of companies for the last four decades or so. Studies have proven its usefulness time and again, but despite all its potentials, some challenges have also been identified in its application and usage. Specific objectives of this research paper are as follows:

- ♦ To do a thorough literature review and come up with a comprehensive analysis of the Altman's z-score model and its application
- ♦ To calculate the prominent ratios of the cement companies enlisted in the Dhaka Stock Exchange and enumerate their Altman Z-scores for the past ten years.
- ♦ To try and assess the financial position of these companies based on the calculated Z-Scores and see if we can make any logical and meaningful deductions out of it.
- ♦ To do a time series analysis of the Z-scores vs. the excess gain over industry average for each of the companies and investigate if the two variables are related.
- ♦ To check if companies with high Z-scores have a tendency to outperform the industry average, and those with low Z-scores underperform compared to the industry average.
- ♦ Overall, to test and deduce the potential of the Z-score model as an indicator of market performance & share returns and, therefore, judge its importance as a decision making tool for investors, in the context of the cement industry in Bangladesh.

3. Methodology

This research is based on empirical data collected from the annual reports of the cement companies enlisted in the Dhaka Stock Exchange. All of the enlisted seven companies have been included in the analysis, and the data for the last ten years have been collected and used.

Secondary research was also extensively done for the literature review portion, making use of all sorts of journals, books, reports, and website documents available on the subject matter.

3.1 Analytical framework and tools

The two main variables used for the purpose of this report are Z-scores of the companies and the excess returns earned over the industry average, calculated by deducting the capital gain/loss (captured through share price increase or decrease) of each of the companies from the industry average capital gain/loss (captured through the average share price movements of all the companies enlisted in the cement industry)

Independent variable: Z-scores of the companies

Dependent variable: Excess returns earned over the industry average

After calculation of the Z-scores and corresponding excess returns over industry average, statistical tools like cross tabulations, correlation and regression analysis, and independent samples t-test to compare mean returns of companies with high and low z-scores, were applied to test any connection between the two variables stated above and to make meaningful analysis out of the data.

3.2 Hypothesis used and tested

The primary hypothesis that the research is based on is that if the companies are divided into two groups based on their Z-scores calculated from the figures quoted in their published

annual reports *(considering 1.8 the cut-off point as any score below that is considered to be dangerous and financially unhealthy by the original Altman model)*, the mean returns of the two groups will not vary significantly.

(Null hypothesis) H_0: *Mean return of the group with Z-score >=1.8 is the same as the mean return of the group with Z-score < 1.8*

(Alternate hypothesis) H_a: *Mean return of the group with Z-score >=1.8 is not the same as the mean return of the group with Z-score < 1.8*

Next, when a correlation and regression is run between the two variables: z- score and excess return over industry average, the hypothesis used are:

(Null hypothesis) H_0: $r = 0$; that is there is no correlation between the two variables

(Alternate hypothesis) Ha: $r \neq 0$; there is significant correlation between the two variables

4. Limitations of the Research

This research deals with only the case of the cement industry in Bangladesh. The same study could be replicated for other major industries and, on a larger scale, for the entire stock market in Bangladesh, to get a better idea about the applicability of the Altman's Z-score model as a market performance indicator in a wider context.

Also, there are certain limitations in the context of Bangladesh that might have limited the applicability of this model as revealed by this study. For example, the quality and accuracy of the data quoted in the published annual reports and the general awareness level of the mass public investors are big challenges in the context of this country which might potentially curtail the usefulness of the Altman's model.

5. Literature Review

5.1 What is the Altman's z-score and how does it work?

Many researchers have tried to investigate, interpret and summarize the Altman's model over the years, with the facts more or less remaining the same. Of these, Chuvakhin & Gertmenian (2003) does a good job of explaining and highlighting the main points of Altman's work. Based on this source, the original research by Altman was based on data from publicly held manufacturers - 66 firms, half of which had filed for bankruptcy, selected on a stratified (by both industry and asset size) random basis. Altman calculated 22 common financial ratios that could be intuitively linked with bankruptcy for all of the companies. He then used multiple discriminant analysis to come up with a model that finally contained only five ratios that could best distinguish between a bankrupt firm and a healthy one. Using these ratios in different proportions he came up with a measure that he called the z-score. (Chuvakhin & Gertmenian, 2003; Altman, 1968; Altman, 2000)

From the summary of Chuvakhin & Gertmenian, and the original and subsequent articles of Altman, we further come to know that according to the bar set by Altman, if the Z-score was below the cut-off line – initially set at 2.675 – the firm was classified as bankrupt (i.e., insolvent, or headed that way) and if above the cut-off line, as non-bankrupt. This model allowed Altman to correctly classify 94% of the bankrupt firms and 97% percent of the non-bankrupt firms one year prior to the filing of bankruptcy. An attempt to predict bankruptcy earlier, i.e., two years in advance, yielded lower but still impressive accuracies of 72% and 94%, respectively.

