IS THE ALTMAN Z-SCORE MODEL RELEVANT IN PREDICTING CORPORATE FAILURE IN NIGERIA? - AN EMPIRICAL STUDY OF SELECTED MANUFACTURING AND NON-MANUFACTURING COMPANIES

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ABSTRACT

This study is aimed at empirically ascertaining the relevance of Edward Altman's original z-score and revised z" score models in predicting corporate failure in Nigeria. The sampled companies is modelled after the Altman's secondary sample of non-bankrupt firms and selected from companies quoted in the Nigerian Stock Exchange and comprises of twenty six companies which suffered temporary profitability difficulties between 2001 and 2005 but did not actually go bankrupt. The results show that the z-score for manufacturing companies correctly classified 75% of the sample as non-bankrupt while the enhanced z" score classified 100% of the sample of non-manufacturing firms as non-bankrupt. The study therefore concludes that the z-score and the z" score models are relevant in predicting corporate failure in Nigeria, provided the assumptions and conditions of Altman are put in their proper perceptive.

1. INTRODUCTION

The last decade has witnessed significant changes in the economics of developing countries like Nigeria. One major change is the establishment of Stock Exchanges and the subsequent listing of privately held companies. This development has created investment opportunities for investors as well as providers of debt finance. Improvements in information and communications technology have enhanced investor awareness through availability of information on most of these companies. However, serious deficiencies still exist in most developing economies in the quality of the available information especially information on the financial health of these companies. The expansion in awareness, availability of investment opportunities as well as the deficiencies in available financial information gives rise to a need for regulatory bodies, investors, business executives and finance professionals to utilize corporate failure prediction models to ascertain the viability of companies (Chuvakhin and Gertmenian, 2003). Prediction models such as the traditional ratio analysis are often used by researchers to predict corporate failure. Beaver (1966) was the first to use this traditional approach in his univariate analysis to predicting corporate bankruptcy.

Corporate failure (bankruptcy) could be said to refer to a condition in which a company fails to fulfill its debt obligation. It could also include the prediction that a company would be unable to meet future debt obligations and thus enter into reorganization or liquidation. McRobert and Hoffman (1997) attributes corporate failure to the occurrence of a catastrophic event (such as a natural or man made disaster) or the end result of a lengthy process of decline. They described the latter as a process that begins with management defects, poor decisions, financial deterioration and subsequently corporate collapse. They propose that the signs of imminent corporate collapse are obvious long before the actual event occurs. Other reasons for corporate failure include fraud and embezzlement of funds. Corporate failure could impose huge financial costs/losses on several parties including customers, suppliers, shareholders, employees, providers of debt finance and even governments. It becomes necessary to device a means of establishing a pre-knowledge of possible corporate failure. This will help not only to reduce or eliminate associated costs/losses but also to contend with the inherent linkage effect common with such failures. Such pre-knowledge means have been developed mathematically in form of models called prediction models.

Several experts and researchers have proposed various models for predicting corporate failure. Ratio analysis is one of the oldest models adopted. Other models include Multiple Discriminant Analysis (MDA), P-Score, Z-Score, Z''-Score, etc. This study focuses on the Z-score model introduced by Edward Altman (1968) and the revised Z" score model for

non-manufacturing companies and emerging markets (Altman 1993). This is with a view of establishing its relevance in the Nigerian environment given that its application is foreign-based and its recent local application by Dandago and Abbas (2001) failed as a prediction model in Nigeria.
To put this paper into proper perceptive, it is organized into five sections. Section 1 introduced the study while Section 2 reviews previous literature. Section 3 considered the methodology and Section 4 highlighted and discussed the results while Section 5 concludes the paper.

