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Portability of Multiple Discriminant Analysis Prediction Model of Listed Firms: An Emerging Market Perspective

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Abstract
This paper tests the portability of Altman's (2000) Z-score model in predicting corporate failure of listed firms in an emerging market, Ghana. The study applies the model on financial statements of fifteen (15) firms listed on Ghana Stock Exchange (GSE) for 2013 fiscal year. The empirical result shows that 66.7 percent of the listed firms were misclassified as failed firms (Type II Error) and correctly classified 33.3 percent as success firms or safe zone firms. The study concludes that the Altman (2000) financial model is not portable in Ghana due to high type II error rate and this is calling more research for the use of non-financial models in predicting corporate failure in emerging markets.
Keywords: Multiple Discriminant Analysis, Corporate failure, Altman Z-score, Listed firms, Ghana

1. Introduction

Stakeholders such as shareholders, managers, employees, financial institutions, and investors are concerned about their organizational financial health. The ability to predict corporate financial distress is particularly significant to these stakeholders in order to take the necessary preventive measures. Also, corporate ethics and governance although have created a platform to prevent financial failure, an early prediction is essential for stakeholders especially investors that intend to protect their financial investments (Muntari, 2015; Muller et al., 2009). Several corporate failures have occurred in both developed and emerging markets, and thus corporate failure prediction model is crucial to serve as benchmark for organizations.

In developed countries, companies such as WorldCom, Enron Corporation, Freddie, AIG, General Motors (GM), Xerox, Lehman Brothers are some of the companies that have collapsed. Emerging markets like Ghana, corporate failures include Ghana Airways, Bank for Housing and Construction, Gateway Broadcasting Services, Ghana Co-operative Bank, National Savings and Credit Bank (Appiah, 2011). A case of corporate failure that is still fresh in the minds of Ghanaians is the collapse of DKM, Noble Dreams Saving and Loans, and Ghana Commercial Bank that recently took over UT Bank and Capital Bank due to liquidity and solvency challenges.

Thus, predicting corporate failure can enable companies to reduce bankruptcy costs, avoid failure and help improve financial stability. This paper is timely in addressing the needs of companies in the Ghanaian economy. In Ghana, there have been some recent studies on corporate failure prediction, notably among is the corporate failure prediction study conducted by Appiah (2011) using Altman (1968) model. The results of Appiah (2011) indicated that the Altman (1968) prediction model is not applicable in Ghana in predicting the success and failure of companies. However, the revised model, Altman (2000) Z-score has not be tested in Ghana to find out whether it can be used by stakeholders as a benchmark in predicting failure or success of their companies. This current paper intends to replicate Appiah (2011) to test the revised model, Altman's (2000) model if it is portable among listed firms in Ghana. The results of the study will contribution to literature on the stability of listed companies in Ghana, and seeks to assist the general public and investors on the financial health of companies listed on Ghana Stock Exchange.

The rest of the paper is presented as follows: Section 2 gives brief literature on corporate failure prediction, Section 3 discusses the methods and Altman's (2000) multiple discriminant analysis model used for the study, Section 4 presents and discuss the empirical results, and finally Section 5 concludes the study.

2. Literature Review

Corporate failure prediction is essential for mitigation negative economic cycles in a national economy (Simic et al., 2012) that has become a significant concern for corporate governance. Empirical studies reveal that failure predictions of most businesses concentrate on financial data, but few considered other non-financial variables as being relevant. The contribution of Altman (1968); Altman, Haldeman, and Harayanan (1977); Beaver (1966); Deakin (1977); Blum (1974); and Ohlson (1983) are phenomenal in literature among the topic on corporate failure. In Ghana, some extant literature focuses on qualitative research on specific company (see Amankwah-Amoah and Debrah, 2010), or testing and incorporating a particular tool on listed firms (Amoamah and Winful, 2013; Appiah, 2011; and Mahama, 2015). None of the studies discussed above has actually given a complete comparison of many different approaches toward corporate failure predictions. However, there have been some important contributions on the theoretical perspective of corporate failure prediction.

The development of corporate failure models started with Univariate analysis, pioneered by Beaver (1966)

study that uses 30 financial ratios among 79 failed and non-failed firms from 1954 to 1964. Beaver identified that the most important ratio in predicting failure is 'Cash flow to Total debt' ratio with 78% success rate for five years before failing and 13% of the sample for one year before insolvency. Altman (1968) extended Beaver's approach using Multiple Discriminant Analysis (MDA) known as the Z-Score. Altman (1968) study uses 66 failed and non-failed manufacturing industries among 22 ratios classified into five groups namely; profitability, liquidity, leverage, activity and solvency ratios. The Z-Score model overall correctly classified 95% of the total sample, one-year prior to bankruptcy.

