



**Strathmore**  
UNIVERSITY

**VALIDITY OF THE MULTIPLE DISCRIMINATE  
ANALYSIS FAILURE PREDICTION MODEL ON  
CORPORATE FINANCIAL DISTRESS: AN ANALYSIS  
OF THE KENYAN MARKET.**

**RESEARCH PROJECT**

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Science in Financial Economics at Strathmore University**

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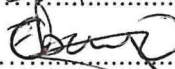
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## **DEDICATION**

This project is dedicated to my parents and my sister without whom I would not have completed this projects as it is through their support and continuous words of wisdom that I have been able to get this far. They have shaped my academic life and I am eternally grateful.

## ABSTRACT

The core objective of the study was to test the applicability of the multiple discriminate analysis model in predicting corporate failure of financially distressed companies in different industries in Kenya based on a 3 part criteria. These companies should have been listed in the Nairobi Securities Exchange as listed companies greatly affect investment and the economy as a whole. Second, the companies should have previously experienced financial distress to the point that it was on the verge of failure. Finally, the companies should have sought assistance from the Kenyan Government as a final resort before complete failure. Thus the author was able to pick out 4 companies out of the 62 listed. This will assist various stakeholders in the Kenyan financial industry to react to corporate distress signals early enough to avoid financial failure. Descriptive analysis research design was adopted in this study which was carried out on a total of 21 companies classified as either distressed or non-distressed to allow for proper discrimination. The period of study was 20 years ranging from 2000-2019. The audited financial accounts of the chosen companies provided secondary financial data. This data was used to extract liquidity, profitability, efficiency, activity and leverage ratios which were then summed up to arrive at the Z-Score. Data analysis was conducted through the use of MS Excel where correlation and regression tests were tabulated. The research findings indicate that the MDA model both for manufacturing(1968) and of non-manufacturing(2006) are reliable in predicting financial distress of companies in Kenya as it predicted accurately 71% of non-distressed corporations and 64% of distressed firms. Furthermore, the findings provide evidence that liquidity (WC/TA), profitability (RE/TA), Efficiency(EBIT/TA) and leverage (MVE/TL) ratios had a major influence on financial distress prediction. However, the activity ratio (Sales/TA) did not have much influence. The outcome of this study suggests that stakeholders in a firm can predict failure before it occurs by paying close attention to liquidity, profitability, efficiency and leverage ratios. This will enable them avoid the losses associated with failures by taking appropriate actions in advance.

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## **LIST OF ABBREVIATIONS**

**MDA** – Multiple Discriminate Analysis

**NSE** – Nairobi Securities Exchange

**NBK** – National Bank of Kenya

**KCB** – Kenya Commercial Bank

**KQ** – Kenya Airways Limited

**EBIT** – Earnings Before Interest and Tax

**RE** – Retained Earnings

**TA** – Total Assets

**WC** – Working Capital

**TL** – Total Liabilities

**MVE** – Market Value of Equity

# CHAPTER ONE

## INTRODUCTION

### 1.1 Background Information

The ability of a company to remain solvent and prevent bankruptcy is important to any firms' corporate management, be it big or small in terms of the operations it manages. It would therefore be in the best interest of both shareholders and stakeholders (both internal and external), to ensure that any company attains optimum levels of performance. Hence, it is crucial for any management to analyse the symptoms of bankruptcy in order to anticipate the future condition of a company and prevent the company's downfall.

After the failure of huge global firms like Enron, WorldCom and Arthur Anderson, economists became wary of corporate demise. The collapse of such large companies led to large losses that were incurred by both investors and lenders committed to the businesses. As a result, companies globally began to place their main focus on, not only, corporate governance but also in risk management in the hope of minimizing economic financial distress. Financial distress has affected many investors and huge cash flow has been lost as a result of this problem (Malcolm Baker, 2011). Early detection or prevention has become essential in the corporate world so as to protect investors and lender funds. This has led to the creation of various financial distress models.

The first model that predicted and classified corporate bankruptcy was created by Beaver in 1966. Beaver defined financial distress as bankruptcy, insolvency, liquidation for the benefit of a creditor, default of loan obligations by firms or missed preferred dividend payments by firms. Beaver's research concluded that the income to debt ratio was the most effective indicator for financial distress because it had a 78% accuracy level in predicting incoming bankruptcy of sampled firms. However, Beaver's definition of the term financial distress has been challenged. This is largely due to the difference between Financial distress and Bankruptcy considering that financial distress includes a multiplicity of issues that affect companies as a consequence of operating decisions or external forces while bankruptcy is a decision, stemming from financial distress, that is made to safeguard company assets from creditors (Platt, 2006).

Edward Altman(1968) further developed Beavers model which gave rise to the Multivariate Discriminate Model. His model would be a numerical measurement that is accustomed to predicting the prospects of a business going bankrupt within a period of two years.

Financial ratios are a relative measure of two selected numerical values from any business's financial statements (Pandey, 2005). In accounting, we find that different standard ratios are used in the evaluation of an entities financial position and its general condition. However, in financial analysis, a ratio is employed as a benchmark to gauge this (Edmister, 1972). Financial ratios could even be utilized by internal stakeholders like managers within the firm, by current or potential shareholders of a firm and additionally the firm's creditors. However, to financial analysts, ratios are used as a measure of the company's strengths and weaknesses which are important in business analysis like that of SWOT (Strength, Weaknesses, Opportunities and Threats).

Multivariate discriminant analysis is primarily made up of financial ratios. This proves that these ratios are the key to evaluating the financial health of any firm. In 1980, Ohlson later became the pioneer of the Logistic Regression model in financial distress prediction research. Olson deployed the use of eight financial ratios in his model concluding that total liability divided by total assets, current liability divided by current assets, and size are the foremost important predictors (Ohlson J. A., 1980).

Omary J. Ally (2014) conducted a study of testing financial distress on six companies in Tanzania from 2010 to 2014 using the MDA model. The study found that 5 companies were experiencing financial health with one experiencing financial distress. Similarly, in South Africa, in 2006, Steyn-Bruwer and Hamman conducted a study on predicting financial distress of companies listed on the Johannesburg Stock Exchange with the use of different models. However, they concluded that the MDA model correctly predicted the most failed companies with the lowest normalized cost of failure; this taking into account that type I error is more costly than type II error by 20% - 38%.

In Kenya, a study conducted by Mohamed (2013) using descriptive analysis was used to present the results from Altman Z score model as applied on listed Kenyan firms which he narrowed down

to 34 firms. He concluded that the MDA model sufficiently predicted financial distress. Similar studies were conducted by Kariuki (2013) that focused mainly on the banking sector in Kenya. Using the Z-score model, he concluded that non-listed banks were at a higher risk of facing financial distress than the listed banks. Mamo (2011), Shisia et al. (2014) and Mohamed (2012) also concluded that the MDA model was appropriate in testing financial distress.

Given that Financial Distress is an important factor to consider in the management of firms in the corporate world, it is imperative for any economic system to prevent risks such as systematic risk that would affect not only a company but a whole industry. Therefore, the study will look into companies in different industrial sectors such as Uchumi Supermarket, Kenya Airways Limited, National Bank of Kenya and Mumias Sugar Company Limited which are all trailblazers in their respective industries in the Kenyan market. The aim of this study is to show the validity of Multivariate Discrimination Model on the prediction of financial distress in different industrial sectors in Kenya. that may have prevented the company's demise had it been used at an earlier stage.

## **1.2 Research Problem**

After the great recession of 2008, the world experienced the downfall of large companies such as: Rococo, Knight-Celotex, Kane Steel and American International Group. It became clear that failure prediction models were important in the corporate world. Being that the main aim of any company is generating profits without paying much attention to signals of distress this eventually leads to a rushed last-minute effort to devise solutions that are often futile due to the limited time left to correct it. Therefore, early detection is a key component for a company to avoid falling prey of financial distress. Accurate prediction is thereby important as it also prevents the loss of funds by the entity as well as prevents great economic blows emanating from large companies and companies considered "too big to fail". The lack of emphasize in the use of financial distress models in the past has proven to be very costly to large companies e.g. Uchumi supermarkets (2006), Discount Securities (2008), Invesco insurance (2008), Standard Assurance (2009), Ngenye Kariuki Stockbrokers (2010) and Hutchings Biemer (2010).

Alexaki (2008) using Multiple discrimination model, noted that the model performs well in predicting business failures for a period of up to five years earlier and could be used by portfolio managers in decision making on the specific portfolio as well as corporate management on the decision to merge or when making acquisitions. This creates a gap, as most researchers are focused on testing financial distress for mergers as well as comparing different distress models and with the government continuously bailing out large Kenyan companies only for them to fail again, there is a need to find implications that can curb this vicious cycle. Aside from that, with the increase in financial crisis globally that has been a result of the changes in macro-economic factors leading to a domino effect on businesses due to increasing interest rates, the notable increase in the volatility of exchange rates, relatively high inflation rates that seem to be on the rise, and changes in Gross Domestic Product has motivated the need to carry out this study.

### **1.3 Research objectives**

- This research aims to determine the validity of Multiple Discrimination Analysis as a failure prediction model in predicting corporate financial distress in different industries in Kenya with a focus on 4 companies.
- To determine the implications of the financial distress on the predictive ability of the MDA model in the different industries.
- To determine ratios as used in the Multiple Discrimination Analysis (MDA) Model would have the greatest impact on an industry when predicting financial distress.

