

Predicting Corporate Business Failure in the Nigerian Manufacturing Industry

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Abstract

This paper employed ratio analysis, and in particular the multi discriminant analysis model in predicting and detecting failing businesses in the manufacturing and other sectors of the Nigerian economy. Data were gathered for a five year period for eleven firms sampled from the manufacturing, oil marketing and the conglomerates sectors of the Nigerian economy. The result revealed that MDA is a veritable tool for assessing the financial health of firms in Nigeria. Accordingly MDA has high predictive power to deduce from a set of ratios the likelihood of failure or otherwise. It is remarkable to note that the MDA model not only predicts business failure but revealed most importantly that the warning signals of impending failure can be revealed one to two years before the actual failure.

Keywords: Multi discriminant analysis; corporate failure; firm financial health; corporate bankruptcy predictor model.

1. Introduction

To guarantee sustainable economic growth it is very important to control the number of firms that fail (Warner, 1977). The abnormal behaviours of firms should serve as leading indicators of unhealthy performances. As a consequence, researchers, shareholders, managers, workers, lenders, suppliers, clients, the community and policymakers have demonstrated a great interest in the detection of corporate distress. This is as to develop early warning systems and signals so that the concerned firm will be able to take actions to prevent the firm failure. The possibility of using ratios to detect problematic businesses has been vastly explored by several academics. Among the three existing approaches to the problem (accounting analytical approach, option theoretical approach and statistical approach), the statistical approach tries to assess corporate failure risk through four widely known methods that make use of balance-sheet-based ratios: linear or quadratic discriminant analysis, logistic regression analysis, probit regression analysis and neural network analysis. The balance-sheet-based ratios involve the use of certain financial information to assess firm performance. Firm performance could be viewed in terms of profitability, interest coverage, debt coverage, working capital and liquidity performances.

The manufacturing sector of the Nigerian economy has really experienced great shocks and distresses in recent years. Though the distress syndrome appears to be more prominent and far-reaching in the banking sector, the truth is that more manufacturing companies have failed than banking institutions of late. Besides outright failure, few manufacturing organisations utilize over fifty per cent of their installed capacities. The reasons for this ugly development range from exchange rate problems, inflation, government unstable policies and other disequilibria in the macro economy. The capacity under-utilisation snowballs into very adverse business times for most manufacturing companies and those who failed to monitor the early warning signals eventually go under. This study is precipitated by the dire consequences of business failure which colossal cost implication is evidenced by loss of jobs, decline in the gross domestic product, declining overall standard of living, general social disequilibrium in the polity and disequilibrium in the macro economy. All these consequences have been witnessed in Nigeria in the past decades. It therefore becomes imperative to ascertain if ratio analysis are sure ways to predicting failing businesses so that the above mentioned consequences can be averted if noticed. This paper seeks to employ ratio analysis in particular as well as the multi discriminant analysis model in predicting and detecting failing businesses in the manufacturing and other sectors of the Nigerian economy. The rest of the paper is divided into four sections. Section 2 highlights the empirical review of related literature. Methodological issues are the concern of section 3. Section 4 is devoted to analysis of results and section 5 concludes the paper.

2. Review of Related Literature.

Prior studies indicate that researchers generally test and evaluate corporate financial distress models

using two popular standard statistical techniques, logit and discriminant analysis (DA). The volume of literature in existence in this area suggests that it is a well-beaten part. Two-widely notable published approaches are associated with Beaver (1966) and Altman (1968, 1977). Gupta (1979) also developed an extensive accounting ratio model for detecting business downturns. While Beaver (1966) made use of traditional ratio analysis, Altman (1966) and Gupta (1979) attempted to build a forewarning system of corporate sickness. Gupta's (1979) study unlike that of Beaver (1966) was based on broadly matching groups of sick and non-sick companies. Argenti (1976) places heavy emphasis on management style. Yet another financial expert, Osezuah (1995) provided a phase by phase analysis of business decline.