2. LITERATURE REVIEW

Various researches have been conducted on the efficacy of financial ratios in predicting corporate failure. Beaver (1966) proposed a univariate financial ratio analysis in which the cash flow to debt ratio was recognized as the single best predictor out of an initial model comprising of six financial ratios. One of the components of the Beaver's model was profile analysis. Nwezeaku (2004) adopted profile analysis in his study on detecting failure in the Nigerian banking industry. Using a sample of fifty banks- twenty failed banks, twenty non-failed banks and a hold-out sample of ten non-failed banks- the study identified ten ratios that can be used to predict financial distress in the banking industry. The ratio of total debt to total assets was however adjudged to be the best predictor. An interesting development from this study is that it is possible to detect distress in the banking industry four years before the actual failure occurs. Altman (1968) developed a multivariate financial ratio analysis model using a technique called multiple discriminant analysis (MDA). The MDA statistical technique is used for classification of observations based on their characteristics into pre-determined categories. The models created by Altman utilize MDA to calculate a z score, which is used to discriminate between companies predicted to fail in the near future and those not likely to fail in the near future. The Altman Z- score models have been applied in several studies with differing results. Goodfriend et al (2004) analyzed the performance of two statistical models (the Altman z-score and the P-score) in predicting the likelihood of severe financial distress for corporations in the United States. The study focused on the airline industry and the results showed that the indices were strongly correlated with the likelihood that an airline will enter into chapter 11 bankruptcy. The researchers used the adjusted z-score model for non-manufacturing companies and concluded that both the z-score and the p-score are good indicators of impending financial distress for the airline industry although they added that the models alone cannot be relied on as infallible predictors of corporate failure. They stated that the models are vulnerable to irregular accounting practices that may mask the true financial state of the company in the short run and secondly, the models highlight the variables that are keys to successful financial performance that could help reverse negative trends in the ratios. They also stated that the Z-score model uses financial ratios that have been demonstrated to be statistically significant. On the issue of irregular accounting practices, Chuvakhin and Gertmenian (2003) argue that the z-score has the ability to withstand certain types of accounting irregularities. They conducted a limited case study by computing z-scores for WorldCom for fiscal years ending December 31, 1999, 2000 and 2001 based on its annual reports submitted to the United States Securities and Exchange Commission. The results showed that the company experienced a rapid deterioration of its Z-score in spite of accounting irregularities. Ricci (2003) applied the Altman Z-score model to companies in the Competitive Local Exchange Carriers Sector (CLECS) and found that the model has an 87 percent rate of correctly predicting companies likely to fail. On the other hand, Kareb and Prakesh (1987) proposed that the use of Multiple Discriminant Analysis for financial ratios analysis may yield erroneous results because of its restrictive assumptions and problems. They suggested these problems as bias of extreme data points, multivariate normality assumption and equal group covariance assumption. They argued that these problems and assumptions make multiple discriminant analysis incompatible with the complex nature, boundaries and interrelationships of financial ratios. Extending this view is a study by Dandago and Abbas (2001). The study reported a 90 percent failure rate of the original Z-score model in predicting corporate failure in Nigeria. A primary sample of two companies was analyzed as well as a secondary sample of four companies for the period 1989, 1990, 1994 and 1996. All the companies reported z-scores below the cut off point of 1.81 for most of the period studied. The researchers argued that the Altman z-score model is not applicable in Nigeria and by extension in developing countries for various reasons: first is time related factors. They argued that the model

was developed at a time the United States was experiencing vast increase in the rate and scale of business activities resulting from post war rehabilitation whereas the period studied using Nigerian data is characterized by unprecedented hardship by the industrial sector and therefore Nigerian companies have lower ratios than their United States counterparts. Secondly, they stated that the predictive capability of the model deteriorates with time and hence the discriminant parameters are not relevant for analyzing recent data. Thirdly, they suggested that the economic situations in both countries are significantly different: United States being a developed economy whereas Nigeria is a developing economy, and thus the discriminant values should also be different. A critical examination of the study by Dandago and Abbas (2001) reveal that the Altman prediction model may have been inappropriately applied. The study stated that the sample of two selected firms was modeled after Altman's 'secondary sample of non-bankrupt firms' without considering the criteria used by Altman to select his sample. Altman's sample was based on manufacturing companies that have 'suffered temporary profitability difficulties without going bankrupt' but the companies chosen by Dandago and Abbas have no history of financial difficulties. This disparity could be the reason for the results obtained by Dandago and Abbas (2001).