### **1.4 Research Questions**

- Which ratios as used in the Multiple Discrimination Analysis (MDA) Model would have the greatest impact on the prediction of financial distress?
- What are the implications of the financial distress on the predictive ability of the MDA model in the different industries?

### **1.5 Scope of the Study**

This study is limited to Kenyan based companies which are Uchumi Supermarkets Limited, Mumias Sugar Company Limited, National Bank of Kenya and Kenya Airways Limited, that represent 4 industries; the manufacturing industry, the transport industry, the banking industry and

the retail industry. These companies should observe three selected criteria; that the company should have been listed in the Nairobi Securities Exchange, previously experienced financial distress to the point that it was on the verge of failure or failed, and as a consequence, was bailed out by the Kenyan Government. However, due to the nature of these companies and the limitation of similar companies in the market, the companies that will be used to discriminate (non-distressed firms) may be from other geographical locations.

### **1.6 Value of the Study**

In accounting, the going concern theory assumes that a business operates with the notion that it will still be in operation in the subsequent years to come. However, it is known that this is not always the case as there may be occurrences that may affect future operations based on different events. It is therefore important to be able to predict the risks that the company may be facing so as to devise corrective measures as early as possible and prevent the firm's retrogression. As such this study is important for the Kenyan economy considering that Uchumi was a trendsetter in the supermarket franchise and for a long time was and still is, seen as an important entity in the country's economic backbone as is clear from the various bailouts it has received from the government. Aside from that, being largely owned by the government, the franchise was continuously used to better the lives of citizens by ensuring that the prices were affordable for all. They did this by creating price ceilings on the products sold thus creating competition for other retailers forcing them to reduce their prices.

Mumias sugar company was also a big contributor to the Kenyan Economy as it was the main source of sugarcane for the country and it provided a source of income for thousands of Kenyan farmers. Kenya Airways is often seen as the flagbearer of Kenya as it is the only Kenyan owned airline after the dissolution of East African Airways. National Bank of Kenya at inception was designed to be rolled out into Kenya's Rural Areas as a commercial entity to provide credit to Kenyans after the attainment of independence. With the aim of giving Kenyans control of their economy, it was seen as a very important bank to the Kenyan economy.

The study can be used by the Government of Kenya to come up with new strategies as well as policies that will assist in assuring the success of different government firms, especially for those

that have previously been bailed out like Kenya Cooperative Creameries, so as to prevent a second occurrence of corporate distress as in the case of the firms included in this study. The study also seeks to act as a whistle-blower for any future company decay being that the shareholders are attempting to revive the company once again. Aside from that, it may also assist in the protection of shareholders wealth which is one of the main priorities of any business. It may also assist in the analysis of investments. The study also seeks to prevent economic collapse effected by loss of government tax revenue from an entity's lack of funds which ultimately leads to increased unemployment in the country due to the company's possible foreclosure. This study seeks also to facilitate in the analysis of corporate governance that was identified as a major cause of the company's downfall.

By analysing the reviews and accounts by all the company's management in terms of the effects on a company's performance abilities, the risks involved as well as mergers and acquisitions, the model may also help make investment decision for shareholders when choosing between bearish and bullish shares. In terms of loan credit analysis, the study may enable lenders to decipher the company's risk of failure when making the decision to lend or not depending on the prediction outcome. The study may also form a basis on which other related studies and replication papers may be based on.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter begins with discussing the meaning of financial distress as well as the factors that cause financial distress; this will be followed by the costs associated with financial distress as well as the empirical study, a brief summary of the companies involved in the study and a summary of the literature review.

#### 2.2 Financial Distress

Gordon (1971) in his article on “The event of Economic Distress” stated that it was a process that included specific dynamics. Gordon further explains that financial distress is simply a part of the method, followed by failure and eventually resulting in a far needed restructuring that ought to be interpreted in terms of economic structuring and security valuation (Gordon, 1971). The firm gets to this point when it is unable to generate sustainable earnings and the firm’s debt ratio is greater than 1, meaning that there is more total debt than total assets. Andrade and Kaplan (1998) later identified two-forms of economic distress; the primary being failure of debt payment, and the secondary as an attempted restructuring of debt so as to forestall a situation where a party may default. Financial distress therefore occurs when a corporation does not have the capacity to satisfy its liabilities to the third party, which was earlier described as bankruptcy (Andrade, 1998).

Whitaker (Whitaker, 1999) later interpreted financial distress as a vital point for a firm as it separates the firm’s financial health from when it gets to a point in financial distress whereby it requires immediate corrective measures to forestall the demise of the company. Garrett (2008) noted, after the Great Recession, that when a firm is in financial distress, it faces either low levels of cash on the assets side of the record or as debt extended in liabilities. However, in both circumstances, one can draw similar results from both instances that basically transcends into insufficient funds leading to a shortcoming of hiding one’s obligations. This necessitates forced negotiations by the firm with its creditors as the firm then attempt to restructure to incorporate new fund generating mechanisms (Outecheva, 2007).

### **2.3 Causes of Financial Distress**

Financial distress according to Beaver who likened a venture to a water supply filled with inflow of cashflow and whose outlet is the outflow of cashflow, stated that financial distress is like an emptied water supply. This means that the venture is devoid or almost devoid of cashflow which is an important factor for any business' survival (Beaver W. H., 1966). Financial distress therefore occurs when any business is faced with a shortage of liquidity that leads to an inability to meet one's financial obligations. This situation may be temporary or finite leading to inevitable bankruptcy. However, the deterioration of a company's financial health is often a gradual process due to abnormalities in business operations that are caused by different factors (Jahur M. &, 2001). Slatter and Lovett (1999) in their published book, divided these causes into two main categories; endogenous and exogenous factors. They argued that exogenous factors, being external factors, can only affect the entity to certain extent while endogenous factors play the biggest role (Lovett, 1999).

Endogenous factors are mainly attributed to poor management. This could be because of poor or lack of managerial skills as well as poor corporate policies and strategies. Management is in charge of planning, organizing, motivating and controlling all the workings of an organization. All these functions are key to accomplishing the aim of the organization using the employees and resources under the organization. Therefore, if the management is not skilled enough to realize these objectives, then the organization would ultimately fail. Aside from that, there are risks such as corruption and the agency problem that would lead to internal battles that would undermine the organizations general operations (Prijcker, 2008). For start-ups however, the main cause of financial distress is the lack of enough capital which is important in the development of the business and in absorbing any abnormal losses (Adeyemi, 2011).

Aside from that, Slatter and Lovett also stated that destruction and loss to physical assets and raw materials may also be a factor. Aside from the management being skilled, the loss or lack of a skilled workforce may be detrimental to the organization. An organizations reputation also plays a key role its survival i.e. Bankers Trust, a company that lost the trust of its customers due to fraud allegations and questionable credibility. It never regained its reputation leading to its eventual acquisition by Deutsche Bank (Lucia Michalkovaa, 2018).

Exogenous factors are mostly accredited to macroeconomic factors and competition as they are uncontrollable under the organization. Macroeconomic factors include changes in interest rate, the state of the economy, change in input and prices in any direction, changes in market demand, strikes, government policies and taxes amongst others (Lucia Michalkovaa, 2018). To combat competition in any industry, one has to incorporate creativity and innovation into their products. This can however be a costly to an organization without the assurance and certainty that it will be profitable to the organization. This poses a general risk which has only been examined to a certain degree (Chao, 2012). The effect of innovation therefore has an equal probability of driving the organizations profitability higher or it may lead to the firms demise due to financial distress (Jahur M. &, 2012).

Even with the above factors, companies often focus primarily on financial performance indicators as their measure of financial health. This leads to the lack of awareness of signals that may assist in preventing financial distress in future that may lead to bankruptcy. Operational, Financial and Managerial signals are therefore a key factor in the indication of early warning signs as to when a company is experiencing problems (Zwaig & Pickett, 2001).

#### **2.4 The Costs of Corporate Financial Distress**

Financial Distress occurs when a company is not able to meet its obligations. This means that the company has taken up more debt. It therefore has high leverage and is ultimately less profitable. Thus, the company will need to increase its assets or it would find itself on the verge of bankruptcy. This would therefore mean that the companies would need to remedy the situation before its demise (Wilkinson, 2013).

This could mean losses incurred from sale of assets, legal fees, administrative fees as well as advisory fees which are all classified under bankruptcy costs also known as direct costs as they are all borne as result of formally beginning the bankruptcy process. According to Warner (1976) in his paper, he estimated the total value of bankruptcy cost to be 4% of the firms value before the bankruptcy process begun which was almost similar to the findings of Weiss who estimated the cost to be 3% (Weiss, 1990).

The indirect costs on the other hand is borne when the company is experiencing financial distress. If this occurs the company may have to forego the costs incurred from research costs and investment costs so as to cut down on expenditure as an attempt to remedy the situation (Wilkinson, 2013). Opportunity costs may also be incurred as management avoids taking up risky projects. Aside from that, the effect on reputation may lead to reduced sales, reduced trade credit from suppliers which will make them vulnerable to competitors in the industry (Hotchkiss, 2006). Warner estimated the indirect costs to be worth 15% to 20% of the company's value (Warner, 1976).

