

An Exploration of the Financial Economics Arena of Earnings Management through the Beneish M-Score Model to Assess Investment Risk in the Listed Cement Companies of Bangladesh

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Abstract

This research investigates the interaction among financial economics, earnings management practices, and investor-focused risk assessment in cement companies listed on the Dhaka Stock Exchange (DSE). This paper concentrates on the audited financial reports of seven (07) cement companies in Bangladesh for the period 2020-2024. The cement industry is a significant sector in Bangladesh, providing vital elements for housing, urbanization, infrastructure development, and construction projects. This industry drives the nation's economic growth by boosting economic activity through job creation, attracting investment, and generating foreign exchange through exports. The Beneish M-Score model is initially used as a forensic accounting tool to evaluate whether there is any manipulation through eight corresponding independent variables. Furthermore, descriptive statistics, temporal analysis, and multivariate regression are allied to dependent variables such as liquidity, profitability, leverage, management efficiency, growth, and firm size. The results show that most companies are less likely to manipulate earnings. To support investors' decision-making, this study highlights that a less likely earnings manipulator attracts more investors, and conversely, a more likely earnings manipulator attracts fewer investors. The outcomes complement the field of financial economics by reconnecting risk management to investment selections in a rising market. As the Beneish M-Score is a probabilistic approach, the empirical results of this study guide future research

Keywords: Beneish M-Score, Cement industry, Earnings management, Financial economics, Investment risk.

1. INTRODUCTION

Financial economics focuses on how individuals and organizations are able to manage money and make sound investment decisions for the future. The reliability of financial economics has become a keystone for comprehensive policy and investment decisions in today's globalized, competitive business environment. Regulators, stakeholders, and especially investors depend heavily on transparent financial reporting and earnings management to evaluate investment risk. Earnings

management is a practice where management manipulates accounting figures to achieve specific goals. It is regarded as a dynamic challenge for investors to assess investment risk. In emerging economies such as Bangladesh, where the capital market is still sprouting and regulatory gaps are often imperfect, the risk associated with earnings management is particularly noticeable. Detecting these manipulations early can help investors make more informed decisions and guard market integrity. The financial economics perspective provides a valuable lens for exploring how much falsification in earnings management can influence market behavior, firm valuation, and investment stability.

A widely recognized accounting tool for analyzing potential earnings management and manipulation is the Beneish M-Score model, developed by Professor Messod Beneish in 1999. Beneish (1999) comprised a combination of eight financial ratios derived from publicly obtainable accounting data to estimate the likelihood that a firm has manipulated its earnings. Opposing traditional auditing methods, the Beneish M-Score model relies solely on financial statement analysis. Over the years, it has been applied across industries and countries as a forensic accounting and investment risk assessment tool. This paper applies the Beneish M-Score model to the seven listed cement companies of Bangladesh to explore the presence and extent of earnings management in this manufacturing sector. Listed cement companies are Aramit Cement Limited, Confidence Cement Limited, Crown Cement PLC, Heidelberg Cement Bangladesh Limited, LafargeHolcim Bangladesh PLC, Meghna Cement Mills Limited, and Premier Cement Mills Limited. Although the cement industry plays a crucial role in Bangladesh's infrastructure development and industrial growth, it faces exchange rate fluctuations, high operational costs, and pricing pressures. These issues may incentivize managers to engage in earnings manipulation to enhance profitability and investor confidence.

The core objective of this study is to investigate whether the listed cement companies exhibit signs of earnings manipulation indicated by the Beneish M-Score ratios. These ratios are regarded as the independent variables. Several dependent variables, including liquidity, profitability, leverage, management efficiency, growth, and firm age, are allied to the study. The current ratio is calculated by dividing current assets by current liabilities to assess liquidity, and operating margin is calculated by dividing operating income by net sales for profitability. The debt-to-equity ratio is calculated by dividing total liabilities by total shareholder equity for leverage; asset turnover is calculated by dividing net sales by average total assets for management efficiency; return on assets (ROA) is calculated by dividing net income by average total assets for growth; and the log of total assets is used for firm size. Interpreting the findings through the lens of financial economics for investment decisions is also a significant objective of this study. The study aims to evaluate the likelihood of earnings management practices among listed cement companies and to assess how these practices might distort financial stability and investment risk. Therefore, this paper attempts to answer the following questions:

RQ1: Do the listed cement companies in Bangladesh provide any signal of earnings manipulation under the Beneish M-Score?