The literatures examined in this paper suggest that there is no consensus among researchers on the predictive ability of financial ratios in categorizing companies with respect to corporate failure. However, it is interesting to note that empirical evidence support the ability of financial statements in signaling the probability of failure of a company before the event occurs (Nwezeaku 2004).

3. METHODOLOGY

Due to the dearth of data on failed companies in Nigeria, the sample used in this study is modeled after Altman's secondary sample of non-bankrupt firms (Altman 2000) and based on the assumption that corporate failure is the end result of a lengthy process of decline in profits, which begins with management defects, poor decisions, financial deterioration and subsequently corporate collapse (McRobert and Hoffman 1997). Thus, selection of sample from the population of quoted companies in the

Nigeria Stock Exchange (NSE) was based on companies with deficit net income report from 2001 to 2005, their sizes notwithstanding. A sample of twenty six companies, comprising of sixteen manufacturing companies and ten non-manufacturing companies were selected. These are companies which suffered temporary profitability difficulties but did not actually go bankrupt as signified by their negative net income as contained in their five year financial summary reports and published in the *Nigerian Stock Exchange Fact Book* 2006,. More than 80% of the selected companies reported three years of negative net incomes within the five year period. Thus the signs of corporate failure as reflected in declining profits are evident long before actual collapse sets in.

In order to determine the failure potential of the selected companies, they are evaluated using the Altman Z-score model for manufacturing companies and the Altman Z" score model for the non-manufacturing companies. These models have their foundation on Multiple Discriminant Analysis (MDA).

The Multiple Discriminant Analysis (MDA) is a statistical technique used for classifying firms on the basis of their observed characteristics. The technique attempts to predict the probability of failure of a firm using eight variables from the firm's financial statements. These variables are: earnings before interest and taxes, total assets, Net sales or turnover, market value of equity or book value of equity, total liabilities, current assets, current liabilities, and retained earnings. Using MDA, Altman (1968) combined a set of five financial ratios to study a sample of sixty six manufacturing firms and came up with the Altman z-score. This original Altman model was intended for use in cases of publicly-traded manufacturing companies (Chuvakhin and Gertmenian 2003).

The Altman z-score model or discriminant function is given as:

$$Z= 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$$

where:

X_1 = working capital / total asset
X_2 = retained earnings / total assets
X_3 = earnings before interest and tax / total assets
X_4 = market value of equity / total liabilities
X_5 = sales / total assets
Z = overall index

The z-score is interpreted as follows:
z-score above 3 – the firm is safe based on their financial figures only
z-score 2.7 and 2.99 – investors should be on alert and exercise caution
z-score 1.8 and 2.7 – possibility of the firm failing within two years of operations from the date of the financial statement used. This is also referred to as the 'gray area'.
z-score below 1.8 – probability of bankruptcy is very high

The original version of the model stated all ratios as percentages except X_5, which was stated as an absolute value. This meant that the values had to be interpreted appropriately so as not to obtain erroneous results. However, a more convenient model was proposed as shown below:

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

Altman (1993) revised the above model to make it adaptable for non-manufacturing firms and emerging markets. The modified model analyzed the characteristics and accuracy of a model without X_5 that is sales/total assets. This was done to minimize the potential industry effect of asset turnover, which is an industry sensitive variable. In addition, the revised model for emerging markets incorporates a constant term of +3.25 and uses the book value of equity rather than the market value of equity for X_4.

The Z" score model for non-manufacturing firms is given as:

$$Z" = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

Companies with $z < 1.21$ are classified as bankrupt, $z > 2.90$ as non-bankrupt and between 1.23 and 2.90 is the grey area where probability of incorrect classification is high. All the parameters are as previously defined. Altman (2000) stated that this model was used to assess the financial health of non-United States companies. In particular, Altman, Hatzell and Peck (1995) applied this enhanced z"score model to emerging markets specifically Mexican firms that had issued Eurobonds denominated in U.S. dollars. The original z-score and revised z" score models are applied in this study. For non-manufacturing firms, the book value of equity is used in computing X_4 rather that the market value of equity.