Discriminant analysis characterizes an individual, or a phenomenon, by a vector of variables which constitute a multivariate density function. The discriminant function maps the multidimensional characteristics of the density function of the population's variables into a one-dimensional measure, by forming a linear combination (Zavgren, 1983). The linear discriminant function as modeled by Chung, Tan and Holdsworth (2008) is as follows:

$$Z_i = XA = a_0 + a_1X_1 + a_2X_2 + \dots + a_nX_n$$

Where; Z = discriminant score for the company i

X = vector of n independent variables or characteristics

A = vector of discriminant coefficients

MDA computes the discriminant coefficients and selects the appropriate weights (cut-off score) which will separate categories. The average values of each group, while minimizing the statistical distance of each observation and its own group means (Altman, 1966). By using the Z score and cut-off score, a company is classified into failed or non-failed. The pioneers of the empirical approach are Beaver (1966), Altman (1968), and Ohlson (1980). Beaver (1966) was one of the first researchers to study the prediction of bankruptcy using financial statement data. However, his analysis is very simple in that it is based on studying one financial ratio at a time and on developing a cutoff threshold for each ratio. The approaches by Altman (1968) and Ohlson (1980) are essentially linear models that classify between healthy/bankrupt firms using financial ratios as inputs. Altman uses the classical multivariate discriminant analysis technique (MDA). It is based on applying the Bayes classification procedure, under the assumption that the two classes have Gaussian distributions with equal covariance matrices. The covariance matrix and the class means are estimated from the training set. Altman (1968) used the following financial ratios as inputs:

- 1) working capital/total assets;
- 2) retained earnings/total assets;
- 3) earnings before interest and taxes/total assets;
- 4) market capitalization/total debt;
- 5) sales/total assets.

REVIEW OF EMPIRICAL LITERATURE.

Country wise, there are few studies in Australia that investigated the power of statistical models for predicting firm failures. Castagna and Matolcsy (1981) applied linear and quadratic discriminant models to a sample that consisted of 21 failed firms matched to 21 non-failed firms over the period 1963-1977. The results one year before failure from Discriminant Analysis show that the model correctly classified 81% of the failed firms and that of non-failed was 95%. Lincoln (1984) was the first study to use Discriminant Analysis to analyze Australian property-finance failures from 1969-1978. The author also considered a more general model with firms from property, retailing and manufacturing. These sectors were combined into two groups: manufacturing retailing firms and property-finance firms. The predictive accuracy for the manufacturing-retailing model was high, but very low for the property-finance model. Izan (1984) applied Discriminant Analysis to a larger sample composed of 53 failed and 50 non-failed firms over the period 1963-1979. These firms were selected from several industrial sectors. The results one year before failure from Discriminant Analysis show that the model correctly classified 94% of the failed firms and that of non-failed was 89%. However, logit, probit and DA models require assumptions such as normality of the data and independence of the predictors. In particular DA assumes the covariance matrix for the failed and non-failed groups are the same. When the data do not satisfy these assumptions, both logit and DA provide non-optimal solutions (Altman et al. 1977; Ohlson, 1980).

Yim and Mitchel (2005) noted that a number of studies using discriminant analysis have been carried out in Brazil. Yim and Mitchel (2005) reviewed empirically those notable studies thus: Elizabetsky (1976) used

DA on a sample of 99 Brazilian firms that failed and 274 non-failed firms. The best model correctly classified 63% of the failed firms and 74% of the non-failed firms. Matias (1978) applied DA to a sample of 100 Brazilian firms of which 50 were failed. The best model correctly classified 77% of the failed firms and 70% of the non-failed firms one year prior to the event. Altman *et al.* (1979) used DA on a sample of 23 Brazilian firms that failed during 1975-1977 and 35 non-failed firms. The best model correctly classified 83% of the failed firms and 77% of the non-failed firms. Siqueira and Matias (1996) applied the logit model to a sample of 16 Brazilian banks that failed during 1994-1995 and 20 non-failed banks. The best model correctly classified 87% of the failed banks and 95% of the non-failed banks. Minardi and Sanvicent (1998) applied DA to a sample of 81 Brazilian firms of which 37 failed during 1986-1998. The best model correctly classified 81% of the failed firms and 80% of the non-failed firms one year prior to the event.

Chung, Tan and Holdsworth (2008) in this study pointed out that model of insolvency are important for managers who may not appreciate how serious the financial health of their company is becoming until it is too late to take effective action. In this study, they utilized multivariate discriminant analysis and artificial neural network to create an insolvency predictive model that could effectively predict any future failure of a finance company and validated in New Zealand. Financial ratios obtained from corporate balance sheets were used as independent variables while failed/ non-failed companies' were the dependent variable. The results indicate the financial ratios of failed companies differ significantly from non-failed companies. Failed companies were also less profitable and less liquid and had higher leverage ratios and lower quality assets.