However, after conducting three subsequent tests, Altman recommended a lower cut-off score of 1.81. Companies with Z-scores between 1.81 and 2.675 are to be treated to be in a

"gray area" or "ignorance zone" which means that the company in question has a chance to go bankrupt, but it is not certain that it will. (Chuvakhin & Gertmenian, 2003)

The current interpretation of the z score can be summarized the following way (Croft, 2011):

1. Z-score>2.99: "Safe" Zones. The company is considered 'Safe' based on the financial figures only.
2. 1.8<Z-score<2.99: "Grey" Zones. There is a good chance of the company going bankrupt within the next 2 years of operations.
3. Z-score<1.80: "Distress" Zones. The score indicates a high probability of distress within this time period.

As specified by Altman (2000) in a follow up paper, the formula for calculating the Z-score of public companies is as follows:

1.2*T1 + 1.4*T2 + 3.3*T3 + 0.6*T4 + 1.0*T5, where

1. T1 = Working Capital / Total Assets. This measures liquidity; firm in trouble will usually experience shrinking liquidity.
2. T2 = Retained Earnings / Total Assets. This indicates the cumulative profitability of the firm; shrinking profitability can be a sign of danger.
3. T3 = Earnings before Interest and Taxes / Total Assets. This ratio shows how productive a company is in generating earnings, relative to its size.
4. T4 = Market Value of Equity / Book Value of Total Liabilities. This offers a quick test of how far the company's assets can decline before the firm becomes technically insolvent (i.e. its liabilities exceed its assets).
5. T5 = Sales/ Total Assets. Asset turnover is a measure of how effectively the firm uses its assets to generate sales.

It is to be noted that the original Altman model is intended for use in cases of publicly-traded manufacturing firms. However, Altman has used the same approach to develop other models: Z' for privately-held manufacturing firms and Z" for non-manufacturing firms (Chuvakhin & Gertmenian, 2003). Please refer to Appendix 1 for formula of these two modified Z-scores. Both these revised measures have slightly different zones of interpretation.

However, this model is not much usable in case of financial institutions due to the ambiguity in the nature of their Balance Sheets. (Croft, 2011)

5.2 Criticisms of the Altman Model and Counterarguments

The Altman Z-score model has also drawn several statistical objections over the years. Some of the major arguments against the model are that it uses unadjusted accounting data, it uses data from relatively small firms, and it uses data that is around 60 years old (Croft, 2011). However, despite these flaws, the original Z-score model is still the most widely used measure of corporate financial distress.

An interesting fact that counters the logic of accounting distortions to some extent is that the Z-score model is inherently able to withstand certain types of accounting irregularities (Chuvakhin & Gertmenian, 2003). If we take the bankruptcy case of WorldCom, in which management improperly recorded billions of dollars as capital expenditures instead of as operating expenses, such a treatment would have a two way impact on financial statements: (1) overstating earnings, and (2) overstating assets. Overstated earnings would increase the

T3 ratio in the Z-score model, while overstated assets would actually decrease three ratios, T1, T2, and T5 (all three are calculated with total assets in the denominator). Therefore the overall impact of these accounting improprieties on the company's Z-score is likely to be downward (Chuvakhin & Gertmenian, 2003).

5.3 Applicability of the Altman Z-Score

5.3.1 Instances where the model was found to work

Over the years many subsequent works have been done to test the applicability of the Z-score, from different dimensions. In its initial test, the Altman Z-score was found to be 72% accurate in predicting bankruptcy two years prior to the event. In subsequent tests over 30 years up until 1999, the model was found to be 80-90% accurate in predicting bankruptcy one year prior to the event (You May Want to 'Alt-Ctrl-Del' These Stocks from Your Portfolio, 2011).

The model was intended as a measure of "Financial Distress" where financial distress"is a term used to indicate a condition when promises to creditors of a company are broken or honoured with difficulty. If financial distress cannot be relieved, it can lead to bankruptcy" (Financial Distress, 2015). But subsequently the model has also been extended as a measure of market performance to test if it can identify the better performing companies from the companies not doing so well.