4. ESTIMATION RESULTS AND DISCUSSION

The financial information extracted from the companies' five year summary reports as shown in table 1 (appendix) include: earnings before interest and taxes, total assets, net sales/turnover, market value of equity, total liabilities, current assets, current liabilities, book value of equity and retained earnings. The financial ratios as derived from these variables and used as the dependent variables (X) as shown in table 2 (appendix) are: working capital/total assets (WCTA), retained earnings/total assets (RETA), earnings before interest and tax/total assets (EBITTA), market capitalization/total liabilities (MCTL), sales/total assets (SATA) and book value/total liability (BVTL). The calculated z scores after application of the model are also shown on table 2.

The resulting z-scores in table 2 (appendix) shows that four companies out of the sixteen manufacturing companies are misclassified by the model as failed companies. These companies are Dunlop Plc., Nigeria Wire and Cable Manufacturers, Christlieb Plc. and Enpee Ind. Plc. The misclassified companies report z-scores less than 1.8 and this may signal a note of caution while investing in these firms as the results indicate the likelihood of failure in future. The remaining thirteen manufacturing companies in the sample are correctly classified as non-bankrupt showing a 75% success rate. Figure 1 (appendix) presents a clearer picture of the analysis. From figure 1, International Breweries Plc., Evans Medical, Benue Cement Company, Berger Paints, Thomas Wyatt, Union Dicon Salt and Onwuka Hi-Tek recorded very high z scores showing a low failure rate although these companies have suffered deterioration in their financial statements in the recent past.

On the other hand, the enhanced z" score correctly classified all the non-manufacturing companies as non-bankrupt. All ten companies examined reported high z-scores with the lowest being 2.81 indicating a 100% success rate of the model in classifying the companies as non-bankrupt. Figure 2 (appendix) shows companies like SCOA, Juli Plc. and Eterna Oil and Gas with z" scores above 10 while Capital oil, John Holt, Smart Products and Daily Times recorded z" scores averaging 4. These

results indicate that none of the companies on the non-manufacturing sample is likely to go bankrupt although thee companies have all suffered financial deterioration as reflected in their annual statements.

The results indicate that the Altman z-score models are valuable in predicting corporate failures in developing countries like Nigeria and also classifying companies based on their potential to fail. However, these results alone must not be relied upon solely as a final predictor of corporate failure.

5. CONCLUSION

This study utilized Edward Altman's original z-score model for manufacturing firms as well as the revised z" score model for non-manufacturing firms to ascertain the present viability of selected publicly traded companies on the Nigerian Stock Exchange and determine whether using available financial information, investors, stockbrokers and other market participants can predict corporate failure before it happens. The selected sample of companies is modelled after the Altman's secondary sample of non-bankrupt firms (Altman 2000). The sample therefore comprises of twenty six companies which suffered temporary profitability difficulties between 2001 and 2005 but did not actually go bankrupt. The results show that both models are useful in classifying companies based on their viability and potential to fail. The z-score for manufacturing companies correctly classified 75% of the sample as non-bankrupt while the remaining 25% classified as bankrupt include companies like Dunlop Plc., Nigeria Wire and Cable Manufacturers, Christlieb Plc. and Enpee Ind. Plc. Although these companies are not actually bankrupt, the deterioration in financial performance has continued. The enhanced z" score classified 100% of the sample of non-manufacturing firms as non-bankrupt implying that none of the companies in the sample is likely to fail. The study therefore concludes that the z-score and the z" score models are relevant in classifying companies into likely/not likely categories to fail given their deteriorating financial positions.

The results of this study present significant implications to stakeholders such as company managers, regulatory authorities, providers of debt finance, investors, stockbrokers and other capital market participants. The models show the variables that are crucial to successful financial performance (financial leverage, liquidity and profitability) and therefore managers of companies recording dwindling fortunes can focus on those ratios that can reverse the negative trends in their performance. The results are also beneficial to regulatory authorities in detecting companies likely to fail in future so as to set up necessary machinery to check such companies and so reduce inherent losses to stakeholders and restore confidence in that sub sector. Similarly, providers of debt finance, investors, stockbrokers and other capital market participants can use these prediction models to identify companies experiencing financial stress and potential future failure, provided the assumptions and conditions of Altman are put in their proper perceptive.

