Application of Altman Bankruptcy prediction model in Ghana

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Abstract
The study examined the applicability of the Altman Z-score model in predicting bankrupt companies or financially distressed companies on the Ghana Stock Exchange. A sample 10 listed firms were selected and one other company to be used for validation purposes. The validation process involved data for 2016 and 2017 for Aluworks which represented a distressed company and GOIL Ghana Limited which represented non-distressed company. The final analysis was based on a random sample of 10 listed firms using their 2017 financial statement. The results of the initial prediction showed 50 percent of the companies were correctly predicted whiles the others were misclassified. Additional analyses showed that the size of the company influence the probability of bankruptcy whiles the nature of the business does not. The conclusion drawn shows that the Altman Z-score cannot accurately predict financially distressed firms in Ghana but can still be useful in giving signals.

Keywords: *Altman Z-Score, Bankruptcy, Firms, Ghana*

JEL Classifications: G33, M41

INTRODUCTION

Corporate failures around the world and even in Ghana has raised the need for a reliable bankruptcy prediction model to help reduce the menace (Samanhyia, Oware & Anisom-Yaansah, 2016). Some studies have argued that financial distress in companies can be linked to corporate governance (Appiah, 2011; Datta & Iskandar-Datta, 1995). In this regard some studies have even concluded that there is a relationship between corporate governance characteristics and corporate failure (Appiah, 2011; Daily & Dalton, 1994). Almost every major economy in the world have had its fair share of corporate failures of which Ghana is not an exception. The most famous cases are Enron and WorldCom in the United States but post-Eron period also witnessed some financial distress situations with companies such as Chrysler, General Motors, Delta Airline, America International Group etc. (Appiah, 2011). These scandals renewed the debate for the need to be able to predict some of these scandals before they occur.

Several corporate failure prediction models have been developed and used in various context with some modifications over the years all in an attempt to help predict bankruptcy of companies (Appiah, 2011; Wu, Gaunt, & Gray, 2010; Appiah & Abor, 2009). The first of such corporate failure prediction model was the one developed by Beaver (1966) which became the basis for subsequent models (Wu, Gaunt, & Gray, 2010). Other models came up but were all based on data from developed economies (Altman, 1968; Altman, 1984; Edmister, 1972; Trieschmann & Piches, 1973; Sinkey,

1975; Deakin, 1977; Piches & Trieschmann, 1977; Casey & Bartczak, 1985 etc.) all the way to Altman & Narayanan (1997).

These models have however been used on other context to test corporate failure prediction both in developed and developing and emerging economies. Wu, Gaunt, & Gray (2010) however argued that most of these models fails to accurately predict bankruptcy in different context like they did in the environment they were developed. This notwithstanding, there is some consensus that corporate failure prediction models are still useful and can predict bankruptcy if there are no methodological problems in their application in other environment (Appiah & Abor, 2009).

According to Appiah (2011), Ghana has had its fair share of corporate failures affecting almost all sectors. For instance, the study mention companies such as Ghana Airways Ltd, Juapong Textiles Ltd, Bonte Gold Mines, Devine Sea foods, Ghana Cooperative Bank, Bank for Housing and Reconstruction. In recent time the collapse of respectable banks like UT Bank, Capital Bank, Unibank Ghana Limited, Royal Bank Ghana Limited, Beige Bank, Sovereign Bank, Construction Bank etc. The impact of the collapse of these banks have been dire especially with regards to job loss. Up till date, some people are still losing their jobs as a result of the collapse of these banks. Several Micro-finance and non-bank financial institutions have also collapsed as bank of the Bank of Ghana clean-up of the financial sector.

The increasing number of corporate failures as enumerated above and the potential impacts on jobs, people's lives and the economy in general means that it is imperative to be able to predicts this events in Ghana before they occur. Several stakeholders such as government, employees, debtors, shareholders and other investors lose substantially in these corporate failures (Appiah, 2011).