In one noteworthy study by Graham Secker, a Morgan Stanley strategy analyst, (Mathurin, 2009), the Z-score was used to rank a basket of European companies. It was found that the companies with weaker balance sheets underperformed the market more than two thirds of the time. Morgan Stanley also found that a company with an Altman Z-score of less than 1 tended to underperform the wider market by more than 4% over the year with a probability of 72% (i.e., in 13 out of the 18 years for which data was analyzed in the study). In only 5 of the 18 years of study had a stock with an Altman score of 1 or less outperformed the market. These were generally years of strong economic growth. From the same study we also get to see that European companies had the lowest Z-score averaging 2.8, compared with 4.0 for Asia and the US. On a sector basis, healthcare and IT companies had the highest Z-scores and the utility sector the lowest.

Secker saw this result as logical - companies with balance sheets that are perceived to be weak are deemed a higher risk by lenders and face a higher cost of capital. This turns market sentiment against them and will generally lead to their share prices falling below their peers (Mathurin, 2009).

In an analysis conducted on a case-study setting, dealing with the notorious case of WorldCom debacle, Z-scores for WorldCom for fiscal years ending December 31, 1999, 2000, and 2001 were calculated based on its annual reports filed with the U.S. Securities and Exchange Commission (Chuvakhin & Gertmenian, 2003). It was found that the company indeed experienced a rapid deterioration in its Z-score, and the study showed how particular types of accounting impropriety can affect the Z-score. The study concluded that the Altman score is "a comprehensive synthesis of accounting and market-based measures which remains the cornerstone of contemporary credit analysis".

Research on companies enlisted in the Malaysian stock exchange revealed that Altman Z-Score model can be used to differentiate failure Companies (lowest category stock as per their stock exchange classification) from Non failure Companies (highest category stock as per their stock exchange classification) listed in the Trading Services Sector under the Malaysian Stock, since their z-scores varied and carried statistic significance. (Ng Kim Soon, April, 2014). The study concluded that the Altman model is a useful tool for investors to predict financial failure of companies.

Similar findings were revealed and the usefulness of the Altman model corroborated by several other studies (Kim-Soon, Ahmad, Tat, & Mohammed, 2013), (Mohammad & Kim-Soon, 2012), (Jones, 1987), (Scott, 1981). Hayes, Hodge, & Hughes (2010), in their study conducted on retial firms, found out that 94% of the firms in financial distress could be accurately predicted using the Altman's Z-score model. Study on Lebanese firms (El Khoury & Roy, 2014) classified firms according to Altman Z-score model, then compared this to their actual classification, and found the results to be substantially accurate within the same sub-business sector. Another group of researchers worked with the Thai Stock Exchange and highlighted that the use of the Z-score model can completely predict the sign of a possible bankruptcy that may occur, and it was more effective when two years of information was used rather than one year (Meeampol, et al., 2014).

A study conducted in the context of India (You May Want to 'Alt-Ctrl-Del' These Stocks from Your Portfolio, 2011) tried to investigate how listed Indian companies with weak Altman Z-Scores (less than 3.0) performed compared to companies with good scores (more than 3.0). The findings showed that the companies with good Altman-Z scores hugely outperformed the ones that had bad scores, over the span of five years of analysis. While the 5-year return for the former group stood at a huge 348%, the latter group had actually destroyed capital, with its returns standing at negative -59%. Similar was the finding from another Indian study (Anjum, 2012), which, through its qualitative research and literature review, concluded that – "Altman's Z score Model can be applied to modern economy to predict distress and bankruptcy one, two & three years in advance".

Finally, coming to Bangladesh, a study was conducted using the Z-score model to predict risk of financial distress of Z category companies listed in Dhaka Stock Exchange. Results suggested that five of fifty three companies were out of danger; seven were in the gray area, and forty one (almost 78%) of the companies were operating with high distress risk as suggested by the model. The study concluded that the model may not be fully applicable for companies in Bangladesh, but it proves strong accuracy in predicting distressful status of the Z category companies (Chowdhury & Barua, 2009).

5.3.2 Instances where the model was found not to work

The validity of the Altman's Z-score model could not always been proven to be entirely positive. Alareeni & Branson (2013) wanted to test the relevance of the model for Jordanian firms and found that while it was generalisable in the Jordanian context for assessing failed industrial companies, for service companies, however, the Altman model could not provide strong indicators to differentiate between failed and non-failed companies. Also in another study conducted in India the results showed that Altman's Z score model could not fully predict sickness among Indian companies and the percentage of sick companies correctly classified was maximum at 83.33% in the second year prior to sickness (Shanmugam & Mahalakshmi, 2014). Aasen (2011) in his research on Oslo stock exchange came up with findings that indicated that the Z-scores' ability to predict bankruptcies significantly worsened during financial crisis.