In 1980, Ohson (1980) uses logit analysis among 105 bankrupt companies and 2058 non-bankrupt companies from 1970 to 1976 and that results show that size, financial structure (Total Liabilities to Total Assets), performance and current liquidity were important determinants of corporate failure. Also, Charitou et al (2004) examined the incremental information content of operating cash flows in predicting corporate bankruptcy using neural networks and logit analysis on 51 matched pairs of failed and non-failed of United Kingdom companies for the year 1988 to 1997. They developed a parsimonious model with three financial ratios, financial leverage, profitability and operating cash flow that yielded an overall classification accuracy of 83%.

Among all these models and others not presented, the MDA (specifically the Z-score) model is seems to be reliable in predicting corporate failure. The use of the Z-score has received international recognition due to its significant predictive power (Altman and Hotchkiss, 2010). However, the model is difficult to ascertain whether its assumption is valid or invalid in every country. This current paper assesses whether the Altman (2000) Z-score model that have received international recognition is portable and capable in predicting non-failed firms in emerging market, Ghana.

3. Methods

The study uses quantitative analysis on the dataset of financial statement taken from the website of Ghana Stock Exchange (GSE) and Annual Reports Ghana (ARG). Fifteen (15) companies were selected due to up-to-date data on the website of GSE and ARG. The study covered the year ended 2013, a period where the selected companies have fully adopted the international accounting principles in the presenting financial statements in Ghana. Ghana adopted International Financial Reporting Standards (IFRS) in 2007 and prior studies that uses financial statement were based on Ghana National Accounting Standards like the study conducted by Appiah (2011). The paper replicate Appiah (2011) style of methodology using experimental case study setting, and the revised Altman's (2000) Z-score model is tested using fifteen (15) non-failed firms to ascertain its predictive rate and applicability. The next section discusses the model.

3.1 Altman's (2000) Multiple Discriminant Analysis (MDA) Model

This study adopts the revised MDA model developed by Professor Edward Altman in 2000. According to Altman (2000), the overall index more than 2.9 is seen as safe or success firms, less than 1.23 is categorized as failed firms, and between 1.23 and 2.9 is the gray area or the ignorance zone. The model is illustrated as:

$$Z = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5$$

Where;

Z = Overall Score

X_1 = Working Capital/Total Assets

X_2 = Accumulated Retained earnings/Total Assets

X_3 = Operating Profit/Total Assets

X_4 = Book Value of ordinary and preference shares/Total Liabilities at Book Value

X_5 = Sales Revenue/Total Assets

X_1- Working Capital/Total Assets

The Working capital/Total assets ratio is a measure of net liquid assets of the firm relative to the total capitalization. Working capital is equal to the difference between current assets and current liabilities. Liquidity and size characteristics are explicitly considered. Normally, a firm experiencing consistent operating losses will have shrinking current assets in relation to total assets.

X_2 = Accumulated Retained earnings /Total Assets

This ratio measures the leverage of firms that represents the total accumulated earnings re-invested into the assets of firms, with the remaining of the total assets being financed through debt capital. The retained earnings of the firms are subject to distortion due to restructurings and dividends (Altman and Sabato, 2005).

X_3 = Operating Profit/Total Assets

Operating profit refers to the earnings generated from the operating activities of the firm. This ratio measures the efficiency of assets in generating profits. If the ratio is low, it indicates that the firm is not using the assets efficiently in generating profits. This ratio estimates the cash supply available for allocation to creditors, government and shareholders.

X_4 = Book Value of ordinary and preference shares/ Book Value of Total Liabilities

This is reciprocal of debt equity ratio. However, the equity value is the book value of ordinary and preference shares represented in the statement of financial position. The other variable is the book value of total long-term liabilities which is also taken from the statement of financial position. This ratio measures the extent of decline of asset value that can be afforded by companies without being insolvent.

X_5 = *Sales / Total Assets*

This index calculates the ability of total assets to generated earnings (i.e. how often invested capital produces cash returns collected on sales). This ratio is also called the asset turnover ratio. Altman (2000) asserts that sales revenue over total assets makes the least important contribution to the accurateness of the Z-Score model, nevertheless when it is combined to other components of the model, it significantly increases the predictive ability of the model.