## **2.5 Empirical Review**

Research on Financial Distress prediction garnered the interest of researchers in the early 1930's with Fitzpatrick who in 1932 used ratios to compare successful firms in the industries to the failed firms by matching the firms according to size and date (Fitzpatrick, 1932). In the late 1960's however, Beaver amplified this research using financial ratios as predictors of financial failure with the use of 79 companies that were considered 'failed' and 'non-failed' at the time. This was done to remove the industry factor and include a 'control' environment for the failed company as he stated that the difference in industries prevents direct comparison in terms of ratios. Aside from that, he noted that larger companies were more solvent hence less likely to fail as compared to the smaller companies in the same industry (Beaver W. H., 1966). Throughout the years, numerous researchers have attempted to develop these models and continue to do so up to date. There are a few models that stand out and can be grouped in terms of methodology; 1) Statistical models, 2) Artificial Intelligence models and, 3) Hybrid variations of the mentioned models (G.H. Muller et al, 2009).

Beaver's single variable analysis is the earliest model credited with the concept that led to the formation of the statistical models. The single variable analysis was divided into profile analysis which he later followed up with the univariate discriminant analysis model (Jie Sun  $\uparrow$ , 2014). This model was an improvement as the previous profile analysis, which could only use one financial ratio at a time, which he identified to be the financial ratio – Cash flow/ Total Debt, as the best predictor of corporate bankruptcy. Therefore, the use of different ratios in the prediction models

would cause conflict in terms of conclusions for the same company. The univariate model, however, uses five traditional financial ratios as independent variables and unlike the profile analysis, this model was stronger in prediction and was lower in misjudgment as the failure date neared (Jie Sun et al., 2014). The integrated effect of any set of financial ratios or variables is lost. The univariate analysis assumed a linear proportionate relationship between the group of financial ratio variables. However, this is not always the case since a constant may play a role within the relationship between two financial variables. This technique therefore becomes an inappropriate measure and often leads to inaccurate findings hence one cannot draw accurate conclusions (Ooghe, 2006). Another limitation of this model, however, would be that this model only takes into account whether each ratio is above or below the cut-off point without looking at the distance between the ratio and the cut-off point. This is important because, the further away the ratio is from the cut-off point, the more confidence one can place on it (Jayasekera R. , 2017). Being that the model classifies firms into failed or non-failed based off of the analysis of only one ratio being below the cut-off point without considering the other ratios, ‘an inconsistency problem’ is created. However, this is not possible. This is because, even though financial ratios are important in the prediction of corporate distress, due to a company’s complexity and dynamic in nature, the use of a single ratio would not be an effective measure (Argyrou, 2006). Potential errors inherent in univariate analysis are however minimized using statistical methods.

Beaver in his suggestion for future research indicated that the use of multiple ratios analysed simultaneously may have higher predictability power. This set the pace for multivariate analysis. Altman (1968) in his research constructed the Z-score model that was based on Multiple Discriminate Analysis to discriminate between 33 failed and non-failed companies between 1946 and 1965. This model was a continuation of Beavers univariate analysis model. Similarly, Altman used the same methodology when conducting his research in terms of industry and the difference in company size. Based on popularity of past studies and the assumption of potential relevance, Altman used 22 ratios that were classified into 5 standard ratio categories, namely: liquidity, profitability, leverage, solvency and activity ratios (Jayasekera R. , 2017). The model predicted a company's financial health based on a discriminant function of the form:

*Equation 1: Altman z-score for manufacturing firms (1968)*

$$Z = 0.012X1 + 0.014X2 + 0.033X3 + 0.006X4 + 0.9995X5$$

Where;

*Z = the outcome of the MDA equation*

*X1 = Working Capital / Total Assets*

*X2 = Retained Earnings / Total Assets*

*X3 = Earnings Before Interest and tax / Total Assets*

*X4 = Market Value of Equity / Book Value of Total Liabilities*

*X5 = Sales / Total Assets*

X1 was more related to the firm size as it mainly measured the firm's liquid ratios. X2 was in relation to failure rates as it measures the firm's earning power. X3 ratio is related to the firm's long-run viability and measures the operating earnings. X4 was added to the equation to mimic the market so as to foretell any future problems related to security price changes. X5 however is the standard turnover measure thus varies from industry to industry.

He used these ratios and concluded that with a score greater than 2.99, the firm would fall into the non-bankrupt group, while the companies with a Z-Score below 1.81 were classified as bankrupt. The area between 1.81 and 2.99 is defined as the zone of ignorance or 'the grey area'. He found that its predictive power a year before bankruptcy was significantly higher than that of univariate analysis model as it was 95% compared to the univariate's 87%. Altman et al (1977) further developed the Z-score in an attempt to curb the assumption of normal distribution of financial ratios through a new model, the ZETA model. Though he was successful and achieved higher statistical significance than his previous Z-score, the practicality of the ZETA model became difficult due to its complexity (Neophytou, 2001).

The Z-score has however been revised severally over the years so as to improve it in terms of parameters, business environment conditions and to include adjustments to the globally social and economic dynamics. Therefore, in response to a model that predicts the likelihood of failure in non-manufacturing firms, Altman (Altman E. a., 2006) developed the Z'. The formula therefore became:

Equation 2: Altman z-score for non-manufacturing firms (2006)

$$Z'' = 6.56X1 + 3.26X2 + 6.72X3 + 1.05X4$$

Where;

$Z$  = the outcome of the MDA equation

$X1$  = (Current Assets – Current liabilities) / total assets

$X2$  = Retained earnings/ total assets

$X3$  = earnings before interest and taxes/ total assets

$X4$  = book value of equity / total liabilities

The ratio  $X5$  was omitted because the turnover for non-manufacturing firms was higher than for manufacturing firms. Therefore, if the previous model was to be employed to non-manufacturing firms, then the model would underpredict bankruptcy due to lower capital intensity. In the  $Z''$  model, scores from 2.6 onwards indicated that the firm was in the 'safe zone' while the range from 1.1 to 2.6 represents the 'grey zone' and the zone below 1.1 indicated financial distress.

It should also be noted that the MDA technique has a few presumptions (Edmister, 1972). To begin with, it expects that the dataset is dichotomous; which implies that the groups are discrete, non-overlapping and identifiable. Second is that the utilization of the MDA model depends on three prohibitive assumptions: (1) multivariate normally distributed independent variables, (2) equal variance-covariance matrices across the failing and non-failing group, and (3) specified prior probability of failure and misclassification costs (Joy, 1975). Albeit certain researchers have focused on the significance of the initial two prohibitive assumptions, most MDA prediction studies do not check whether the collected data fulfils the presumptions. Accordingly, the MDA demonstrating procedure is frequently applied in an improper manner and the subsequent MDA models are not appropriate for speculation (Joy, 1975). The last assumption of the model is the lack of multicollinearity. In spite of the fact that Altman and Eisenbeis (1978) brought up that multicollinearity is immaterial in MDA models, most researchers concur that extreme correlation among the independent variables may lead to false model accuracy due to unstable parameter estimates accuracy (Doumpos, 1999).

Altman's model was later adopted by Olsen (1980) who restructured the MDA model and developed the Logit Analysis model and later Zmijewski (1984) the probit analysis. The Logit Analysis Model is a linear probability model that assumes a logistic distribution to transform the dependent variable of a financial distress probability into one that is continuous making it suitable for use in a linear regression. Ohlson (1980) applied this model to study 105 bankrupt firms and 2058 non-bankrupt firms from 1970-1976 (Ohlson J. , 1980). The model was to describe the relationship between different financial situations and financial ratios. Unlike previous studies however, Ohlson (1980) derived his data from 10-K financial statement as opposed to Moody's manual as he claimed that this was an important factor in forecasting (Ohlson J. , 1980). This is because, a firm may file for bankruptcy at the end or after a fiscal year, neglecting the period prior to the release of the its financial statements leading to retrospective analysis (Ohlson J. , 1980). His focus was mainly on; the size of the firm and the measures on financial structure as well as performance which led to the incorporation of 7 ratios into the model which were: logarithm of Total Assets/GNP Price Level Index, Total Liabilities/Total Assets, Working Capital/Total Assets, Current Liabilities/Current Assets, Net Income/Total Assets, Funds from Operations/Total Liabilities, equals 1 if Net Income < 0 for the last two years and 0 otherwise and change in Net Income. The model used was:

*Equation 3: Logit model by Ohlson*

$$P(f) = 1 / [ 1 + e^{-(a_0 + a_1X_1 + a_2X_2 + \dots + a_nX_n)} ]$$

Where;

*P(f) = the probability of failure for a firm*

*a<sub>0</sub> – a<sub>n</sub> = the coefficients for each independent variable*

*X<sub>1</sub> – X<sub>n</sub> = the value of the ratio/ independent variables*

With the probability of financial distress being  $1 / (1 + e^{-y})$ . In this case, the independent variables with a negative coefficient increased the likelihood of financial distress when  $e^{-y}$  tends to zero, with the outcome that the financial distress (probability function) approaches 1/1, or 100 percent. Similarly, the independent variables with a positive coefficient reduce the probability of

financial distress (Ohlson J. , 1980).He suggested that the Logit model was more rational than the MDA model in the prediction of a company's financial distress due to the derivation from financial statements as stated above. However, it had an accuracy of 87.6% of bankrupt firms one year prior to bankruptcy as opposed to Altman's model which had an accuracy of 95% (Ohlson J. , 1980) .