In some other researches the results were even more drastic. Shumway (1999) showed that half of the variables included in Altman-Z are no longer predictive of bankruptcy and he also identified a model that trumps the Altman-Z. Further, Chava & Jarrow (2004) verified with expanded data that Shumway's model is superior than Altman's model in predicting financial distress and that controlling for industry effects can significantly improve bankruptcy prediction models.

5.3.3 Z- Score and its impact on Stock Prices

As we have seen in the previous section, a lot of work has been done testing the validity of the Altman's Z-score model in predicting the financial distress of companies and the results vary, but mostly bear positive indication of the model's strength. Though the model was originally developed as an indicator of a company's failure, from here, one may naturally wonder if this score can therefore be used as an indicator of a company's success as well, working as a barometer for a market performance and share price movement. Though this question came up time and again, not much work has been done in this regard. As Cilliers (2013) observed in his article that though higher the Z-score, ideally higher should be the success potential of the company, he could not find many academic journal articles that tested this theory.

In a paper on company strategy by Calandro (2007), the author referred to an academic text book by Robert Carton and Charles Hofer (Carton & Hofer, 2006). Carton and Hofer found that the Z-score might be just what investors look for - a formula for predicting superior share price performance. Calandro (2007) agreed that despite all the potentials "strategists generally haven't discovered the usefulness of the model as a performance management tool".

To test the validity of the model in this regard, some limited work have been done so far, with both positive and negative results. A study conducted by Greek researchers (Apergis, Sorros, Artikis, & Zisis, 2011) tried to design a new empirical model that relates stock price movements to Altman's Z-score, regardless of the validity of the model. This study showed that there was positive cross correlation between the Altman Z-score and the firm stock price. But at the same time, it cautioned that this finding was based on mature stock markets at times of relatively calm stock exchanges, and that this correlation may not work in cases of emerging markets characterized by econmic growth.

Study conducted in the context of the Transportation sector in the Indonesian Stock Exchange, showed that the prediction of financial distress based on the Altman Z-score model influenced the stock price of the enlisted comapnies positively and significantly (Lasmanah, Amaliawiati, & Lestari, 2012). But contradictory results were given by another research conducted on the Indonesian banking industry (Prihatni & Zakaria, 2011)that concluded that though using Altman approach for the years 2004-2008 all banks were found to be in financial distress (all scores were less than 2.60), they were all continuing normal operations, and there were no significant differences in stock prices between banks with positive and negative Z-scores. However, the applicability of the Altman model is anyways limited when it comes to financial institutions.

Bezhanishvili & Henderson (2009) discussed in their paper that there was no significant difference between special announcement effects (like equity offerings) for healthy firms and unhealthy firms and that the financial health of the firm, as measured by Altman's Z-score, had no significant impact on abnormal returns after equity offering announcements. This suggested that investors' knowledge of company health was insignificant.

The study conducted by Chowdhury & Barua (2009) in Bangladesh also revealed that though the Altman model was quite accurate in predicting the status of the Z-category companies in Bangladesh, its reflection in the stock price was absent from the market in many instances.

6. Research Gap

Literature review reveals that the model has the potential to work as an indicator for market performance and share price movements, such that it can work as a handy tool for investors to assess the condition of the companies for investment purpose. But not much work has

been done in this regard till date. Especially, given the context of Bangladesh, there is no such noteworthy work or research done from this field.

This research tries to fill in that gap and studies the case of the cement industry - an important industry in Bangladesh having a strong presence in the Stock Exchange of this country, as a starting point for testing the application of the Altman's Z-score model in evaluating the market performance and returns of stocks. The analysis and findings are summarized in the following section.

7. Analysis and Findings

Currently seven companies from the cement industry in Bangladesh are enlisted in the Dhaka Stock Exchange (DSE) as per the DSE website (Sector wise comapny list, n.d.)

Aramit Cement Limited, Confidence Cement, Heidelberg Cement, Lafarge Surma Cement, Meghna Cement Mills, MI Cement, and Premier Cement.

The relevant twelve years' data – starting from 2004 to 2015, of each of the companies were collected from their annual reports and their Z-scores were calculated accordingly. The major ratios, along with the calculated Z-score for each of the companies are given in appendix 2.