Wang and Campbell (2010) studied data from Chinese publicly listed companies for the period of September 2000-September 2008 to test the accuracy of Altman's Z-score model in predicting failure of Chinese companies. Prediction accuracy was tested for three Z-score variations: Altman's original model, a re-estimated model for which the coefficients in Altman's model were recalculated, and a revised model which used different variables. All three models were found to have significant predictive ability. The re-estimated model has higher prediction accuracy for predicting non-failed firms, but Altman's model has higher prediction accuracy for predicting failed firms. The revised Z-score model has a higher prediction accuracy compared with both the re-estimated model and Altman's original model. This study indicates that the Z-score model is a helpful tool in predicting failure of a publicly listed firm in China.

Through an extensive literature review, (Aziz and Dar, 2006) provided a comprehensive analysis of the methodologies and empirical findings from these models in their applications across ten different countries. The predictive accuracies of different models seem to be generally comparable, although artificially intelligent expert system models perform marginally better than statistical and theoretical models. Individually, the use of multiple discriminant analysis (MDA) and logit models dominates the research. Given that financial ratios have been dominant in most research to date, it may be worthwhile increasing the variety of explanatory variables to include corporate governance structures and management practices while developing the research model. Similarly, evidence from past research suggests that small sample size, in such studies, should not impede future research but it may lead researchers away from methodologies where large samples are critically necessary.

A variety of models have been developed in the academic literature using techniques such as Multiple Discriminant Analysis (MDA), logit, probit, recursive partitioning, hazard models, and neural networks. Despite the variety of models available, both the business community and researchers often rely on the models developed by Altman (1968) and Ohlson (1980) (Boritz *et al.*, 2007). A survey of the literature shows that the majority of international failure prediction studies employ MDA (Altman, 1984; Charitou, Neophytou & Charalambous, 2004).

3. Methodology.

This study is geared towards proving the validity or otherwise of ratios and Multi Discriminant Analysis (MDA) model in the manufacturing, oil marketing and conglomerate industries of the Nigerian economy. The information vital for this kind of analysis were obtained from the financial statements of companies belonging to the above industries but quoted on the Nigerian Stock Exchange. These exist in the form of Annual reports and accounts of quoted companies on the Stock Exchange. The sample size derived via a non-probabilistic sampling technique was influenced majorly by the availability of data for the sampled companies belonging to the various industries. The sample consists of eleven Nigerian firms in the following categories:

CATEGORY A: CONGLOMERATES

1. Cadbury Nigeria PLC
2. A.G Leventis (Nigeria) PLC

3. Unilever Nigeria PLC

CATEGORY B: OIL MARKETING

4. Texaco PLC
5. Oando plc
6. Mobil PLC
7. African Petroleum PLC

CATEGORY C: OTHERS

8. Premier Breweries PLC
9. Thomas Wyatt PLC
10. Nigerian Cement Company PLC
11. Guinness Nigeria PLC.

In line with Altman (1968) this study computed univariate ratios based on the information available in the financial statements for a five year period (2000-2004). The critical variables/ratios computed for the sampled firms include the liquidity, activity, leverage and profitability ratios. Statistical weights were then given to the various ratios in the order of importance as follows: 1.2, 1.4, 3.3, 0.6, and 1.0 for numbers 1,2,3,4 and 5 above respectively in consonance with Altman (1968). The study then computed an average Zeta (Z) score for each company using the annual reports and accounts of the various firms to represent the composite MDA value for each firm concerned. Expected Z scores were assigned to each company being investigated using a ranking approach (Gupta, 1979). Then the computed values were ranked and discriminated as to likelihood of failure/bankruptcy using the MDA model as postulated by Altman in 1968.

The parametric test (t test) was used to test the hypothesis and stated thus:

$$t = \frac{D - O}{SE}$$

Where t = t test

D = Mean of difference in scores

SE = Standard Error

Decision Rule: Accept Ho if computed value of $t_c < t_t$ otherwise reject Ho.

4. Findings

The financial ratios were used and employed to evaluate the sampled firms financial performance and condition. Accordingly, the liquidity, activity, leverage and profitability ratios have been used in interpreting the empirical results obtained.

Table 1. Current Ratio of Sampled Manufacturing Firms in Nigeria.

Year	CardBury	Unilever	Guinness
2004	1.86	1.05	1.28
2003	1.76	1.26	1.53
2002	---	0.40	
2001	---	0.34	
2000	---	0.26	

Source; Author's Computation.