RQ2: Is the Beneish M-Score associated with firm size and several indicators (leverage, liquidity, profitability, management efficiency, and growth) that investors typically consider when assessing investment risk?

This research aims to provide a more informed understanding of investment risk and market behavior in developing economies by integrating the Beneish M-Score model's financial ratios with theoretical insights from financial economics. As it is a probabilistic model, the preliminary findings are expected to offer practical implications for improving financial disclosure standards and strengthening investor protection within the Bangladesh capital market.

2. LITERATURE REVIEW

2.1 Theoretical Background

Previous empirical research has applied the Beneish M-Score model to assess the likelihood of earnings management. Mollah and Sakib (2020) used the Beneish M-Score model to detect financial statement fraud from 14 listed pharmaceutical companies in Bangladesh for the years 2014-18. Another study by Gyawali (2021) explored the Beneish M-Score model on 16 selected private commercial banks in Nepal for 2018-19. Sharif and Asfakuzzaman (2023) detected earnings manipulation practices using the M-Score model for 22 selected power companies in Bangladesh from 2014 to 2020. Earnings manipulation was found by Nyakarimi (2022) in a study from East Africa. Furthermore, Earnings manipulation in the banking industry was estimated by Khatun et al. (2022) from 2009 to 2018 using the Beneish M-Score model. Also, Saleem et al. (2024) reported evidence of earnings management among Pakistani non-financial firms between 2012 and 2019 using this model. The fraud triangle and earnings management were studied by Narsa et al. (2023) in their research on 284 manufacturing companies listed on the Indonesia Stock Exchange in the period of 2017-19. A conference paper by Arman and Sharmin (2019) quantified the likelihood of manipulation for 105 companies listed on the Dhaka Stock Exchange through the Beneish M-Score model. Using this model, Adoboe-Menash et al. (2023) conducted an additional study to detect fraud in the microfinance industry in Ghana.

2.2 Hypothesis Development

Based on the above literature review, the study addresses the following two hypotheses:

H1: The Beneish M-Score is related to firm size and several indicators (leverage, liquidity, profitability, management efficiency, and growth).

H2: The likelihood of earnings manipulation score does not vary significantly in the cement industry.

RQ1 is addressed descriptively through the manipulator and non-manipulator classification and its temporal stability; whilst RQ2 is addressed in the above hypotheses.

3. RESEARCH METHODOLOGY

3.1 Research Design, Data and Sample

The research is conducted using secondary data and financial data from audited financial statements of the selected 7 cement companies listed at the Dhaka Stock Exchange (DSE). The observations of 35 (7 companies* 5 years of financial statement data) sets are stated for the years 2020 to 2024. The financial statements are collected from the company's website, and it is observed that the company presented the annual reports using Bangladeshi Taka (BDT).

3.2 Variable Measurements

The earnings manipulation detector M-score is calculated via the Beneish M-Score model. The Beneish M-Score model shows the degree of manipulation with the following formula:

$$\text{M-Score} = -4.84 + 0.92 \cdot \text{DSRI} + 0.528 \cdot \text{GMI} + 0.404 \cdot \text{AQI} + 0.892 \cdot \text{SGI} + 0.115 \cdot \text{DEPI} - 0.712 \cdot \text{SGAI} + 4.679 \cdot \text{TATA} - 0.327 \cdot \text{LVGI}$$

The components of the formula are:

- Days Sales Receivable Index (DSRI) is the calculation of receivable days of the current and prior year. “t” stands for the current year and “t-1” stands for the prior year.

$$\text{DSRI} = (\text{Receivables}_t / \text{Sales}_t) / (\text{Receivables}_{t-1} / \text{Sales}_{t-1})$$