Tseng and Lin (2005) proposed a quadratic interval Logit model for FDP by using a quadratic programming approach to deal with binary response variables in the logistic regression. The results indicated that the new Logit model improved the discriminate performance of the model and it also provided researchers with more information (Fang-Mei Tseng, 2005) . Recently, Serrano-Cinca and Gutiérrez-Nieto applied partial least square discriminant analysis (PLS-DA) to predicting the 2008–2011 USA banking crisis and found that results resembled linear MDA and Support Vector Machine (SVM) results. PLS-DA has the advantage that it is not affected by multicollinearity (C.Serrano-Cinco, 2013). Zmijewski's (1984) probit model was first applied to the firm failure prediction between 1972 and 1978. The probit analysis model uses the ROA (Net Income/Total Assets), Total Debt/Total Assets and Current Assets/Current Liabilities as financial ratios. The mode had an accuracy of 92.5% accuracy however, when applied in a study without matched sampling, the accuracy falls to 62.5% (Zmijewski, 1984) .

In 2004, some econometric issues with the logit model were discussed by Hillegeist, Keating, Cram and Lundsted. Beginning with, the sample bias that emerges from utilizing just one, non-randomly chosen observation per bankrupt company, as well as the models failure to incorporate time-varying changes to mirror the underlying dangers of insolvency (Hillegeist, 2004). Shumway (2001) found that these issues resulted in biasedness, inefficiency, and inconsistent coefficient estimates. To overcome these problems, he came up with the hazard model which he found to be better than the logit and the MDA models with the main difference being that the model requires that the firm specific covariates be time-varying in nature to increase efficiency (Shumway, 2001). The limitation from this model however occurs in instances where companies have long-term credit agreements with their creditors. The model does not take this into consideration and may therefore wrongfully classify a model as failed. Aside from that, both the Hazard and Logit model suffer from timing issues. This is because, according to Ohlson, the evaluation of a models predictive is relationship requires the independent variables to be available beforehand while

annual audit reports are available a year after the end of a financial year which may be too late for firms that are already at high risk of insolvency. Aside from that, being that variables are not specified, one may omit an important variable hence the model may inaccurately predict corporate distress (Nyakio, 2013).

Abdullah et al (2008) in his study compared three methodologies of identifying financially distressed companies in Malaysia these are: multiple discriminant analysis (MDA), logistic regression and hazard model. In a sample of 26 distressed and 26 non-distressed companies with a holdout sample of 20 companies, the predictions of hazard model were accurate in 94.8% and 63.9% of the total cases. On the other hand, the MDA predicted up to 80.2% and 85% accuracy while the logit model predicted up to 82.7% and 80% accuracy. However, when the holdout sample, which is a data sample that is excluded when fitting a model often used to assess the performance of the model, was included in the sample analysed, MDA had the highest accuracy rate of 85%. From his study, he found the Ratio of Debt to Total Assets as well as the Net Income Growth to be a significant variable for prediction of corporate distress amongst all the variables used regardless of the methodology one chose to utilize. While in the MDA model, the Net Income Growth was found to be a significant predictor. And the Return on Assets, used in both the logit and hazard models was found to be an important predictor (Abdullah, 2008) .

Tam (1991) in his study presented the use of Artificial Intelligence to Financial Distress prediction using Neural Networks that initiated Evaluation Algorithms, Support Vector Machines and Case-based reasoning among other models (Tam, 1991). Tang and Kiang provided evidence that these models are progressively better than the statistical models as they are not subjected to the same assumptions (Kar Yan Tam, 1992). Not long after that, the hybrid models were proposed. These models depend on fewer algorithms, with the most popular incorporating Neural Networks, Case-based thinking or the Support Vector Machines with different techniques (Jie Sun ↑, 2013).

For instance, Yam and Mitchell (2005) utilizing a hybrid Neural Network's method to anticipate corporate failure in Brazil. The models used in their examination were contrasted with statistical methods and standard Neural Network models. The outcomes recommend that the hybrid Neural Networks had greater predictability power in foreseeing firms in distress one year in advance. This

proposes for researchers, policymakers and others intrigued by early distress signs, that the hybrid Neural Networks might be a more helpful apparatus for anticipating corporate failure. The outcomes demonstrated that the most financial ratios for failure predicting in the Brazilian market are the: Return on Capital Employed, Return on Total Assets, Net Assets Turnover, Solvency and Gearing ratios (Yim, 2005).

Different parts of corporate distress have been undertaken in the Kenyan setting. Kogi (2003) did a study to develop a discriminant model by including financial ratio stability that could be utilized to anticipate corporate distress. He tried to recognize significant ratios with critical prescient capacity. His finding indicated that it was possible to foresee financial failure with up to 70% precision three years before the actual failure utilizing stability discriminant model. Kiege (1991) prior to this had developed a model anticipate financial distress among Kenyan organizations. He accomplished an accuracy level of 90% two years prior to corporate demise.

Ng'ang'a (2006) looked to investigate and uncover potential indicators of looming failures among numerous organizations in developing nations and developed a forecasting model for insurance agencies in Kenya. He determined a corporate failure prediction model using cash-flow data and numerous discriminant analysis techniques. The model yielded a general accuracy of 85% a year preceding failure thus confirming that cash-flows can be used to give clear and exact information about a company's financial health.

Taliani (2010) undertook a study on anticipating financial distress in commercial banks in Kenya. His investigation uncovered that neither the activity nor the turn-over ratios were seen to be significant in foreseeing financial trouble in commercial banks in Kenya. The model was able to attain an accuracy level of 70% and 100% in the 1<sup>st</sup> and 3<sup>rd</sup> year respectively. His findings are consistent with those of Kiragu (1991), Kiege (1991) and Nganga (2006). Bwisa (2007) in his research noted that the MDA model was relevant locally. He found the model to be relevant as the model was able to pick out 6 of 10 failed firms with 70% accuracy.

This study therefore seeks to find the validity of the Multiple Discriminate Analysis model in different industrial sectors in Kenya as most studies are often focused on narrowing down their

studies to a specific industry which in turn narrows down the implications. This will be done using 3 criteria. The first being that the company should have been listed in the Nairobi Securities Exchange. This is because listed companies greatly affect investment and the economy as a whole.

Aside from that, listed companies have access to more capital due to the involvement of the public hence should seek minimal assistance from the government. The second criteria are that the company should have previously experienced financial distress to the point that it was on the verge of failure. This is so as to show the validity of the MDA model through analysis. This is because, the MDA model should effectively predict the years leading up to failure as well as the years that the company was in distress. Finally, the last criterion is that the company should have sought assistance from the Kenyan Government as a final resort before complete failure. This is also in line with the first criteria as it shows the company had not been attractive to investors which could be due to either exogenous or endogenous problems that can assist in generating more accurate implications.

## **2.6 Brief Overview of Firms**

Below is a brief overview of the chosen firms based on the criteria as per the study.

### **2.6.1 Mumias Sugar**

Mumias Sugar Company Limited is a manufacturing company in Kenya. It was founded in 1971 by the Government of Kenya who at the time owned 71% of the shares while the Commonwealth Development Corporation owned 17%, Kenya Commercial Finance Company 5%, Booker McConnell 4% and the East African Development Bank 3% (Situma, 2015). This came at a time when the late Idi Amin, who was the then President of Uganda, closed down the Asian owned sugar plantations creating a gap in the importation of Sugar into Kenya as Uganda was the main supplier. In addition to sugar however, it also co-generates electricity and it is involved in the manufacturing of ethanol and distilled water annually (MSCL, 2012). In 2001 it listed its shares at the Nairobi Securities Exchange. In 2003, during the firms change in management, the company had a Ksh.300 million debt (Mburu, 2015). This did not change even with the firm producing its highest quantity of sugar in 2005. In 2010, there were talks of delisting as a petition had been made by the Nairobi Securities Exchange however this was declined by the Capital Markets Authority.

By 2012, when the then managing director decided to leave in pursuit of the Nairobi Gubernatorial position, the company had accumulated a debt that surpassed Ksh.1.67 billion. Its shares, which had been on a downward spiral, dropped to a whopping Ksh.1.45 (Situma, 2015).

In the same year an audit was conducted by KPMG which found irregularities by management that led to a loss of Kshs.1 billion that was hidden from the board of directors (Gibendi, 2014). This led to a restructuring which saw 52 senior management officers sent home. In 2015, the company requested a bailout that totalled Kshs.2.3 billion from the Kenyan Government with Kshs.500 being paid in advance (Andae, Mumias Suspends 52 Top Employees Over Loss of KSh400 Million, 2015). Legal proceedings were also filed against the officials who were alleged to be behind the financial and procedural irregularities. The company is however not seeing an improvement in profit or operations. In April 2020, the company was officially suspended alongside other companies like Deacons. This comes just three months after it resumed operations in January 2020 (Reporter, 2020).

### **2.6.2 Kenya Airways**

Kenya Airways Limited (coded KQ), originally East African Airways was initially founded in 1946 and served the three East African countries; Kenya, Uganda and Tanzania with its headquarters situated in Nairobi (Andae, 2020). However, the relationship between the three countries came to an end after the collapse of the East African Community thus ending East African Airways. Kenya Airways was then established in 1977 by the Government of Kenya. It became the pioneer in Africa to acquire the carrier Airbus A310-300 amongst other achievements. Discussions of its privatization began in 1986 but it was officially listed in the Nairobi Securities Exchange in 1996 with the Government of Kenya retaining 23% of the shareholding, with a public offering of 51% and KLM acquiring 26% stake ( World Airline Directory – Kenya Airways, 1998).