In the liquidity ratio, three factors were examined and they include short term liquidity, current assets intensiveness and cash position. The above indices are very vital for most firms because the early symptoms of an

unhealthy concern are its increasing inability to meet its commitments as they fall due. The short-term liquidity ratio (current ratio) of Cadbury Nigeria Plc stood at 1.86:1 in 2004 and 1.76:1 in 2003 did not suggest any problem, although the results were not up to the benchmark of 2:1. Non-the-less, the short-term liquidity position of Cadbury Nigeria Plc during the period was better than that of the other three companies viz: A. G Leventis 1.5:1 and 1.0:1, Unilever Nigeria Plc 1.05:1 and 1.26:1, Guinness Nigeria Plc 1.28:1 and 1.53:1. The quick asset ratio is used here as a good approximation of a measure of current asset intensiveness. The results for the four companies followed the trend for the current ratio earlier examined. For Cadbury Nigeria Plc, 1.31:1 and 1.25:1 for 2003 and 2002 look good. The result was very poor for A.G Leventis in 2003 0.06:1, but there was a radical improvement in 2004 to 0.94:1. Unilever Nigeria Plc and Guinness Nigeria Plc had 0.72:1 in 2005, 0.72:1 in 2004 and 0.77:1 in 2003, 1.81:1 in 2002. This shows that the current liabilities are more than the current assets of the firm. These positions were not good enough, especially for Guinness Nigerian Plc's, which declined by 57% from 2002 to 2003. This suggest, among other things that semi-liquid current assets like stock and raw materials piled up and that such firms may be unable to settle their short-term obligations as they fall due.

Table 2. Net Profit Margin of Sample Firms.

Year	CardBury	A.G. Leventis	Guinness
2004	13	6.7	25.1
2003	14	4.8	19.8
2002	12.4	2.0	24.0
2001	10.5	1.6	25.1
2000	8.4	-0.11	25.6

Source; Author's Computation.

The Net Profit Margin for the firms recorded varying degrees of increases and decreases during the period under review. A.G. Leventis though recording the a single digit ratios and the least ratios among its peer but has recorded a steady increase throughout the period under review. Cardbury Plc recorded the highest NPM in year 2003 and the least in year 2000. Guinness Nigeria Plc recorded the highest increase of 25.6% in year 200 and 19.8% which is the least in 2003. However, the higher the Net Profit Margin for firms, the more impressive their profitability performance.

A business' life can be adequately captured by measuring its activity levels. The hand and limbs of a business allegorically can be turned the stock, debtors and credit's these do not remain same over time; they move or vary. Accordingly the average collection period of Cadbury Nigeria Plc increased from 63 days to 89 days between 2002 and 2003. As usual with all ratios, all these statistics mean little when observed individually, but when looked at between years comparisons between firms could be made. For A.G. Leventis Nigeria Plc, Average collection period increased from 68 days to 82 days between 2003 and 2004. The stock turnover improved from 2.8 times in 2005 to 3.2 times in 2004 Unilever Nigeria PLC posted a bad result in 2005 as concerns Average collection period, which increased from 33 days in 2004 to 102 days in 2005. These increases recorded in the average collection period shows that the firms studied did not ab-initio establish an average collection period for trade credits granted to customers. The implication of increase in the number of average collection days for firms is that firms becomes illiquid as a of funds are tied in the form of credit granted to customers. Its stocks turnover did not show any remarkable movement between 2004 and 2005. The results were 4.4 times and 4.6 times respectively. This is not bad for the company. During 2002 and 2003, Guinness Nigeria PLC had a good result, activity wise. The Average collection period improved from 15.7 days in 2002 to 11.6 days in 2003, its stock turnover was 2 times in 2002 and 1.9 times in 2003. This is somewhere impressive. In summary, on the average, all the companies examined did not make remarkable positive movement in their activity ratios.

Test of hypothesis.

Ho: There is no significant difference between the failure/success factor (Z) of Nigerian manufacturing firms and the multi discriminant analysis model outcome.

H₁: There is significant difference the failure/success factor (Z) of Nigerian Manufacturing firms and the multi discriminant analysis model outcome.

Table 3: Differences between the Z scores.

Firm	Computed z	Expected Z	Difference
African Petroleum	1.98	2.7	-0.72
Unilever	2.245	2.7	-0.455
Mobil	24.623	2.7	21.923
Nigercem	-0.40	1.8	-2.2
Oando	4.498	2.70	1.798
Premier Breweries	0.58	1.80	-1.22
Texaco	54.345	2.70	51.645
Thomas Wyatt	1.5	1.80	-0.3
Cadbury	2.555	2.70	-0.145
AG Leventis	.835	1.80	-0.965
Guinness	2.01	2.70	-0.69
		D	68.671

Source: computed from Annual accounts of sampled firms

Table 4: Computing the Standard Deviation.