- Gross Margin Index (GMI) expresses that a company with poor growth potential is more likely to manipulate earnings, and a deterioration in margin could prompt companies to manipulate earnings.

$$\text{GMI} = \text{Gross margin}_{t-1} / \text{Gross margin}_t$$

- Asset Quality Index (AQI) indicates the change in the percentage of assets other than PPE. Where PPE is property, plant, and equipment; CA is current assets; and TA is total assets.

$$\text{AQI} = [1 - (\text{PPE}_t + \text{CA}_t) / \text{TA}_t] / [1 - (\text{PPE}_{t-1} + \text{CA}_{t-1}) / \text{TA}_{t-1}]$$

- Sales Growth Index (SGI) measures current sales versus the prior year, and it reveals the company's intention to manage the perception of continuing growth by manipulating sales and earnings.

$$\text{SGI} = \text{Sales}_t / \text{Sales}_{t-1}$$

- Depreciation Index (DEPI) measures the declining depreciation rate, which indicates understated depreciation as a means of manipulating earnings.

$$\text{DEPI} = [\text{Depreciation} / (\text{Depreciation} + \text{PPE}) - 1] / \text{Depreciation} / (\text{Depreciation} + \text{PPE})$$

- Sales, General, and Administrative Expenses Index (SGAI) compares current sales, general, and administrative expenses with the prior year.

$$\text{SGAI} = (\text{SGA}_t / \text{Sales}_t) / (\text{SGA}_{t-1} / \text{Sales}_{t-1})$$

- Total Accruals to Total Assets (TATA) shows that higher accruals can indicate earnings manipulation.

$$\text{TATA} = \text{Total accruals} / \text{Total assets}$$

- Leverage Index (LVGI) showcases that leverage is calculated as a ratio of debt to assets.

$$\text{LVGI} = \text{Leverage}_t / \text{Leverage}_{t-1}$$

The independent variables for this study are the variables from the Beneish M-score model, and the dependent variables are chosen from several aspects, like liquidity (current ratio), profitability (operating margin ratio), leverage (debt-to-equity ratio), management efficiency (asset turnover ratio), growth (ROA), and firm size. The formulas of the above ratios are given below:

- Current Ratio = Current Assets / Current Liabilities

- Operating Margin Ratio= Operating Income/ Net Sales
- Debt to Equity Ratio= Total Liabilities/ Total Shareholder's Equity
- Asset Turnover Ratio= Net Sales/ Average Total Assets.
- Return on Assets= Net Income/ Average Total Assets
- Firm Size= Log of Total Assets.

3.3 Analytical Techniques

First of all, the Beneish M-score and the ratios of dependent variables have been calculated using Microsoft Excel. Later, Jamovi version 2.7.6.0 was used to assess the classical tests. Jamovi is an open-source statistical analysis software that connects seamlessly with R. For this study, we conducted descriptive statistical tests to check the data distribution. For further checking, we also conducted a Shapiro-Wilk test to check whether the data set is parametric or non-parametric. Since it was found that the data set is non-parametric, Spearman's Rank Correlation Coefficient was used to find out the relationship between all the components of the Beneish M-Score and the dependent variables. A contingency table has been created to identify the percentage of manipulator and non-manipulator companies using the threshold of M-Score > -2.22, which has an impact on investors' decisions during investment policies. An analysis of temporal changes in panel data has been conducted across the years to identify the pattern of manipulation or trend. For this purpose, we have chosen only the M-Score. We conducted a Repeated Measures Analysis of Variance (Non-Parametric) Friedman test and Durbin-Conover pairwise tests applied to the panel of the M-Score values. The reason for picking this test is that our dataset is non-parametric, and we have panel data for only one sub-sector under the manufacturing industry. Finally, a multivariate regression analysis has been conducted to estimate the relationship between the M-Score and all the dependent variables. Model diagnostics (Durbin-Watson Statistic, Cook's Distance) were used to check the regression assumptions.