4. Results and Discussion

This part discusses descriptive statistics, estimation results, validation and analysis of the accuracy of the multiple discriminant analysis model. Table 1 indicates dataset of financial figures obtained from the fifteen (15) listed firms. Using the Altman's (2000) Z-score model parameters, Table 2 shows the calculations of Z-score of the firms, and Table 3 shows the classification results.

From Table 3, Altman's (2000) Z-score crucially misclassified 10 out of the 15 non-failed companies as failed ranging from -5.61 to 2.87 as shown Table 3. The empirical results support Appiah (2011) findings that financial distress prediction models are essentially unstable and that the coefficients of a model will differ according to the underlying health of the economy. Interestingly, only 5 companies representing 33.3% were correctly classified, resulting in a type II error of 66.7%.

Also, it is surprising to realized that the multiple discriminant analysis model predicted one of Ghana Club 100 company, Total Petroleum Company Limited (TOTAL) as failed company. This prompted the researcher to find out the firms that were correctly classified as non-failed and those that were misclassified as failed instead of non-failed. Table 4 and Table 5 show the results.

From Table 4 and Table 5, it is evident that the average total assets for the correctly classified firms and the type II error group of firms are GHS 143,854,710.20 and GHS 120,219,360.90 respectively. Also, the average turnover of correctly predicted firms was 4.7 times of the type II error group: precisely, GHS 465,469,720.40 and GHS 99,124,569.40 respectively. The empirical results of this current study in terms of total assets and turnover agreed with Appiah (2011) findings and contrast with Altman and Hotchkiss (2010) argument that the size of a firm has some influence on their likelihood of failure.

Table 1. Financial Statement Values for the Year 2013

Company Code	Working Capital	Total Assets	Acc. Retained Profit	Operating Profit	Book Value Equity	Book Value Liabilities	Turnover
	GHS	GHS	GHS	GHS	GHS	GHS	GHS
BOPP	13,153,000	45,924,000	34,031,000	4,810,000	43,660,000	2,264,000	35,438,000
GOIL	(13,131,715)	221,943,609	16,017,991	18,776,147	59,335,050	162,608,559	1,005,627,497
MLC	(617,615)	78,386,691	13,762,503	(123,589)	38,395,610	39,991,081	38,410,856
PBC	(28,434,587)	326,819,653	2,089,631	41,100,806	39,520,935	287,298,718	1,123,237,029
TOTAL	(14,510,000)	339,397,000	52,280,000	45,180,000	103,502,000	235,895,000	133,815,000
FML	18,731,000	101,247,000	66,431,000	28,194,000	76,431,000	24,816,000	138,969,000
GGBL	(54,256,000)	297,991,000	56,550,000	31,163,000	152,802,000	145,189,000	321,017,000
CLYD	(875,865)	1,736,281	(946,449)	(188,663)	(142,237)	1,878,518	1,239,043
SIC	7,556,318	151,810,616	4,007,703	5,630,307	73,372,096	78,438,521	98,181,730
ACI	(5,124,902)	1,314,378	(5,506,011)	297,104	(4,000,556)	5,314,934	455,186
ALU	(1,357,000)	128,805,000	(24,426,000)	1,972,000	66,591,000	62,214,000	58,026,000
AYRTN	12,661,603	23,339,289	13,081,329	876,620	19,295,765	4,043,524	24,077,076
SWL	52,783	5,434,556	201,906	552,338	556,771	4,877,785	10,015,789
SPL	1,513,338	5,195,087	916,163	1,075,381	3,028,457	2,166,630	6,678,090
UNIL	(29,474,000)	192,123,000	31,144,000	20,615,000	32,629,000	159,494,000	323,407,000

Table 2. Workings on Financial Statement Values using the Altman's (2000) Z-score Model