In 2012 rights worth Kshs.20 billion were issued to assist in raising capital for expansion purposes. This led to both the Government of Kenya and KLM increasing their stakes in the company (Andae, 2020). From 2015 to 2017 however, the company continuously recorded losses that led to the implementation of corrective measures that led to a complex agreement between shareholders. This saw the Government of Kenya increasing its stake to 48.9% while KLM saw a reduction to

7.8% while a special purpose vehicle known as KQ lenders company 2017 limited received 38.1% (Kamau, 2017). The vehicle was created by a consortium of banks. Through this arrangement, they were able to obtain a loan worth USD 225million with an additional USD 525million debt all guaranteed by the Government of Kenya (2017). In February of this year, the airline received Kshs.5 billion from the Kenyan Government to fix its aircrafts however with the Covid-19 pandemic leading to closure of the country's airspace, the airline applied for another emergency bailout loan worth Kshs.7 billion (Andae, 2020). This comes after its suspension from trading at the Nairobi Securities Exchange in April 2020 (Alushula, 2020).

### **2.6.3 Uchumi Supermarket**

Uchumi Supermarket was founded in 1975 originally as a limited liability under three companies; Industrial and Commercial Development Corporation, Kenya Wine Agencies Limited (KWAL), and Kenya National Trading Corporation. In 1976, the shareholders together with an Italian Supermarket chain, Standa SPA, came into an agreement whereby SPA would train employees on the workings of the enterprise. In 1992, Uchumi was listed on the Nairobi Securities Exchange. In 2006 however, it was delisted, and the outlet was shut down temporarily as the enterprise was struggling financially (Uchumi). The government of Kenya however came to its aid and it was able to open five of its brunches under interim management and administrator (Mwihaki, 2016).

By 2011, the enterprise had seen great profitability and was relisted on the Nairobi Securities Exchange after approval from the Capital Markets Authority (Wahome, 2011). This however did not last as in 2015 the enterprise shut down all non-Kenyan Brunches (i.e. Uganda and Tanzania) due to lack of profitability caused by mismanagement. There was a restructuring under new management (David Evans, 2015). Part of Uchumi's trouble began after senior managers started supplying most of the goods sold in the dozens of outlets owned by Uchumi (Shawiza, 2016). With senior managers doubling up as suppliers, it became difficult to separate business interest and self-interest leading to discriminatory practices when effecting payments for deliveries, often at exaggerated prices (Shawiza, 2016). The trend was investigated by the board, which indicated that it had initiated criminal proceedings against those that were found culpable (Shawiza, 2016).

It has since closed but there have been talks from the end of 2019 of Financial restructuring proposal that would see at least 6 chains gain an 18% profit by 2024. This however may not be possible as they have a debt of Kshs.4.7 billion that is to be settled within the year in an economy pegged by the Corona Virus that has caused a significant decline in the global economy.

#### **2.6.4 National Bank of Kenya**

National Bank was incorporated in 19<sup>th</sup> June, 1968 and officially began operating in November of 1968. This came three years after independence with the objective of credit provision to Kenyans in an attempt to give back control of the economy to the Kenyan citizens. At the time, it was fully owned by the Kenyan Government. It was officially listed at the Nairobi Securities Exchange in 1994 when the government reduced its shareholding by 32%. It listed 40 million worth of shares in 1996 after the Kenyan Government further reduced its shareholding by a further 32% (Kenya, n.d.). This came after a mismanagement crisis that occurred between 1991 and 1992 when National Social Security Fund (NSSF) was unable to withdraw funds that it had deposited earlier worth Kshs. 2 Billion as the bank had no money. The debt was then converted into equity leading to the NSSF becoming the largest shareholders of the Bank with 48.06% (John, 2019).

In 1998, the government paid off the bank's shareholder loan worth Kshs. 4.5 Billion. However, even with the Government's bailout, the bank did not see financial success. In 2003, the government made the decision to convert government loans and a part of the deposits made by the NSSF into preference shares in an attempt to increase the bank's capital base. This was done so as to make the government loans qualify as core capital (Kisero, 2019). There was still no improvement in the bank's financial situation. In 2006, the Government settled the banks Kshs. 20 Billion debt in form of treasury bonds. In 2013, the bank started an action of its properties due to a delay of rights issue approval by its shareholders (Kwama, 2015).

The Bank's financial situation continued to deteriorate until 2016, when there was a change in management which saw Mr. Wilfred Musau appointed as Chief Executive Officer. However, in 2019 the Central Bank of Kenya approved the banks acquisition by Kenya Commercial Bank (KCB) in an attempt to strengthen both banks in terms of leverage as the National Bank of Kenya had been operating below core capital since 2013 (Mboga, 2019).

## **2.7 Summary of Literature Review**

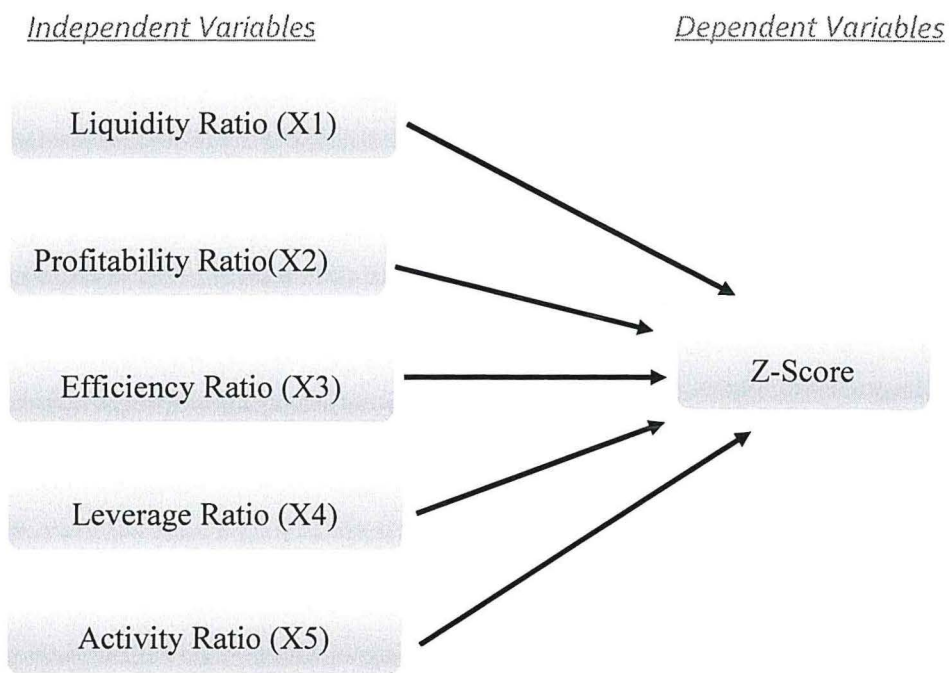
The four firms are therefore ideal for this study to determine the viability of the MDA failure prediction model. Evidently from the above literature review, there have been a number of financial distress models that have been reviewed and depict a certain level of accuracy. The biggest debate among researchers being between Logit Analysis and MDA models. However, as the Z-score is able to signal distress prior to failure as well as its simplicity in conclusion, it is notably more thoroughly tested and therefore broadly accepted. As it is a 'quick-check' model, in event of any indication of financial distress, further detailed analysis should be carried out to prevent further deterioration in the firm's financial health. Aside from that, the simple MDA models has a 90% accuracy level of predictability that can be achieved by the more complex models (Hand, 2004). This is because, the model takes into account the key financial aspects from a firm; working capital, assets, liabilities, earnings and revenue.

This study will generally highlight the various aspects of corporate financial distress to ascertain whether indeed it is possible to predict financial failure by critically analysing various financial ratios of any organization. The knowledge of this information shall be used in data collection so as to meet the objective of the study.

## **2.8 Conceptual framework**

The Conceptual framework outlines the independent and dependent variables used in the research. The independent variable in this study are; liquidity, profitability, efficiency and activity while the reliant variable is Financial distress. As indicated by Gilbert et al. (1990), Financial distress is described by negative total income over at a long period of time due poor deals ,mismanagement and general misfortune that lead to poor portrayal of the company. Further, as indicated by Outecheva (2007), financial distress is separated into four sub-stages: Decrease in capital, financial distress, inability to pay off ones obligations, and finally bankruptcy. Thusly, in this examination we will base financial distress on these definitions given previously.

Figure 1: Conceptual Framework



## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Introduction

This chapter will present the procedure that will be used to undertake this research based on the objectives cited previously. It will look into the research design, followed by a look into the population, sample size and design, the data collection methods that will be used and finally, the technique that will be used to analyse the data and findings that will be presented.

#### 3.2 Research Design

(Kinnear & Taylor, 1996; Churchill & Iacobacci 2005) define research design: “it is the blueprint that is followed to complete the study” and it “ensures that the study is relevant to the problem and will use economical procedure”. This study will use descriptive analysis to investigate the validity of the MDA model as used in Chong’s (1998) study of financial distress of Malaysian companies. Descriptive analysis is a structured study that has clearly stated objectives and makes it possible to distinguish between significant and insignificant risks (Cooper, 2001). Descriptive analysis or formal analysis is important as it enabled one to make simpler interpretation of data as the data is presented in a more meaningful way.