4. RESULTS AND FINDINGS

4.1 Descriptive Statistics

Table 1. *Descriptive Statistics for the Variables (Authors' Own Creation)*

	N	Missing	Mean	Median	Standard Deviation	Minimum	Maximum	Shapiro-Wilk W	Shapiro-Wilk N
DSRI	35	0	1.14	0.971	0.929	0.328	5.10	0.582	<.001
GMI	35	0	13.9	0.946	78.4	-5.39	464	0.171	<.001
AQI	35	0	0.317	0.986	2.73	-12.5	3.03	0.492	<.001
SGI	35	0	0.986	1.06	0.336	0.00136	1.53	0.888	0.002
DEPI	35	0	1.17	0.997	0.814	0.109	5.14	0.571	<.001
SGAI	35	0	1.09	0.984	0.606	0.474	4.02	0.541	<.001
TATA	35	0	-0.0121	0.00276	0.0583	-0.132	0.107	0.979	0.715
LVGI	35	0	1.04	1.02	0.121	0.844	1.50	0.865	<.001
M-Score	35	0	4.10	-2.70	41.5	-7.85	243	0.188	<.001
Firm Size	35	0	9.33	10.1	1.37	6.94	10.6	0.721	<.001
Debt to Equity	35	0	1.63	1.59	8.86	-43.7	14.5	0.531	<.001

Operating Margin	35	0	-0.0168	0.0711	0.432	-1.75	0.255	0.435	<.001
Current Ratio	35	0	0.976	0.817	0.525	0.496	2.42	0.756	<.001
ROA	35	0	0.0302	0.0181	0.0654	-0.0893	0.168	0.953	0.144
Asset Turnover	35	0	0.684	0.701	0.461	-0.0886	1.86	0.957	0.190

As shown in Table 1, the dataset has 35 observations with 0 missing values. Among all, the highest mean value is seen in GMI (13.9), and the lowest value is found in operating margin (-0.0168). The standard deviation ranges from 0.0583 (TATA) to 78.4 (GMI). The M-Score shows a mean of 4.10 and a standard deviation of 41.5, indicating potential data outliers. The Shapiro-Wilk test indicates significant deviation from normality for the variables ($p < 0.001$) except SGI ($p = 0.002$), TATA ($p = 0.715$), ROA ($p = 0.144$), and asset turnover ($p = 0.190$). These values indicate the dataset is non-normally distributed, which justifies the use of non-parametric methods for further testing.

4.2 Spearman's Correlation Rank Coefficient

Table 2. *Spearman's Correlation Matrix (Authors' Own Creation)*

	DSRI	GMI	AQI	SGI	DEPI	SGAI	TATA	LVGI	M-Score	Firm Size	OM	CR	RO A	Asset Turn over
DSRI														
GMI	-0.122													
AQI	0.285	0.206												
SGI	-0.495	0.173	-0.040											
DEPI	0.188	-0.235	-0.006	-0.109										
SGAI	0.328	-0.381	-0.041	-0.439	0.150									
TATA	0.430	-0.202	0.193	0.026	0.108	-0.025								
LVGI	0.203	-0.091	0.227	-0.087	0.222	0.208	-0.015							
M-Score	0.460	0.289	0.746	0.033	0.142	-0.016	0.430	0.084						
Firm Size	0.027	0.030	0.059	0.241	0.200	-0.097	0.334	0.129	0.163					
Debt to Equity	0.181	-0.142	-0.131	-0.133	0.140	0.230	0.181	0.058	-0.005	0.428				

Operating Margin	-0.252	0.076	-0.002	0.279	-0.153	0.013	0.205	-0.279	0.140	0.081	0.011			
Current ratio	0.065	0.081	-0.194	-0.144	-0.218	0.050	-0.266	-0.136	-0.164	-0.467	-0.331	0.062		
ROA	-0.387	0.012	-0.000	0.271	-0.059	-0.237	0.035	-0.397	-0.020	-0.209	-0.355	0.619	-0.026	
Asset Turn over	-0.442	0.313	-0.030	0.351	-0.099	-0.238	-0.401	0.016	-0.193	-0.295	-0.127	0.122	0.075	0.306

(Note: OM stands for Operating Margin, and CR stands for Current Ratio. The confidence interval is 95%. All the Spearman's rho values are shown here)