Share prices of these stocks, over the same time period, were collected from Dhaka stock exchange archive and yearly returns to the shareholders were calculated in the form of capital gain/loss for each of the years. Next, excess return for each of the companies for each of the years were calculated by comparing the individual return with the industry average, to see if any firm outperformed or underperformed the industry over the given time period.

Here, the aim is to understand the relationship that these excess returns earned by the companies bear with the Z-scores calculated for them. Ideally, Z-scores calculated for one year should get reflected in the share price of the next year. If we tally the Z-scores for each of the years along with the excess returns earned over industry average in the next period, the result can be summarized through the following table.

Table 1: Z-scores of companies and excess returns earned over industry average

ramit		Confidence		Heidelberg		Lafarge		Meghna		Premier		MI	
Z-Score	Excess Returns	Z-Score	Excess Returns	Z-Score	Excess Returns	Z-Score	Excess Returns	Z-Score	Excess Returns	Z-Score	Excess Returns	Z-Score	Excess Returns
-0.69	-7.1%	1.07	2.3%	2.03	-24.2%			1.35	2.1%				
-0.01	55.4%	1.14	-7.0%	1.73	0.5%			1.62	-15.2%				
0.52	25.0%	1.77	80.2%	3.27	6.3%	0.70	-58.1%	1.88	-53.5%				
0.76	13.3%	2.42	-16.4%	3.96	-4.1%	0.70	2.2%	1.60	5.1%				
0.80	44.3%	1.73	165.2%	3.83	-97.6%	1.41	-175.7%	1.74	63.7%				
2.17	74.3%	4.74	2.6%	6.50	-39.5%	1.77	-95.6%	2.61	58.1%				
2.77	13.8%	9.98	-17.2%	8.01	11.4%	0.63	-12.4%	3.68	-19.3%			6.91	23.8%
1.81	-31.3%	3.30	-1.8%	5.65	17.4%	1.19	37.7%	2.48	-11.0%			1.60	-11.0%
1.30	19.4%	3.15	9.6%	6.10	-41.1%	2.87	-25.5%	2.61	22.6%	1.65	46.1%	1.28	-31.1%
1.29	-66.6%	3.70	-66.6%	4.88	102.7%	3.78	226.0%	2.39	-47.3%	2.46	-63.7%	1.49	-47.3%

Source: Based on data and calculations from Annual Reports of the Listed Cement Companies

The following summary of findings can be drawn from the above table:

- If we rank the companies in terms of their Z-scores, Heidelberg seems to be in the best position maintaining Z-scores above the danger zone of 1.8 in about 100% of the cases, and above 2.99 in 80% of the cases. It is followed by Confidence - with Z-scores above 1.8 in about 80% of the cases, out of which 50% of the times it was above 2.99; and then Meghna - with a 70% occurrence of Z-scores above 1.8.
- Premier and MI are too new to comment on. But Aramit and Lafarge are at the bottom of the Z-score table with only 30% and 37.5% respective incidence of Z-scores above 1.8.

However, if we compare the excess return over industry average and the corresponding Z-scores of these firms, we will see that this position derived by Z-scores is not reflected in share returns. The relationship between the two can be summarized through the use of a simple matrix, as exhibited in Table 2:

Table 2: Z-Score by Market Performance Matrix

	Out performed Industry Avg.	Under performed Industry Avg.	Total
Z-Score>2.99	8(14.8%)	8(14.8%)	16(29.5%)
Z-Score>1.8	8 (14.8%)	9(16.7%)	17(31.5%)
Z-Score<1.8	11(20.4%)	10(18.5%)	21(39%)
Total	27(50%)	27(50%)	54(100%)

Source: Based on data and calculations from Annual Reports of the Listed Cement Companies

We can observe the following points from the matrix:

- Combining all the data points for all the cement companies, about 39% of the times the Z-score was found to be less than 1.8, i.e., in the danger zone. The rest 61% of the times the Z-score was at least within the grey range.
- As far as share performance is concerned, it is really not distinguishable based on Z-scores.
  - Companies with Z-scores higher than 2.99 outperformed the industry 50% of the times and underperformed 50% of the times.
  - More or less the same equal split in performance, i.e., almost similar probabilities of both outperforming and underperforming the industry, is noticeable in case of companies with z-scores greater than 1.8, and less than 1.8.