#### 3.3 Population, Sample and Sampling Design

The population in this study is comprised of sixty-two listed companies from the Nairobi Securities Exchange. This study will base its population on 2 groups in order to allow for proper discrimination. The groups will be classified under failed and non-failed based on the chosen review period. The firms should have been listed in the Nairobi Securities Exchange, previously experienced financial distress to the point that it was on the verge of failure or failed, and as a consequence , been bailed out by the Kenyan Government. Thus the study will be limited to only 4 (Uchumi Supermarket, Mumias Sugar Limited, National Bank of Kenya and Kenya Airways Limited) firms amongst the 62 listed on the Nairobi Securities Exchange based on the last 2 criteria. The chosen sample size is therefore 21 firms with firms in each group (failed and non-failed). The 17 non-failed companies were chosen based on asset size so as to clearly discriminate the model. The data will be collected over a period of 20 years from January 2001 to December

2019. This is to ensure that the study is able to make accurate implications based on the predictive ability of MDA each time the firms were in distress being that some of the chosen firms have 'failed' more than once within the 20 years. Aside from that, it has been stated as a limitation by previous studies that the use of a smaller time period may be a hindrance when trying to test for the validity of financial distress models while a large time period like that of the original author, Altman who used 50 years, may be redundant as his main focus was the three years before bankruptcy (Altman E. E., 1978). An average period therefore is between 20 – 30 years.

### **3.4 Data Collection Methods**

This study will primarily rely on secondary data that will be extracted from financial statement, journals, publications and financial reports published by the different firms. The data from the various findings will be analysed and compared to generate the required reports. Conclusions will be drawn from the analysis of the data and recommendations made for the way forward. The time frame will be within three months. It is prudent to note that, the most compelling interest for this research is to build on existing knowledge from the analysed sources. It provides an excellent opportunity to explore previous literature and analyse current sources to discover the gaps and plan for the future. Besides saving time and money, it will be beneficial to sum up ideas and derive conclusions from various credible secondary sources which will inform future research studies. The secondary data are in abundance and easily accessible hence there is sheer volume and breath of information that can be utilized to derive conclusions.

The data collection procedure will involve a couple of steps. One is to synthesize the purpose and research objectives. Secondly, the selection of multiple data sources such as financial statements and journals among others. The cost of the research will be covered by the researcher. The projected costs are however not high as secondary data is readily available unlike that of primary data.

### **3.5 Data Analysis**

This study will use statistical methods to analyse the data as per Altman (Altman E. , 1968; Altman E. a., 2006). Based on the assumptions made, the study will first test for multivariate normality of the independent variables. This will be followed by a test for correlation (Joy, 1975; Tuda, 2016).

The method will then use the ratio identification process that will be used to discriminate between the failed and non-failed firms. However, being that this study includes both manufacturing and non-manufacturing firms, the key MDA models will be the two methods used by Altman. First is the 1968 model (5 ratios for the manufacturing firms) for Mumias sugar company :

$$Z = a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5$$

Where;

*Z = the outcome of the MDA equation*

*a1 to a5 = the discriminant coefficients of the MDA Equation*

*X1 = Working Capital / Total Assets - It measures corporate liquidated net assets close to total capitalization*

*X2 = Retained Earnings / Total Assets - It measures accumulative profitability over time. Company's life-time is implied in this ratio. Recently-incorporated companies may show a decrease in retained profits relative to total assets, since they wouldn't have enough time to build accumulative profitability. Consequently, recently-incorporated companies oppose such analysis. Their chance to be classified as bankrupt is relatively higher than older ones, other factors being the same.*

*X3 = Earnings Before Interest and tax / Total Assets - It measures real effectiveness of corporate assets. This index was the most effective in measuring bankruptcy as per Altman(1968) study. It depends on earning power of corporate assets. Bankruptcy occurs when total liabilities exceed fair assessment of company's assets.*

*X4 = Market Value of Equity / Book Value of Total Liabilities - The measure shows us how corporate assets may reduce value. This is before liabilities exceed assets and a company became bankrupt.*

*X5 = Sales / Total Assets - It demonstrates the ability to generate sales from corporate assets. It measures management's ability to deal with competitive conditions*

Discrimination zones:

*Z" > 2.99 "Safe" zone*

*1.81 < Z" < 2.99 "Grey" zone Z"*

*Z < 1.81 "Distress" zone*

And the 2006 model for the non-manufacturing firms inclusive of Kenya airways, National Bank of Kenya and Uchumi Supermarket:

$$Z'' = a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4$$

Where;

*Z = the outcome of the MDA equation*

*a1 to a4 = are the discriminant coefficients of the MDA Equation*

*X1 = (Current Assets – Current liabilities) / total assets*

*X2 = Retained earnings/ total assets*

*X3 = earnings before interest and taxes/ total assets*

*X4 = book value of equity / total liabilities*

Discrimination zones:

*Z'' > 2.6 "Safe" zone*

*1.1 < Z'' < 2.6 "Grey" zone Z''*

*< 1.1 "Distress" zone*

This study will use Microsoft Excel in the data analysis. This is because it is a simpler statistical program that offers a wide range of graphical data analysis. The data will first be analysed, thereafter a series of charts and tables will be used to describe and present the findings.

## CHAPTER FOUR

### DATA ANALYSIS AND RESULTS

#### 4.1 INTRODUCTION

This chapter contains data collection, analysis and the results brought about by the idea of the MDA model on the chosen firms. The sample is comprised of 4 distressed firms and 17 relatively profitable firms for over a 20 year period. To have a matching sample, the profitable organizations were chosen cautiously by comparing the firm's asset size to that of the non-profitable firms all within the same industry as well as listed on the Nairobi Securities Exchange (Abdullah, 2008).

However, being that these Kenyan firms are unique in terms of being singular entities in the field i.e. Kenya Airways, most of the counter firms with the same asset size were found to be outside the Kenyan market. Once these sample firms had been identified, information from company balance sheets, Income statements and the NSE pricing data and pay articulations were gathered. The Z-score condition created was then applied on the 21 firms. In order to classify the firms into 2 distinct groups, the author utilized the profitability results from the 2001 and 2019 financial years, with those detailing losses put against those detailing profits. 0 for distressed firms, 1 for non-distressed firms where X1(working capital/total assets), X2(Retained Earning/total assets), X3(EBIT/total assets), X4(Market value of Equity/total liabilities) and X5 (sales/total assets) are the chosen variables.

Given the above, it is seen that the researcher uses ratios as the chosen variables tested over a specified time period. These ratios must be tested before carrying out the Multiple Discriminate Analysis in order to gauge their significance in the model. Therefore, in this unique circumstance, the chosen methodology thought about three explicit attributes:

##### 4.1.1 Time

At the point when Altman developed the Z-Score in 1968, he used data from organizations between 1946 and 1965. This implies that the data was at least fifty years of old. Even so, he was mainly

focused on the most recent two years before the organization announced bankruptcy. The economists anyway, utilized the Altman Z-score model created for developing business sectors like Kenya ( (Jayasekera R. , 2017). For this study, the financial ratios of the data used were chosen from the financial statements between 2001 - 2019 of firms listed in the Nairobi Securities Exchange. The decision to use data from these years is that it is the latest data present, with enough information to explain the validity of the MDA model.

#### **4.1.2 Accounting Principles**

Since the emphasis was put on organizations recorded in Nairobi Securities Exchange in Kenya, consequently, the proportions utilized were those which were viewed as markers for surveying the security of organizations inside the extent of financial study. The explanation of utilizing financial ratios in consolidating information was since viable in ratios as they are compelling apparatuses for reducing the size impact among various organizations. Along these lines, when examining the organizations, their asset sizes were not always considered for this situation as it may not always be a necessity. The financial ratios were chosen under 4 classes – liquidity, profitability, leverage and Efficiency/activity. These proportions are equivalent to Altman's that were utilized in his study.

#### **4.1.3 Test for Model Fit and Assumptions**

Being that the final model has been developed, it is of importance to research further the properties of the model. Various analysis and tests were done in this section. To start, tests on the major model's assumptions were performed. At that point, more extensive tests on the model are executed.