Table 2 exhibits Spearman's Correlation tests of the relationship between M-Score components and dependent variables with 35 observations. From the analysis, it is found that the Spearman's rho value of -0.495 for the pair SGI and DSRI (indicates firms with higher sales have lower receivable growth), -0.439 for the pair SGAI and SGI (shows efficient sales, general and administrative costs might have lower sales growth index), and -0.381 for the pair SGAI and GMI (sales general and administrative with lower gross margin) show a significant negative correlation. The ROA is negatively correlated with DSRI (Spearman rho = -0.387) and LVGI (Spearman rho = -0.397). The ROA and operating margin demonstrate a positive correlation (Spearman rho = 0.619), showing that return on assets increases profitability. The M-Score is strongly correlated with AQI (rho=0.746) and moderately correlated with both the DSRI (rho=0.460) and TATA (rho = 0.430), which indicates the deterioration of asset quality and accrual-driven earnings as manipulation signals.

4.3 Manipulation Classification (Contingency Table)

Table 3. *Contingency Table Manipulator Classification (Authors' Own Creation)*

Company Type	Potential Manipulator	Non- Manipulator	Total
Cement (% within the row)	28.6%	71.4%	100.00%
Total (% within the row)	28.6%	71.4%	100.00%

Table 3 shows that 28.6% of companies are likely to be tagged as potential manipulators and 71.4% are non-manipulators. This helps investors to decide whether to invest in the given sector.

4.4 Temporal Analysis (Friedman's Repeated-Measures ANOVA)

Table 4a. *Friedman's ANOVA by Rank Test for the M-Score (Authors' Own Creation)*

χ^2	Df	P
2.91	4	0.574

Table 4b. *Pairwise Comparisons-Durbin-Conover (Authors' Own Creation)*

	2020-2021	2020-2022	2020-2023	2020-2024	2021-2022	2021-2023	2021-2024	2022-2023	2022-2024	2023-2024
Statistic	1.2443	0.4148	0.3318	0.3318	0.8295	0.9125	1.5761	0.0830	0.7466	0.6636
P	0.225	0.682	0.743	0.743	0.415	0.371	0.128	0.935	0.463	0.513

The repeated-measures ANOVA (Non-parametric) Friedman test for M-Score has been conducted to determine temporal consistency across the years for the same firms (N=35). The P-value is 0.574, and χ^2 is 2.91, showing no statistically significant variation; and the pairwise comparisons (Durbin-Conover) show a marginally significant pair for the years 2020-2023 and 2020-2024, as the P-value is 0.743. This suggests no evidence of increasing usage of aggressive accounting (like overstatement of the financial statements) for any particular year to attract investors.

4.5 Multivariate Regression Analysis

4.5.1 Model Fit Measures

Table 5a. *Overall Model Fit- Multivariate Linear Regression Predicting M-Score (N= 35) (Authors' Own Creation)*

Overall Model Test							
Model	R	R ²	Adjusted R ²	F	df1	df2	P
1	0.267	0.0715	-0.127	0.359	6	28	0.898

4.5.2 Model Coefficients- M-Score

Table 5b. *Regression Coefficients: M-Score (Authors' Own Creation)*

Predictor	Estimate	SE	t	P
Intercept	31.3319	94.83	0.3304	0.744
Firm Size	0.0992	8.25	0.0120	0.990

Debt to Equity	-1.2348	1.61	-0.7654	0.450
Operating Margin	26.1350	47.67	0.5483	0.588
Current Ratio	-11.0285	19.40	-0.5685	0.574
ROA	-2.7376	179.04	-0.0153	0.988
Asset Turnover	-21.7147	25.90	-0.8383	0.409

4.5.3 Assumption Checks:

Table 5c. *Assumption Checks (Cook's Distance, Durbin-Watson Test of Autocorrelation and Collinearity Statistics) (Authors' Own Creation)*