Despite the numerous corporate failures in Ghana, little has been done in literature to predict corporate failures or even test the applicability of the bankruptcy prediction models developed in other economies (Appiah, 2011). Appiah (2011) used the Z-Score developed by Altman (1968) to test corporate failure of l15 listed firms in Ghana using a data sample from 2004 to 2005. Mahama (2015) also used the Z-score to predict corporate failure of listed firms using data from 2007 to 2013.

This current study is an upgrade as its seeks to use data set of non-financial firms covering 207 and 2018. Besides, apart from Appiah (2011) who examined the applicability of the Altman model in Ghana, the other studies focused on using the model to predict corporate failure. The data set used in that study is old which this study was to cure using recent data to see if the same results can be achieved. The study seeks to establish the extent to which Altman (1968) model helps to predict corporate failure in Ghana.

LITERATURE REVIEW

There are many studies that have examined the applicability of Bankruptcy models in different environment (Grice & Dugan, 2001). This several studies attest to the importance of bankruptcy prediction models in corporate governance (Appiah, 2011). There is general global concern for risk to corporations as a result of high debts especially after the collapse of top giants' companies in the United States and other parts of the World. Appiah (2011) argue that even through there are several reviews on corporate failure prediction models, most of these studies are mostly out of date or are too narrow focused. Some of these studies include Scott (1981), Zavgren (1983), Altman (1984), Jones (1987).

Most of these studies relied on statistical models even though latter studies such as Jones (1987) and Dimitris et al. (1996) failed to incorporate full theoretical models. Most of these studies have failed to incorporate the different approaches to corporate failure prediction models (Appiah). Moreover, they failed to provide solution to the problem of choosing the right model.

Some studies focused on using accounting ratios, a scoring model in a univariate discriminant analysis to predict the risk of bankruptcy of companies (Patrick, 1932; Durand, 1941; Beaver, 1966). It has been established that their method produces inconsistent results which gives confusing signals about the financial health of the company (Appiah, 2011). The improvement on the above models came with multiple discriminants analysis which has since been applied in several studies to estimate corporate failure prediction Altman, 1968; Zavgren, 1983).

The multiple discriminant analysis uses a linear discriminant function that helps to separate the variables into two disjoint components (Appiah, 2011). Altman (1968) is believed to be the first study that applied this model to estimate corporate bankruptcy prediction. The study fist sample was based on 66 firms from the United State from 1946 to 1965. The study first classified into two different groups, bankrupt firms and non-bankrupt firms. The discriminant function was developed based on a sample of 33 firms in each group. It involved 22 accounting and non-accounting ratios which was later reduced to 5 ratios. These ratios were what the model believed to be able to estimate corporate failure.

The first model that came out from the study was;

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

Where:
X_1 = working capital divided by total assets
X_2 = retained earnings divided by total assets
X_3 = earnings before interest and tax divided by total assets
X_4 = market value of equity divided by book value of total liabilities
X_5 = sales divided by total assets.

Based on the above model Altman argued that a cut-off of 2.675 was adopted which translate into 6% and 3% type I and type II errors respectively for a sampled firm in a year before failure. Where there is the need to predict the risk of bankruptcy will result in an increase in the type I error and type II error to 28% and 6% respectively (Appiah, 2011). To correct the above deficiency, Altman & LaFleur (1981) developed a more upgraded Z-score which was given as;

$$Z= 1.2X_1+1.4X_2+3.3X_3+0.6X_4+1.0X_5$$

The definition of the variable did not change from that presented in the first model

After this model was developed and to test its reliability in predicting corporate bankruptcy, a new set of sampled companies was used. Out of the sample 86 companies went bankrupt in 1969 to 1975, 110 went bankrupt between 1976 to 1995, 120 went bankrupt between 1996 to 1999. Altman after this observation now reduced the cut-off point to 1.81. The further stated that the range between 1.81 and 2.7 as the point where the failure of the company was still uncertain. The model developed by Altman was similar to that of Beaver (1968) with the exception of the multiple discriminant analysis as against the univariate.