From here if we take our analysis one step further and divide the data into two groups – one with Z-score higher than 1.8 and another with less than 1.8, the average excess returns for both the groups and major statistics from conducting an independent samples t–test in SPSS generate the following results:

Table 3: Summarized output of independent samples t-test

	Z – Score	N	Mean	Std. Deviation	Std. Error Mean
Excess return over industry average	>= 1.80000000	28	.0032142857	.61501613090	.11622712390
	< 1.80000000	26	.0130769231	.62990011418	.12353357592

Source: SPSS generated using data from Annual Reports

Where, H_0: *Mean return of the group with Z-score >=1.8 is the same as the mean return of the group with Z-score < 1.8*

H_a: *Mean return of the group with Z-score >=1.8 is not the same as the mean return of the group with Z-score < 1.8*

Table 4: T-test for Equality of Means

		T	Df	Sig. (2-tailed)
Excess return over industry average	Equal variances assumed	-0.058	52	0.954
	Equal variances not assumed	-0.058	51.49	0.954

Source: SPSS generated using data from Annual Reports

As we can see from Table 4, the significance level is too high (0.954) which shows that mean returns of the two groups do not vary significantly; the difference between them is insignificant.

Next to further investigate if there is any relationship between the Z-scores calculated and the excess returns over industry average, correlation and regression analysis is tried between these two variables for each of the companies separately, and then in total for an overall picture. The results are summarized in Tables 5 and 6 accordingly:

Table 5: Correlations

		Aramit		Confidence		Heidelberg		Lafarge		Meghna		Whole Industry	
		Excess return*	Z – Score	Excess return*	Z - Score	Excess return*	Z - Score	Excess return*	Z - Score	Excess return*	Z - Score	Excess return*	Z - Score
Pearson Correlation	Excess return*	1.000	-.013	1.000	-.328	1.000	.080	1.000	.562	1.000	-.062	1.000	.017
	Z - Score	-.013	1.000	-.328	1.000	.080	1.000	.562	1.000	-.062	1.000	.017	1.000
Sig. (1-tailed)	Excess return*	.	.486	.	.177	.	.413		.074		.432		.452
	Z - Score	.486	.	.177	.	.413	.	.074		.432		.452	

**over industry average*
Source: SPSS generated using data from Annual Reports

Table 6: RegressionModel Summary

Aramit		Confidence		Heidelberg		Lafarge		Meghna		Whole Industry	
Adjusted R Square	Sig.	Adjusted R Square	Sig.	Adjusted R Square	Sig.	Adjusted R Square	Sig.	**Adjusted R Square**	Sig.	**Adjusted R Square**	Sig.
-.125	**.972**	**-.004**	**.354**	**-.118**	**.825**	**.202**	**.147**	**-.121**	**.865**	**-.019**	**.905**

Source: SPSS generated using data from Annual Reports

The tables above highlight the following points:

- For none of the companies the Pearson correlation coefficient between the Z-score of the companies and the returns earned by them carry any substantial value. The corresponding levels of significance for all companies are also very high, indicating there is no significant relationship between these two variables for any of the companies. **(H_o: r = 0; H_a: r ≠ 0)**
- Coming to the strength of the regression model or the strength of the relationship between these two variables, once again we see that the adjusted R square value is not significant enough.
- Correlation and regression for MI and Premier have not been done separately because they are relatively new companies and their individual data points are not substantial in number.
- Overall when all the data points are combined and the analysis is done for the whole industry, naturally, both correlation and regression between the Z-scores and Excess returns earned by the companies are found to be extremely weak with very high levels of significance.

From all these findings it can easily be concluded that in the context of the cement industry in Bangladesh, there is no correlation between the Z-scores calculated from the companies' annual reports and the actual returns that these companies are enjoying in excess of the industry average out in the market and the strength of the relationship between these two variables as suggested by their regression model is also extremely weak.

8. Conclusion

This report did a thorough literature review and found out that the Altman's Z-score model has been an important tool for predicting the financial distress of companies for the last four decades or so. Most studies found this model to be really accurate and useful in predicting the fianncial distress of firms, but of course there were evidences against it as well in some of the studies and some challenges were identified in its application and usage. Literature review also revealed that the model has the potential to work as an indicator for market performance and share price movements, such that it can work as a handy tool for investors to assess the financial condition of the companies for investment purpose. But not much work has been done in this regard till date, especially, given the context of Bangladesh.

The report dealt with the case of the cement industry in Bangladesh as a starting point for tetsing the vaidity of the model in working as a market performnace indicator in the context of Bangladesh. All the cement companies enlisted in the Dhaka Stock Exchange were taken and the data for the last ten years analyzed with application of advanced statistical tools.