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Table 2 - Empirical Results of application of the Altman z-score and z" score models

Ratio	WCTA	RETA	EBITTA	MCTL	SATA	z-scores
Weight	**1.2**	**1.4**	**3.3**	**0.6**	**1**	
Manufacturing Co.						
Dunlop Plc	0.26	0.03	0.06	0.08	0.46	0.89
International Breweries	2.04	1.31	4.31	0.11	1	8.77
Benue cement co.	1.1	0.16	0.23	0.23	0.2	1.92
African Paints	0.72	0.29	0.68	0.05	0.58	2.32
Berger Paints	0.21	0.56	0.18	0.68	1.5	3.13
IPWA	0.72	0.12	0.27	0.18	0.71	2
Thomas Wyatt	2.35	0.64	1.5	0.02	0.14	4.65
CFAO	0.11	0.17	0.34	0.05	2.31	2.98
Nig wire and cable	0.64	0.23	0.54	0.3	0.06	1.77
Onwuka hi-tek	1.22	4.67	0.41	0.28	0.4	6.98
Union Dicon Salt	0.28	0.52	1.19	0.17	0.61	2.77
Christlieb Plc	0.3	0.12	0.27	0.01	0.05	0.75
Evans Medical	0.16	0.01	0.01	5.76	1.83	7.77
West African Glass	1.17	0.14	0.32	0.02	0.82	2.47
Afprint Nig Plc	0.25	0.14	0.13	0.04	1.83	2.39
Enpee Ind. Plc	0.02	0.13	0.32	0.15	0.84	1.46
Ratio	**WCTA**	**RETA**	**EBITTA**	**BVTL**		**z" scores**
Weight	**6.56**	**3.26**	**6.72**	**1.05**		
Non-Manufacturing Co.						
Costain (WA)	0.27	0.78	1.61	0.15	n/a	2.81
Capital oil	3.54	0.21	0.4	0.12	n/a	4.27
SCOA	4.85	1.06	2.33	13.01	n/a	21.25
John Holt	1.13	0.03	0.03	3.34	n/a	4.53
Juli Plc	2.96	0.02	0.09	14.76	n/a	17.83
Smart Products	1.67	0.29	0.6	3	n/a	5.56
Lennards	3.25	0.06	1.36	0.73	n/a	5.4
Tourist Co of Nig	2.49	0.74	0.06	0.31	n/a	3.6
Eterna oil and Gas	7.95	1.68	3.37	0.3	n/a	13.3
Daily Times Nig Plc	2.34	0.4	0.82	0.36	n/a	3.92

APPENDIX Table 1- Financial data of manufacturing and non-manufacturing companies