Several studies have since used this model in various methodologies such as logit, linear probability, probit among others. What is common among all these new variations

and models is the fact that they all have some assumptions which restrict their applicability. Subsequent models that were developed also had their own challenges in terms of reliability of estimating corporate bankruptcy. Altman himself later expanded his work in 1993.

In essence whiles the first models by Beaver (1966) and other that followed relied on accounting ratios to predict corporate bankruptcy and used the assumption that same ratios differ between bankruptcy firms and non-bankruptcy firms, critics argued that there were no standard ratios and that their estimates were not reliable. The Altman model and other subsequent model relied on multiple discriminant analysis unlike the first ones that used Univariate analysis. In this approach, bankruptcy score was used to predict corporate failure. Appiah (2011) argued that all the models emphasized the importance of statistical techniques in estimating corporate failure even though their ability to do so accurately is still questionable. The study further argued that there is no statistical technique in this case that is superior to the others suggesting that caution is key in using these methods. The other way around it is to use simple rank alongside the multiple discriminant analysis techniques which this study intends to adopt.

Some few studies have examined corporate prediction in Ghana using the Altman Z-score on both financial and non-financial firms. For instance, Appiah (2011) examined the use of Altman Z-score to predict corporate bankruptcy in Ghana based on a sample of 15 non-failed firms listed on the Ghana Stock Exchange. The test was based on data set from 2004 and 2005 for the sampled firms. The results showed that Altman Z-score was capable of predicting bankruptcy in Ghana but depends on the size of the firm. However, the model misclassified all the manufacturing, insurance, food and beverage as well as printing companies. It was rather able to classify all distribution companies. The study concluded that the nature of the business influence the applicability of Altman prediction model in Ghana. Also, large companies appeared to have been correctly predicted as compared to small companies.

Mahama (2015) examined the state of financial distress of listed firms in Ghana using the Altman Z-score model. The study sampled 1o listed firms covering a period from 2007 to 2013. The results of the study showed that six companies were financially sound with no bankruptcy threats, two companies were in financial distress and two other have deteriorated were near financial distress. The companies that were found to be in a state of financial distress however had not filed for bankruptcy yet.

Amoa-Gyateng (2014) examined the risk of corporate failure on Anglogold Ashanti, a mining company listed on the Ghana Stock Exchange and other exchanges as well. The study used a sample period from 2010 to 2012and relied on the modified Altman model and Beneish model. The results of the Altman Z-score showed that the company was in financial distress while the Beneish model showed the company was not engaged in any reporting fraud.

Samanhyia, Oware & Anisom-Yaansah (2016) examined financial distress of listed bank in Ghana in the midst of the several collapse of banks in Ghana. The data set covered a period from 2008 to 2014. The study used the Altman Z-score and Boone indicator. The results showed that poor corporate governance contributed to financial distress and that smaller board size was negatively associated with firm performance. In the nutshell these studies have examined different part of the problem in Ghana.

It appears Appiah (2011) study is the only study that attempt to examine the applicability of the Altman Z-score model in Ghana. The other studies rather focused on just predicting corporate bankruptcy on selected firms without necessarily checking the

applicability of the model. Since data set used for the study was 2004 and 2005 and the fact that a lot has changed in the Ghanaian business environment, it is imperative that a new study is conducted using recent data such as 2017 and 2018 on the same sample of firms to see if the same results could be achieved.

METHODS

In line with the study by Appiah (2011), the study adopts the methodology used by Argenti (1983), Moyer (1977) in predicting corporate failure and bankruptcy prediction in Ghana. The study examines the usefulness of the Altman Z-score for listed firms using some experimental approach. The researcher first used the Z-score to calculate the scores for two listed firms on the Ghana Stock Exchange for the year ended 31st December, 2016 and 2017. The data was extracted from the financial statement of these companies which was downloaded from either the company's website or the Ghana Stock Exchange annual report depository. The researcher validated the model on eight other listed firms with data set for 2017 financial year. The study then adopts the paired sample approach as per Appiah (2011) and other previous studies that have also relied on this approach (Taffler, 1995; Platt & Plat, 1990; Barnes, 1990; Palepu, 1986; Altman, 1968; Beaver, 1966).