Cook's Distance

Mean	Median	SD	Min	Max
0.0541	0.00260	0.192	1.27e-5	1.02

Durbin-Watson Test for Autocorrelation

Autocorrelation	DW Statistic	P
-0.0854	2.17	0.864

Collinearity Statistics

	Firm Size	Debt to Equity	Operating Margin	Current Ratio	ROA	Asset Turnover
VIF	2.23	3.57	7.42	1.81	2.40	2.49
Tolerance	0.447	0.280	0.135	0.551	0.417	0.402

A multivariate linear regression was performed to predict M-Score using firm size, debt-to- equity, operating margin, current ratio, ROA, and asset turnover, which are likely to relate to earnings manipulation. M-Score is treated as the dependent variable, and the other mentioned variables have been put in the covariate section. Here, the R^2 is 0.0715, which indicates weak explanatory power, that a small portion of variation is explained when it is trying to predict. The overall model F-value is

0.359, and the p-value is 0.898, indicating that the model is not statistically significant. All the predictors of P-value indicates that they are non-significant. So, it is found that none of the individual predictors reach the conventional significance threshold.

The Durbin-Watson statistic is 2.17, indicating no evidence of autocorrelation (-0.0854, $p=0.864$), and satisfies the assumption of linear regression. The range of Cook's Distance ($1.27e-5$ to 1.02) indicates no influential points that affect the regression result. The highest VIF value is 7.42 in operating margin, which indicates it is below the critical threshold of 10, and the model has no severe multicollinearity.

5. DISCUSSION

The multivariate regression does not support H2, as the overall model is not statistically significant, and no individual predictors reach a significant value. The outcome from the Friedman test provides a result of ($\chi^2 = 2.91$, $df = 4$, and $p = 0.574$), which supported H1. 71.4% of firms fall below the manipulation threshold, and the classification is stable over time. The AQI-driven relationship with the M-Score ($\rho = 0.746$) suggests asset quality deterioration. RQ2 was answered only in terms of the M-Score's statistical relationship with the dependent variables. As the M-Score is a probabilistic tool rather than a fraud determination, these outcomes show relative risk rather than proof of manipulation for any individual firm. It is best used as an audit quality indicator and direct evidence of investor response when assessing cement-sector holdings on the stock markets.

6. CONCLUSION AND RECOMMENDATIONS

The study proposes a comprehensive statistical analysis of financial metrics and earnings manipulation indicators for the five years 2020-2024. This study suggests valuable insights into the interrelationships of the M-Score and other variables. Through the tests, several statistically significant results have been found. The temporal analysis conducted using Friedman's ANOVA by rank test shows that the Beneish M-Score is not statistically significant and also indicates a consistent reporting pattern of the firms during the time period, which is helpful for investors to make investment decisions. The pairwise comparison illustrates a marginally significant pair, meaning there is no aggressive accounting practice, such as overstating the company's financial performance to attract investors during the years. The multivariate linear regression predicts non-statistical significance, along with very little collinearity. The contingency table shows that only 28.6% of the companies tend to manipulate their earnings, and the majority of the companies (71.4%) do not tend to manipulate their earnings, which influences the investor's decision to invest in the firms.

This study has some limitations that provide the opportunity for future research. Firstly, a limited sample size for the temporal analysis and regression analysis. The sample size made the study an exploratory one. If the sample size were more than 100 observations, then an advanced model for temporal analysis would have been used. Secondly, it is found that the data set is non-normal, so further investigation is needed to identify the potential outliers. Finally, this study does not measure risk through direct evidence such as a questionnaire or survey. To gain better insight into the cement industry in Bangladesh, further research can incorporate other factors, including audit quality and corporate governance characteristics.

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DECLARATION OF AI-GENERATED CONTENT

During manuscript preparation, the authors used AI-based writing tools such as Grammarly and Paperpal to fix grammatical errors, improve language, and refine tone. ChatGPT (OpenAI) was used for brainstorming, such as organizing thoughts and exploring options, phrasing during drafting, polishing, and improving readability. These tools supported language development and structural presentation. The authors reviewed and edited all the output from those tools. The research design, data collection, and statistical analysis were done through Jamovi. Interpretation and conclusion are entirely the authors' own original work. The authors take full responsibility for the accuracy, originality, and integrity of the content presented in the manuscript.

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