##### ***4.1.3.1 Test for Normality***

Before using the discriminant analysis model, it is important to test whether the variables are normally distributed. Specifically, it is sensible to make this assumption since bankruptcy models frequently violate this approach of multivariate normality (Ooghe, 2006). Analysts regularly disregard tests on these assumptions. However, in view of the need to see how well the model can perform, it is important to check for this presumption. Thus, we carry out an descriptive test of all indicators on their skewness and kurtosis. The results are as shown in the table below:

Table 1: Test for Normality on Distressed companies

	<i>X1</i>	<i>X2</i>	<i>X3</i>	<i>X4</i>	<i>X5</i>	<i>Z Score</i>
<b>Mean</b>	-0.1721477	-0.0973316	-0.0353456	0.84330434	0.15255072	-0.7327196
<b>Standard Error</b>	0.04271605	0.06046211	0.02199275	0.15459742	0.03593267	0.48180941
<b>Median</b>	-0.0309079	0.03043892	0.02610937	0.24630259	0.672350652	0.24172619
<b>Standard Deviation</b>	0.37238991	0.52709646	0.19172839	1.34774905	0.31325375	4.20031703
<b>Sample Variance</b>	0.13867424	0.27783068	0.03675977	1.8164275	0.09812791	17.6426632
<b>Kurtosis</b>	2.92297067	9.28198128	1.93656217	12.0996408	1.87390533	1.24245322
<b>Skewness</b>	-1.8019887	-2.7077973	-1.6061839	3.12379532	1.84192706	-1.2358128
<b>Range</b>	1.63960483	3.18238332	0.83717023	8.03534373	1.06756314	19.2175935
<b>Minimum</b>	-1.4246528	-2.7416684	-0.6426029	0.0139424	0	-11.93962
<b>Maximum</b>	0.21495205	0.44071495	0.19456728	8.04928613	1.06756314	7.27797376
<b>Sum</b>	-13.083225	-7.3972009	-2.6862655	64.09113	11.5938544	-55.68669
<b>Count</b>	76	76	76	76	76	76

From the above table , we can deduce that;

*X1*(Liquidity Ratio) – for distressed firms, the mean is -0.1721477 , the standard error is 0.04271605, the standard deviation is 0.37238991the skewness -1.801988694 is and the kurtosis is -1.801988694. This shows that *x1* is left skewed as it is has a value lower than 0 and platykurtic (light tailed) as it has a value lower than 3. The sample values are not spread far from the mean based on the standard deviation while it has a low population distribution from the mean based on the standard error. It is therefore not normally distributed.

*X2*( Profitability ratio) - for distressed firms, the mean is -0.097331591, the standard error is 0.060462111, the standard deviation is 0.527096464, the skewness is -2.707797256 and the kurtosis is 9.281981276. This shows that *x2* is left skewed as it is has a value lower than 0 and leptokurtic (heavy tailed) as it has a value higher than 3. The sample values are not spread relatively

far from the mean based on the standard deviation while it has a low population distribution from the mean based on the standard error. It is therefore not normally distributed.

X3(Efficiency ratio) – for distressed firms, the mean is -0.035345599, the standard error is 0.021992754, the standard deviation is 0.191728387, the skewness -1.606183892 is and the kurtosis is 1.936562166. This shows that x3 is left skewed as it has a value lower than 0 and platykurtic (light tailed) as it has a value lower than 3. The sample values are not spread far from the mean based on the standard deviation while it has a low population distribution from the mean based on the standard error. It is therefore not normally distributed.

X4(Leverage ratio) – for distressed firms, the mean is 0.843304342, the standard error is 0.154597419, the standard deviation is 1.347749048, the skewness is 3.123795318 and the kurtosis is 12.0996408. This shows that x4 is right skewed as it has a value higher than 0 and leptokurtic (heavy tailed) as it has a value higher than 3. The sample values are not spread relatively far from the mean based on the standard deviation while it has a low population distribution from the mean based on the standard error. It is therefore not normally distributed.

X5(Activity ratio) – for distressed firms, the mean is 0.152550715, the standard error is 0.03593267, the standard deviation is 0.31325375, the skewness is 1.841927063 and the kurtosis is 1.873905325. This shows that x5 is right skewed as it has a value higher than 0 and platykurtic (light tailed) as it has a value lower than 3. The sample values are not spread far from the mean based on the standard deviation while it has a low population distribution based from the mean on the standard error. It is therefore not normally distributed.

Z-score - for distressed firms, the mean is -0.732719602, the standard error is 0.481809407, the standard deviation is 4.200317033, the skewness is -1.235812832 and the kurtosis is 1.242453217. This shows that x1 is left skewed as it has a value lower than 0 and platykurtic (light tailed) as it has a value lower than 3. The sample values are not spread far from the mean based on the standard deviation while it has a low population distribution based on the standard error. It is therefore not normally distributed.

Therefore, it can be concluded that the data is not normally distributed. However this was expected as ratios are often not normally distributed

*Table 2: Test for Normality on Non-distressed companies*

	<i>X1</i>	<i>X2</i>	<i>X3</i>	<i>X4</i>	<i>X5</i>	<i>Z score</i>
<b>Mean</b>	-0.1247408	0.21933863	0.05399417	48.6455429	0.75259112	47.4726512
<b>Standard Error</b>	0.03758662	0.01542931	0.00469614	15.8188133	0.06411616	16.5865566
<b>Median</b>	0.00265682	0.15188484	0.04457697	1.27485702	0.45593975	2.39313969
<b>Standard Deviation</b>	0.64993337	0.2667977	0.08120385	273.532853	0.61831386	286.808375
<b>Sample Variance</b>	0.42241338	0.07118101	0.00659407	74820.2218	0.38231203	82259.0437
<b>Kurtosis</b>	8.79389057	-0.1986236	13.2669668	175.413214	0.18650668	177.399521
<b>Skewness</b>	-2.4408119	0.49367138	2.16710537	12.2674962	1.28957636	12.3730633
<b>Range</b>	5.02767125	1.29547402	0.8288497	4158.95175	2.12633528	4393.71
<b>Minimum</b>	-4.0046454	-0.4537501	-0.1698263	-0.7690359	0.17364984	-25.531161
<b>Maximum</b>	1.02302585	0.84172393	0.65902344	4158.18272	2.29998511	4368.17884

From the above table , we can deduce that:

X1(Liquidity Ratio) – for non-distressed firms, the mean is -0.1247408, the standard error is 0.03758662, the standard deviation is 0.64993337 the skewness - -2.4408119 is and the kurtosis is - 8.79389057. This shows that x1 is left skewed as it is has a value lower than 0 and platykurtic (light tailed) as it has a value lower than 3. The sample values are not spread far from the mean based on the standard deviation while it has a low population distribution based on the standard error. It is therefore not normally distributed.

X2(Profitability ratio) - for non-distressed firms, the mean is 0.21933863, the standard error is 0.01542931, the standard deviation is 0.2667977, the skewness is 0.49367138 and the kurtosis is -0.1986236. This shows that x2 is right skewed as it is has a value higher than 0 and platykurtic (light tailed) as it has a value lower than 3. The sample values are not spread far from the mean

based on the standard deviation while it has a low population distribution from the mean based on the standard error. It is therefore not normally distributed.

X3(Efficiency ratio) – for non-distressed firms, the mean is 0.05399417, the standard error is 0.00469614, the standard deviation is 0.08120385, the skewness 2.16710537 is and the kurtosis is 13.2669668. This shows that x3 is right skewed as it is has a value higher than 0 and leptokurtic (heavy tailed) as it has a value higher than 3. The sample values are not spread far from the mean based on the standard deviation while it has a low population distribution from the mean based on the standard error. It is therefore not normally distributed.

X4(Leverage ratio) – for non-distressed firms, the mean is 48.6455429, the standard error is 15.8188133, the standard deviation is 273.532853, the skewness is 12.2674962 and the kurtosis is 175.413214. This shows that x4 is right skewed as it is has a value higher than 0 and leptokurtic (heavy tailed) as it has a value higher than 3. The sample values are spread far from the mean based on the standard deviation while it has a high population distribution from the mean based on the standard error. It is therefore not normally distributed.

X5(Activity ratio) – for non-distressed firms, the mean is 0.75259112, the standard error is 0.06411616, the standard deviation is 0.61831386, the skewness is 1.28957636 and the kurtosis is 0.18650668. This shows that x5 is right skewed as it is has a value higher than 0 and platykurtic (light tailed) as it has a value lower than 3. The sample values are not spread far from the mean based on the standard deviation while it has a low population distribution from the mean based on the standard error. It is therefore not normally distributed.

Z-score - for non-distressed firms, the mean is 47.4726512, the standard error is 16.5865566, the standard deviation is 286.808375, the skewness is 12.3730633 and the kurtosis is 177.399521. This shows that z-score is right skewed as it is has a value higher than 0 and leptokurtic (heavy tailed) as it has a value higher than 3. The sample values are spread far from the mean based on the standard deviation while it has a high population distribution from the mean based on the standard error. It is therefore not normally distributed.

Therefore, it can be concluded that the data is not normally distributed.

### *Comparison of model of fit*

The biggest difference that can be noted is that, for the distressed firms, the variables tend to be left skewed while the non-distressed firms are seen to be right skewed.

#### *4.1.3.2 Assessing model fit*

##### *Correlation Analysis*

The test for Correlation of the variables is performed on each financial theme (for example liquidity and benefit), in order to distinguish variables that are too much correlated in the same economic theme. The table below shows the correlation matrix between the predictors:

*Table 3: Correlation for distressed firms*

	<i>X1</i>	<i>X2</i>	<i>X3</i>	<i>X4</i>	<i>X5</i>	<i>Z Score</i>
<b>X1</b>	1					
<b>X2</b>	0.405665323	1				
<b>X3</b>	0.852523861	0.36095087	1			
<b>X4</b>	0.282642707	0.082579429	0.390939395	1		
<b>X5</b>	0.323717047	0.338904566	0.26379335	0.595154176	1	
<b>Z Score</b>	0.871006352	0.613193531	0.821797425	0.426540711	0.432252791	1

The table above shows the inter-correlation of the variables and the correlation of variables with the z-score. Inter-correlation denotes the correlation of independent variables among themselves, thereby when inter-correlation is low, it means that the relationship of the variables will not have significant impact on their contribution in the formula (Tuda, 2016). In general, correlation results were relatively moderate between variables, meaning that the data covered different parts of the business without overlapping excessively. From the table, we denote that the lowest intercorrelation is between X4 (Market value of equity/Total liabilities) and all other variables with

the inert-correlation with X2(Retained earnings/Total assets) being the lowest. The highest inter-correlation is between X3(Earnings before interest and taxes/Total assets) and X1(Working capital/Total assets). However, the variables with the greatest effect on the Z-score are X1(Working capital/Total assets) ,X2 (Retained earnings/Total assets) and X3(Earnings before interest and taxes/Total assets) with the lowest being X4(Market value of equity/Total liabilities) and X5(Sales/Total assets). This shows that companies rely heavily on their assets to generate future returns. It also shows that the companies must be profitable to do so and thus must maintain higher assets in comparison to their liabilities.