After this stage the study now designed the sample to fit the paired sample. Even though the multiple discriminant methods require random selection of the sample, a sample selection on the basis of size using the sales or turnover was adopted. After this process the data was extracted from the financials of these companies into an Excel sheet to allow for the computation of the ratios or the variables start the necessary analysis. The study intended to test a failed company as part of the validity test but did not have any data on a failed company. However, the study sampled Aluworks Ghana Ltd which is one of the listed firms going through very difficult financial challenges and is looking for an investor to bail them out as by the chairman report to shareholders in the 2017 annual report. The study in line with Appiah (2011) had wanted to choose another company of commensurate size but their Z-scores were not encouraging so the study chose a company with a good Z-score for the initial testing and GOIL was selected. So Aluworks is the failed one company selected and GOIL is the non-failed company. The calculation of the Z-score was based on the revised model of Altman (2000). The model is defined as

$$Z= 0.717a + 0.847b + 3.107c + 0.420d + 0.998e.$$

Where:
a = working capital divided by total assets
b = accumulated retained earnings divided by total assets
c = operating profit divided by total assets
d = book value of ordinary and preference capital divided by book value of total liabilities
e = sales revenue divided by total assets.

RESULTS AND DISCUSSIONS

Initial testing

The initial testing on done using Z-score from GOIL for 2016 and 2017 wiles that of Aluworks also involved Z-score from 2016 and 2017. The Z-scores for Aluworks is -1.19 for 2016 financial year and -0.08 for 2017 financial year. On the other hand, the Z-scores for GOIL for 2016 financial years was 5.22 whiles that of 2017 is 4.95. The results

are in the with Altman argument that a company with a Z-score of less 1.8 has either failed or is failing. The Z-scores of the two companies are presented in the Figure 1.

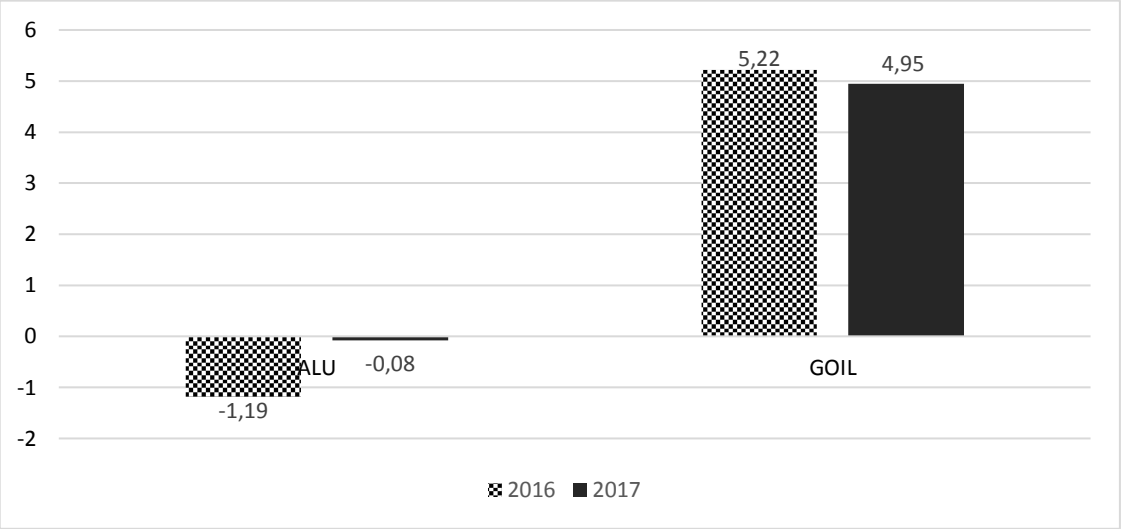

Figure 1. Z-scores for Aluworks and GOIL

The Z-score for Aluworks did improve marginally even though it is nowhere near being safe. On the other hand, that of GOIL saw a small decile from 5.22 in 2016 to 4.95 which is still good as per the Altman model interpretation of the Z-scores.