The results showed If we rank the companies in terms of their z-scores, Heidelberg seems to be in the best position maintaining Z-scores above the danger zone of 1.8 in about 100% of the cases, and above 2.99 in 80% of the cases. It is followed by Confidence (Z-scores>1.8, about 80% of the times) and then Meghna (70% occurrence of Z-scores >1.8). However, these superior scores do not reflect in their market performance as such. Companies with Z-scores higher than 2.99 outperformed the industry 50% of the times and underperformed 50% of the times. Similarly, companies with Z-scores less than 1.8 outperformed the market almost half the times (52%).

When the data was divided into two groups one with Z-scores >1.8, and another with Z-scores<1.8, independent samples t –tests showed that the mean returns of the two groups

were not at all signifiantly different. Also when a correlation and regression was run between the Z-scores and market returns, the results revealed extremely weak relationship between the two variables with very high levels of significance.

Therefore, this report can safely conclude that as far as the cement industry in Bangladesh is concerned, the Z-score fails to work as an indicator of market performance, i.e., the report findings show that the Z-scores in this industry is not at all related to how the share prices of the comapnies move in the market and what returns are earned out of it.

Appendix 1: Calculating Z′ and Z″ for privately held manufacturing and non-manufacturing firms:

The Z' model is used to predict bankruptcy of privately-held manufacturing firms and takes the following form:

$$Z' = 0.717\ X_1 + 0.847\ X_2 + 3.107\ X_3 + 0.420\ X_4 + 0.998\ X_5 \quad (3)$$

Definitions of all ratios are the same that in the original Z-score model, except X_4, which in this case means book value of equity / total liabilities. Firms with $Z' < 1.21$ are classified as bankrupt, $Z' > 2.90$, as non-bankrupt; the space in-between, similar to the original model, is a "gray area", where the probability of incorrect classification is high.

The Z'' model is used to predict bankruptcy of privately-held non-manufacturing firms and takes the following form:

$$Z'' = 6.56\ X_1 + 3.26\ X_2 + 6.72\ X_3 + 1.05\ X_4 \quad (4)$$

Note that asset turnover (X_5) was excluded to minimize the potential industry effect. Other ratios are defined similarly to the Z' model. The cutoff scores are also the same as those used in the Z' model.

In the case or privately held companies, there is no publicly available source of financial information, so you would need to request the data from the firm itself or use Dun & Bradstreet data.

Source: Chuvakhin&Gertmenian (2003)

Appendix 2: Important ratios of all the enlisted cement companies along with their Z-scores

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Aramit										
T1 (Working Capital / Total Assets)	-0.28	-0.37	-0.42	-0.43	-0.32	-0.24	-0.22	-0.25	-0.26	-0.27
T2 (Retained Earnings / Total Assets)	-0.46	-0.45	-0.40	-0.34	-0.27	-0.14	-0.03	0.00	0.02	0.05
T3 (Earnings Before Interest and Taxes / Total Assets)	-0.11	-0.03	0.07	0.11	0.05	0.23	0.17	0.11	0.11	0.10
T4 (Market Value of Equity / Book Value of Total Liabilities)	0.28	0.13	0.23	0.42	0.39	1.21	2.62	1.64	0.83	1.12
T5 (Sales/ Total Assets)	0.49	1.07	1.21	1.15	1.17	1.17	0.93	0.77	0.71	0.55