Firm	Computed z	Expected Z	Difference	D – D bar	
African Petroleum	1.98	2.7	-0.72	-67.951	4617.34
Unilever	2.245	2.7	-0.455	69.126	4778.40
Mobil	24.623	2.7	21.923	46.748	2185.4
Nigercem	-0.40	1.8	-2.2	70.871	5022.7
Oando	4.498	2.70	1.798	66.873	4472.0
Premier Breweries	0.58	1.80	-1.22	69.891	4884.75
Texaco	54.345	2.70	51.645	17.026	289.9
Thomas Wyatt	1.5	1.80	-0.3	68.971	4757
Cadbury	2.555	2.70	-0.145	68.816	4735.64
AG Leventis	.835	1.80	-0.965	69.636	4849.17
Guinness	2.01	2.70	-0.69	69.361	4810.95
					45403.25

Source: computed from Annual accounts of sampled firms.

Computing for the mean of the difference in results from table 1 in the appendix, we have $D = \text{Sum of } D / N$.

Where; D = Mean of difference in scores

N = Sample size.

Therefore, $D = \frac{68.671}{11}$

11

= 6.243.

Computing for the SD (Standard Deviation) from table 2 in the appendix, $SD = \sqrt{45403.25/10} = 67.4$.

SE (Standard Error) = SD / \sqrt{N}

$$\begin{aligned} &= 67.4/\sqrt{11} \\ &= 20.30 \\ t \text{ Value} = t_c &= \frac{D - 0}{SE} \\ &= \frac{6.243 - 0}{20.30} \\ &= 0.0151. \end{aligned}$$

These results when compared with the critical value of t at the degree of freedom of 10 at 5% level of significance reveals that $t_t = 2.228$.

Hence, since $t_c < t_t$. Since $0.0151 < 2.228$, we accept H_0 , which implies that the multi discriminant analysis model is a corporate bankruptcy predictor model. In other words, the model can be applied to predict corporate bankruptcy in the Petroleum marketing sector as well as in the manufacturing sector of the Nigerian economy.

5. Conclusion

The summary of findings revealed that: Financial ratios are veritable tools for assessing the financial health of manufacturing companies in Nigeria; categorisation of financial ratios into univariate and multivariate ratios makes the use of financial ratios more helpful in analyzing and comparing performance among companies; that it is possible to deduce from a set of financial ratios the likelihood of failure or otherwise of a business; the multivariate ratio model as proposed by Altman in 1968 is relevant in Nigeria given the analysis carried out by this study; using the “z” score, failing companies could be detected between two and three years before their eventual failure; and that “Z” score is an all-round working model effective for manufacturing as well as the petroleum marketing sectors of the Nigerian economy.

Having particularly x-rayed the use of ratio analysis and Multi-Discriminant Analysis (MDA) in particular as a tool for predicting business failure in Nigeria, this paper safely concludes that it is not only possible to predict business failure using ratio analysis but most importantly it serves as a warning signal of impending business failure. Ratio analysis can predict business failure two or more years before the actual failure. To this extent, ratios are veritable tools for measuring business performance in all sectors of the economy.

Given the above, the following recommendations become imperative: Financial ratios should be regularly computed and made use of by Nigerian companies in assessing their financial performance. This is because effective use of such ratios provides timely information on the financial health or otherwise of companies; in particular, in computing financial ratios, use should be made of current developments in ratio analysis viz: the multivariate and univariate models of ratios analysis; it is appropriate for companies to set up financial analysis units, which will act as remote sensing units to sensitize developments in their company, industry and the macro economy; the corporate report should be expanded to include a section on detailed financial analyses; since ratio analysis is not an end in itself, the financial analysis unit should be allowed and challenged to come up with appropriate strategies to keep improving business fortunes; that once the “Z” factor of a company becomes uncomfortable, i.e. $z < 2.675$, the company should explore veritable means of revitalizing its business; financial analyst report should be included in the annual report and accounts of companies either as a separate item or as an important addendum to the Chairman and Managing Director ‘s report where applicable; the above report should not only contain the financial state of the company but most importantly set out strategies and plans to keep the company moving forward strategies if they have been in the words.

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