Validation of the model

The study based on the availability of data randomly selected 10 listed firms based on data from their 2017 financial statement filled with the Ghana Stock Exchange and https://africanfinancials.com. The study computed their Z-scores which have been presented below. The Z-scores of the selected firms are presented Figure 2.

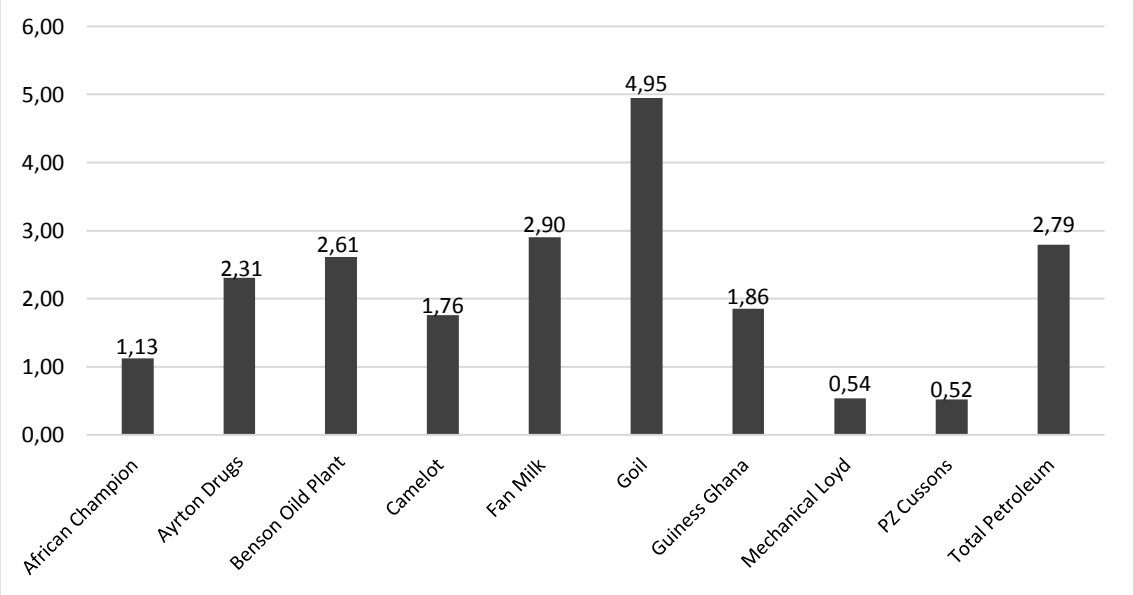

Figure 2. Z-score of selected listed firms

The Altman model classifies companies with Z-Sores below 2.01 as failed companies or at the verge of bankruptcy (Appiah, 2011). Based on the above classifications, 5 of the selected companies are classified as bankrupt companies which according to Appiah (2011), it is a misclassification as they are still operating. The companies which are supposed to be bankrupt from the figure above include African Champions Ltd, Camelot Ghana Ltd, Guinness Ghana Ltd, Mechanical Lloyd Ghana Ltd and PZ Cussons. These companies had Z-score below the threshold of 2.01.

On the other hand, five companies had a Z-score above the threshold of 2.01 and they include Ayrton Drugs manufacturing company Ltd, Benson Oil Plantation Ltd, Fan Milk Ghana Ltd, GOIL Ghana Ltd and Total Petroleum. The percentage pf companies as well as the number of companies not on the brink of bankruptcy or in good financial heath is higher than that reported by Appiah (2011). The number of companies in good financial health in 5 representing 50%. Which result in a type I error of 50%. This is better than the 15.38% reported by Appiah (2011) and a type I error of 84.62%. The model is predicting companies like Guinness Ghana, Mechanical Lloyd and PZ Cussons as bankrupt which can only be as a result of misclassification. In line with the study by Appiah (2011) the author decided to find out the missing link in this potential misclassification.