Company Code	Industry	X_1 WC/TA	X_2 RP/TA	X_3 OP/TA	X_4 E/TL	X_5 S/TA	Z-Score
BOPP	Agriculture	0.286408	0.741029	0.104738	19.28445	0.771666	**10.03**
GOIL	Distribution	-0.05917	0.072171	0.084599	0.364895	4.531005	**4.96**
MLC	Distribution	-0.00788	0.175572	-0.00158	0.960104	0.490018	**1.03**
PBC	Distribution	-0.087	0.006394	0.12576	0.13756	3.436871	**3.82**
TOTAL	Distribution	-0.04275	0.154038	0.133118	0.438763	0.394273	**1.09**
FML	Food & Beverage	0.185003	0.656128	0.278468	3.079908	1.372574	**4.22**
GGBL	Food & Beverage	-0.18207	0.189771	0.104577	1.052435	1.077271	**1.87**
CLYD	ICT	-0.50445	-0.5451	-0.10866	-0.07572	0.713619	**-0.48**
SIC	Insurance	0.049775	0.026399	0.037088	0.935409	0.646738	**1.21**
ACI	Manufacturing	-3.89911	-4.18906	0.226042	-0.7527	0.346313	**-5.61**
ALU	Manufacturing	-0.01054	-0.18964	0.01531	1.070354	0.450495	**0.78**
AYRTN	Manufacturing	0.542502	0.560485	0.03756	4.772017	1.031611	**4.01**
SWL	Manufacturing	0.009712	0.037152	0.101634	0.114144	1.842982	**2.24**
SPL	Manufacturing	0.291302	0.176352	0.207	1.397773	1.285463	**2.87**
UNIL	Manufacturing	-0.15341	0.162104	0.107301	0.204578	1.683333	**2.13**

Table 3. Results of the Z-score Values

Company Code	Industry	Z-Score	Zone of Discrimination
BOPP	Agriculture	10.03	Safe
GOIL	Distribution	4.96	Safe
MLC	Distribution	1.03	Distress
PBC	Distribution	3.82	Safe
TOTAL	Distribution	1.09	Distress
FML	Food & Beverage	4.22	Safe
GGBL	Food & Beverage	1.87	Gray
CLYD	ICT	-0.48	Distress
SIC	Insurance	1.21	Distress
ACI	Manufacturing	-5.61	Distress
ALU	Manufacturing	0.78	Distress
AYRTN	Manufacturing	4.01	Safe
SWL	Manufacturing	2.24	Gray
SPL	Manufacturing	2.87	Gray
UNIL	Manufacturing	2.13	Gray

Table 4: Assessment of Companies Correctly Classified

Company Code	Z-Score	Turnover GHS	Total Asset GHS	Industry
BOPP	10.03	35,438,000.00	45,924,000.00	Agriculture
GOIL	4.96	1,005,627,497.00	221,943,609.00	Distribution
PBC	3.82	1,123,237,029.00	326,819,653.00	Distribution
FML	4.22	138,969,000.00	101,247,000.00	Food & Beverage
AYRTN	4.01	24,077,076.00	23,339,289.00	Manufacturing
Mean		465,469,720.40	143,854,710.20	

Table 5. Assessment of Non-Failed Companies Classified as Failed (Type II Error)

Company Code	Z-Score	Turnover GHS	Total Asset GHS	Industry
SWL	2.24	10,015,789.00	5,434,556.00	Manufacturing
SPL	2.87	6,678,090.00	5,195,087.00	Manufacturing
UNIL	2.13	323,407,000.00	192,123,000.00	Manufacturing
GGBL	1.87	321,017,000.00	297,991,000.00	Food & Beverage
MLC	1.03	38,410,856.00	78,386,691.00	Distribution
TOTAL	1.09	133,815,000.00	339,397,000.00	Distribution
CLYD	(0.48)	1,239,043.00	1,736,281.00	ICT
SIC	1.21	98,181,730.00	151,810,616.00	Insurance
ACI	(5.61)	455,186.00	1,314,378.00	Manufacturing
ALU	0.78	58,026,000.00	128,805,000.00	Manufacturing
Mean		99,124,569.40	120,219,360.90	

5. Conclusion

The paper tests the portability of Altman's (2000) Z-score model using the dataset of 15 companies listed on Ghana Stock Exchange for the year 2013. The results show that the model misclassified all manufacturing and some industrial sector representing 66.7% type II error. However, the model predicted correctly the agriculture sector. From the study, the Altman (2000) model accurately predicted only 5 out of 15 companies representing 33.3% of the sample used for the study. They are firms classified as safe zone ($Z > 2.9$). The conclusion drawn from the multiple discriminant analysis of Altman's (2000) suggests that the model misclassifies approximately 67% companies and evinces that this model is not applicable in Ghana but rather appropriate for firm's classification that depends to the extent the size and nature of the listed firms.

The study concludes that the Altman (2000) financial model is not portable in Ghana due to high type II error rate and the study recommends the use of non-financial models in predicting corporate failure in emerging markets, Ghana where there is no prior study. For instance, future research can use non-financial variables such as management experience, marketing activities, age of firms, partners and others used by Lussier (1995) in an emerging market in predicting the success and failure of firms.

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