Z-score (1.2xT1 + 1.4xT2 + 3.3xT3 + 0.6xT4 + 1.0xT5)	**-0.69**	**-0.01**	**0.52**	**0.76**	**0.80**	**2.17**	**2.77**	**1.81**	**1.30**	**1.29**
Confidence										
T1 (Working Capital / Total Assets)	0.03	0.05	0.09	0.11	0.03	0.08	0.08	0.06	0.09	0.11
T2 (Retained Earnings / Total Assets)	-0.01	0.00	0.00	0.01	-0.02	0.00	0.05	0.09	0.06	0.16
T3 (Earnings Before Interest and Taxes / Total Assets)	0.00	0.04	0.08	0.09	-0.01	0.08	0.05	0.07	0.11	0.13
T4 (Market Value of Equity / Book Value of Total Liabilities)	0.93	0.50	0.76	1.66	1.15	6.42	15.18	3.83	2.97	3.60
T5 (Sales/ Total Assets)	0.50	0.65	0.95	1.00	1.07	0.52	0.53	0.60	0.80	0.76
Z-score (1.2xT1 + 1.4xT2 + 3.3xT3 + 0.6xT4 + 1.0xT5)	**1.07**	**1.14**	**1.77**	**2.42**	**1.73**	**4.74**	**9.98**	**3.30**	**3.15**	**3.70**
Heidelberg										
T1 (Working Capital / Total Assets)	-0.18	-0.14	-0.05	0.01	0.11	0.29	0.36	0.30	0.38	0.43
T2 (Retained Earnings / Total Assets)	0.16	0.17	0.28	0.32	0.36	0.46	0.50	0.51	0.56	0.59
T3 (Earnings Before Interest and Taxes / Total Assets)	0.03	0.07	0.18	0.18	0.15	0.23	0.21	0.11	0.17	0.16
T4 (Market Value of Equity / Book Value of Total Liabilities)	1.95	1.00	1.92	2.99	2.69	5.90	8.40	5.26	5.19	3.50
T5 (Sales/ Total Assets)	0.76	0.85	1.21	1.09	1.08	1.20	1.16	1.06	1.19	0.93
Z-score (1.2xT1 + 1.4xT2 + 3.3xT3 + 0.6xT4 + 1.0xT5)	**2.03**	**1.73**	**3.27**	**3.96**	**3.83**	**6.50**	**8.01**	**5.65**	**6.10**	**4.88**
Lafarge										
T1 (Working Capital / Total Assets)			-0.17	-0.27	-0.30	-0.31	-0.44	-0.25	-0.24	-0.05
T2 (Retained Earnings / Total Assets)			-0.09	-0.15	-0.14	-0.09	-0.18	-0.29	-0.19	-0.05
T3 (Earnings Before Interest and Taxes / Total Assets)			-0.01	-0.02	0.12	0.14	-0.06	0.01	0.18	0.21
T4 (Market Value of Equity / Book Value of Total Liabilities)			1.76	1.93	2.07	2.28	2.16	2.54	3.77	4.36

T5 (Sales/ Total Assets)			0.01	0.14	0.35	0.44	0.32	0.33	0.57	0.60
Z-score (1.2xT1 + 1.4xT2 + 3.3xT3 + 0.6xT4 + 1.0xT5)			**0.70**	**0.70**	**1.41**	**1.77**	**0.63**	**1.19**	**2.87**	**3.78**
Meghna										
T1 (Working Capital / Total Assets)	0.00	0.00	-0.03	0.05	0.17	0.15	0.11	0.11	0.15	0.17
T2 (Retained Earnings / Total Assets)	0.02	0.03	-0.02	0.02	0.03	0.05	0.06	0.05	0.07	0.09
T3 (Earnings Before Interest and Taxes / Total Assets)	0.07	0.08	0.10	0.10	0.05	0.08	0.09	0.07	0.10	0.09
T4 (Market Value of Equity / Book Value of Total Liabilities)	0.45	0.29	0.34	0.35	0.37	1.11	2.65	0.92	0.69	0.96
T5 (Sales/ Total Assets)	0.82	1.15	1.41	0.98	1.12	1.42	1.59	1.48	1.59	1.18
Z-score (1.2xT1 + 1.4xT2 + 3.3xT3 + 0.6xT4 + 1.0xT5)	**1.35**	**1.62**	**1.88**	**1.60**	**1.74**	**2.61**	**3.68**	**2.48**	**2.61**	**2.39**
Premier										
T1 (Working Capital / Total Assets)									-0.15	-0.13
T2 (Retained Earnings / Total Assets)									0.09	0.13
T3 (Earnings Before Interest and Taxes / Total Assets)									0.07	0.13
T4 (Market Value of Equity / Book Value of Total Liabilities)									1.37	2.08
T5 (Sales/ Total Assets)									0.65	0.76
Z-score (1.2xT1 + 1.4xT2 + 3.3xT3 + 0.6xT4 + 1.0xT5)									**1.65**	**2.46**
MI										
T1 (Working Capital / Total Assets)						-0.04	3.75	0.48	0.33	0.31
T2 (Retained Earnings / Total Assets)						0.28	0.16	0.11	0.09	0.10
T3 (Earnings Before Interest and Taxes / Total Assets)						0.26	0.25	0.09	0.06	0.08

T4 (Market Value of Equity / Book Value of Total Liabilities)						0.00	0.00	0.00	0.00	0.00
T5 (Sales/ Total Assets)						1.51	1.37	0.57	0.57	0.70
Z-score (1.2xT1 + 1.4xT2 + 3.3xT3 + 0.6xT4 + 1.0xT5)						**2.72**	**6.91**	**1.60**	**1.28**	**1.49**

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