Table 1. Assessment of companies correctly predicted

Company	Z-score	Turnover	Total Assets	Nature of Business
Ayton Drugs	2.31	35,016,640	30,051,987	Manufacturing
Fan Milk	2.9	524,007,000	300,109,000	Manufacturing
Benson Oil Plant.	2.61	89,979,000	75,760,000	Processing
GOIL	4.95	4,669,509,000	1,036,510,000	Distribution
Total Petroleum	2.79	1,858,478,000	720,473,000	Distribution
Sum		7,176,989,640	2,162,903,987	
Mean		1,435,397,928	432,580,797.4	

The results from Table 2 and three shows that the mean of companies properly classified shows a very high turnover of GHC1,435,397,928 and a total Assets of GHC432,580,797 as compared to the misclassified firms that has a mean turnover of GHC145,037,405 and total Assets of GHC142,326,979. The results confirm the assertion by Appiah (2011) who argue that size influence the probability of failure.

Table 2. Assessment of companies not correctly classified (Failed)

Company	Z-score	Turnover	Total Assets	Nature of Business
African Champion	1.13	4,934,210	5,546,146	Manufacturing
Camelot	1.76	6,420,493	5,321,370	Printing
Guinness Ghana	1.85	587,447,000	527,907,000	Food and Beverage
Mechanical Lloyd	0.54	34,552,736	66,656,999	Trading
PZ Cussons	0.52	91,832,590	106,203,380	Manufacturing
Sum		725,187,029	711,634,895	
Mean		145,037,405.8	142,326,979	

Discussion of findings

The results of the study show corporate bankruptcy cannot be predicted in Ghana using the Altman prediction model as some of the companies labeled as failed as per the model are still operating and appears to be doing well. The result is consistent with the

findings of Appiah (2011) and other studies who also reported the non-applicability of the Altman Bankruptcy prediction model in other jurisdiction. The result is also similar to the findings of Mahama (2015) where the model predicted some solvent firms listed on the Ghana Stock Exchange to be at the risk of bankruptcy. Grice & Dugan (2001) argued that the bankruptcy prediction models are just good indicators that a firms is about to be financially distressed but does not accurately predict bankruptcy especially in different time context other than those used to develop the models. This means that the results from the use of the Altman model should only guide firms and help them take precautions before their situation escalates.

From the study, one thing stood out in the process of coding the data, it appears companies with high debt levels both current and non-current liabilities and low performance in terms of profitability are likely to be included in the bankruptcy bracket. That trend appeared more consistent in the course of the study. The size of the company can also help to product corporate failure as shown in the analysis. The results however show some elements of inconsistency based on the argument presented by Altman. The nature of the business does not accurately predict bankruptcy as some manufacturing companies appeared in both classifications. It can also be argued that the extent to which the country's financial market systems are developed could affect the applicability of the model as some components involves the use of market data which is based on how sensitive the country's capital market responds to information. The model however is useful as it serves as warning sign to listed firms in Ghana.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The study adopted the Altman corporate prediction model as applied by Appiah (2011) to predict the applicability of the model in the Ghanaian context. The results from the analysis shows that the model does not accurately predict corporate failure in Ghana. However, size appears to help predict corporate failure but the nature of business does not from the analysis. The results however give an indication for companies to reexamine their liability and their profitability as these aspects appears to impact on the Z-scores. The model also serves as a useful guide to companies to determine the risk of bankruptcy and reveal areas of potential threats.

Recommendations

On the basis of the above findings and similar studies in Ghana, it can be recommended that future studies attempt to develop an alternative model that can accurately predict bankruptcy in Ghana based on the unique features of the Ghanaian business environment.

The study also recommends that market players take companies financing and capital structure seriously as it has implication on the survival of the company. The high debt level of some listed firms did not reflect in their market valuation which is a sign of weak capital market efficiency. The study further recommends that future studies can examine the extent to which financial market efficiency influence the applicability of the Altman Bankruptcy prediction model.

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