	EBIT	Total Assets	Net Sales/ Turnover	Market Cap	Total Liabilities	Net Working Capital	Retained Earnings	BV of Equity
	₦'000	₦'000	₦'000	₦'000	₦'000	₦'000	₦'000	₦'000
Manufacturing Co.								
Dunlop Plc	207953	11045077	5037493	971460	7109758	2330155	204609	n/a
International Breweries	523657	400519	401399	223118	1229006	682392	523657	n/a
Benue cement co.	1374508	19782055	4005101	8043750	21136926	18183747	2243940	n/a
African Paints	79869	387811	226850	27300	361670	231675	80539	n/a
Berger Paints	68346	1278937	1914236	446691	393148	223408	511019	n/a
IPWA	34448	413545	291903	75345	248120	248120	34848	n/a
Thomas Wyatt	115664	253857	34692	13820	539100	497060	115814	n/a
CFAO	1032656	10066699	23270160	827840	9356949	935126	1225053	n/a
Nig wire and cable	183240	1127146	64957	298200	604646	604646	183240	n/a
Onwuka hi-tek	9352	73436	29510	34086	80011	74406	245216	n/a
Union Dicon Salt	789534	2198033	1333047	572000	1978866	509140	811801	n/a
Christlieb Plc	90600	1102135	59729	6720	372615	276663	93866	n/a
Evans Medical	58265	1294980	2368375	490158	51075	177943	12676	n/a
West African Glass	140736	1455519	1181999	54240	1435054	1417741	140736	n/a
Afprint Nig Plc	127960	3266660	5991295	112239	1644945	680866	318239	n/a
Enpee Ind. Plc	164150	1716086	1436934	289575	1195607	24211	164150	n/a
Non-Manufacturing Co.								
Costain (WA)	280753	1174714	2216355	n/a	1029029	48784	281347	145685
Capital oil	2407	40640	99159	n/a	36623	21911	2594	4017
SCOA	348000	1004000	4493000	n/a	75000	743000	327000	929000
John Holt	15000	2922000	9173000	n/a	698000	503000	25000	2224000
Juli Plc	1385	103892	150808	n/a	7956	46950	547	111848
Smart Products	6567	74084	22494	n/a	19310	18881	6602	55203
Lennards	14673	72472	16490	n/a	42788	35956	1392	29684
Tourist Co of Nig	47177	5304738	1042156	n/a	4102734	2017379	145688	1202004
Eterna oil and Gas	229668	458065	1417582	n/a	580132	554998	235603	543749
Daily Times Nig Plc	352896	2878929	220249	n/a	1900346	1028684	356607	978583

Figure 1

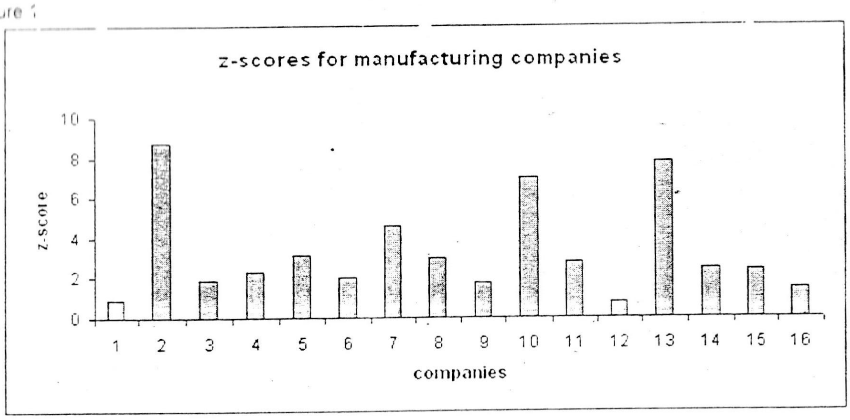
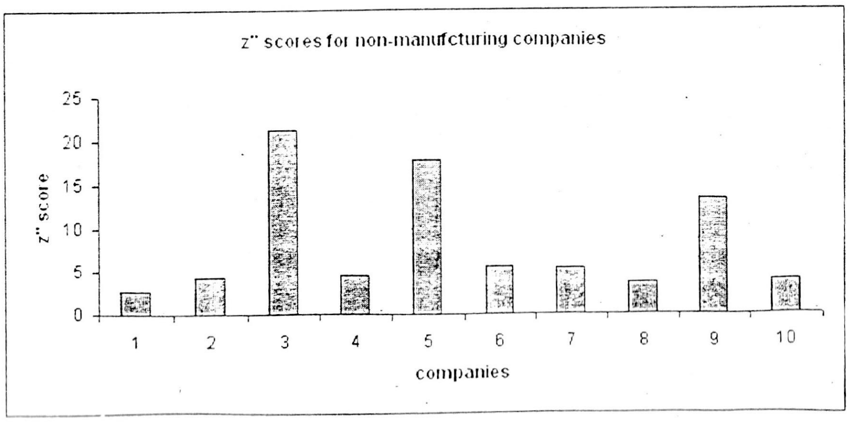


Figure 2



Manufacturing Co.

1 Dunlop Plc

2 International Breweries
3 Benue cement co.
4 African Paints
5 Berger Paints
6 IPWA
7 Thomas Wyatt
8 CFAO
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16 Enpee Ind. Plc

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