Table 4: Correlation for non-distressed firms

	<i>X1</i>	<i>X2</i>	<i>X3</i>	<i>X4</i>	<i>X5</i>	<i>Z Score</i>
<b>X1</b>	1					
<b>X2</b>	0.37229864	1				
<b>X3</b>	0.14106869	0.31173737	1			
<b>X4</b>	0.05903956	0.07396604	0.14961529	1		
<b>X5</b>	0.09124958	-0.801094	0.11064816	-0.1593284	1	
<b>Z Score</b>	0.06411798	0.06244586	0.14922058	0.99873813	-0.1458378	1

From the table above, we denote that the lowest intercorrelation is between X5 (Sales/Total assets) and all other variables with the inert-correlation with X2(Retained earnings/Total assets) being the lowest. The highest inter-correlation is between X2(Retained earnings/Total assets) and X1(Working capital/Total assets). However, the variables with the greatest effect on the Z-score is X4(Market value of equity/Total liabilities) with the lowest being X5(Sales/Total assets). This shows that these companies maintain low debt to ensure profitability.

Table 5: Regression Analysis – distressed firms

<i>Regression Statistics</i>	
<b>Multiple R</b>	0.94153679
<b>R Square</b>	0.88649153
<b>Adjusted R Square</b>	0.87838378
<b>Standard Error</b>	1.46479827
<b>Observations</b>	76

The table above presents the summary of regression statistics for the distressed firms. It can be noted that R squared is 0.8865. The results demonstrates that the variation of X1, X2, X3,X4 and X5 explains the 89% variation in Altman’s Z- score while the Adjusted R Square score of 0.8784 indicates that adjustment in the number of predictor variables explains 88% of the variations in Altman’s Z score.

Table 6: Anova – distressed firms

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
<i>Regression</i>	<i>5</i>	<i>1173.00536</i>	<i>234.601072</i>	<i>109.338813</i>	<i>0.00000</i>
<i>Residual</i>	<i>70</i>	<i>150.1943781</i>	<i>2.14563397</i>		
<i>Total</i>	<i>75</i>	<i>1323.199738</i>			

To test for significance, the author used the ANOVA test so as to ensure that the chosen variables were indeed significant in assessing the z-score.

The hypothesis for the test is :

Ho: The model is jointly insignificant

H1: The model is jointly significant

Therefore, a variable is statistically significant if its significance level is less than 0.05 we will reject the null which states that the model is significant while it is less significant if the significance levels is above 0.05. The table above presents the ANOVA test. The findings show that the F test value is 109.34 and the P value (0.00000) is less than 0.05. This means that the model is acceptable and the chosen variables are jointly significant to the model.

Table 7: Summary of Coefficients

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
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<b>Intercept</b>	0.23940357	0.237560245	1.00775938	0.3170409
<b>X1</b>	6.15895453	0.922146284	6.67893439	0.0000000
<b>X2</b>	2.52023734	0.37308432	6.75514141	0.0000000
<b>X3</b>	3.77799552	1.837706908	2.05582049	0.04353105
<b>X4</b>	0.56695333	0.174974258	3.24020993	0.10182907
<b>X5</b>	-0.07311195	0.749737052	-0.0975168	0.92259469

In the output above, we can see that an increase in liquidity ratio (X1) by a unit leads to an increase in the z score by 6.16, increase in profitability ratio (X2) by a unit results in an increase in the Z-score by 2.52, an increase in Efficiency ratio (X3) by a unit results in an increase in the Z- score by 3.78, an increase in leverage ratio (X4) by a unit leads to an increase in Z-score by 0.57 while increase in Activity ratio (X5) by a unit results into a decrease in the Z-score by 0.073, centeris paribus. It can also be observed that the predictor variables of X1, X2 and X3 are significant because their p-values are below 0.05. A true relationship therefore exists between the Z-Score and the variables X1, X2 and X3 .

Table 8: Regression Analysis - non-distressed firms

<b>Regression Statistics</b>	
<b>Multiple R</b>	0.99886427
<b>R Square</b>	0.99772984
<b>Adjusted R Square</b>	0.9976911
<b>Standard Error</b>	13.7814423
<b>Observations</b>	299

The table above presents the summary of regression statistics for the non-distressed firms. It can be noted that R squared is 0.9977. The results demonstrates that the variation of X1, X2, X3, X4 and X5 explains the 99% variation in Altman's Z- score while the Adjusted R Square score of 0.9987 indicates that adjustment in the number of predictor variables explains 99% of the variations in Altman's Z score.

Table 9: Anova – non-distressed firms

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
<b>Regression</b>	<b>5</b>	<b>24457546.1</b>	<b>4891509.22</b>	<b>25754.5244</b>	<b>0.0000</b>
<b>Residual</b>	<b>293</b>	<b>55648.9485</b>	<b>189.928152</b>		
<b>Total</b>	<b>298</b>	<b>24513195</b>			

The hypothesis for the test is :

Ho: The model is jointly insignificant

H1: The model is jointly significant

Therefore, a variable is statistically significant if its significance level is 0.05 or below as we will reject the null which states that the model is significant while it is less significant if the significance levels is above 0.05. The table above presents the ANOVA test which is important in assessing the usefulness of the chosen variables in the regression. The findings show that the F test value is 25754.52 and the P value (0.00000) is less than 0.05. This means that the model is acceptable and the chosen variables are significant to the model.

Table 10: Summary of Coefficients

	<b>Coefficients</b>	<b>Standard Error</b>	<b>t Stat</b>	<b>P-value</b>
<b>Intercept</b>	0.6709469	1.21119544	0.55	0.58
<b>X1</b>	5.0294364	1.34782042	3.73	0.00
<b>X2</b>	-17.304059	3.39059562	-5.10	0.00
<b>X3</b>	13.060457	10.4912774	1.24	0.21
<b>X4</b>	1.04699982	0.00296779	352.79	0.00
<b>X5</b>	-1.7623383	1.72024218	-1.02	0.31

In the output above, we can see that an increase in liquidity ratio (X1) by one unit leads to an increase in the z score by 5.029, an increase in profitability ratio (X2) by one unit results in a decrease in the Z- score by 17.3, an increase in Efficiency ratio (X3) by one unit results in an increase in the Z- score by 13.06, an increase in leverage ratio (X4) by one unit leads to an increase in Z-score by 1.07 while increase in Activity ratio (X5) by a unit results in a decrease in the Z-score by 1.76, centeris paribus. It can also be observed that the predictor variables of X1,X2 and

X4 are significant because their p-values are 0.000. A true relationship therefore exists between the Z-Score and the variables X1,X2 and X4.

Table 11: Accuracy of Altman model on Distressed Firms.

Classification	Frequency	%Frequency
Distressed Zone	54	71%
Grey Zone	13	17%
Safe Zone	9	12%
<b>Total</b>	<b>76</b>	<b>100%</b>

Table 12: Accuracy of Altman model on Non-distressed Firms.

Classification	Frequency	Frequency %
Distressed Zone	9	4%
Grey Zone	70	32%
Safe Zone	139	64%
<b>Total</b>	<b>218</b>	<b>100%</b>

#### 4.2 Interpretation of Findings

Being that the research was also geared towards investigating the most significant ratios in different industries, a correlation test was carried out individually on the manufacturing firms and non-manufacturing firms so as to find the most effective ratios.

Below are the results:

##### a) Manufacturing Firms – Distressed Firms

	X1	X2	X3	X4	X5	Z Score
X1	1					
X2	0.93241238	1				
X3	0.97718229	0.88230674	1			
X4	0.49597214	0.3813646	0.58169967	1		
X5	0.85657696	0.71137041	0.89984122	0.73404876	1	
Z Score	0.90020333	0.81395229	0.93439073	0.81897884	0.83290655	1

Figure 2: Correlation table - manufacturing distressed firms

From the above, we conclude that the predictor variables are all highly influential to the z-score. In particular, X1 and X3 . Being that X1 and X3 are also relatively high in the combined correlation analysis, it can be assumed that the ratios with the largest impact in the manufacturing industry are the liquidity and Efficiency ratio. This indicates that manufacturing firms heavily rely on assets. In terms of investment and sales.

**b) Non-manufacturing Firms**

	X1	X2	X3	X4	Z Score
X1	1				
X2	0.24402033	1			
X3	0.8083649	0.21146116	1		
X4	0.0792363	-0.2808472	0.295546724	1	
Z Score	0.89538582	0.54554505	0.871356777	0.20169805	1

Figure 3: Correlation table - non-manufacturing distressed firms

From the above, we conclude that the predictor variables are all highly influential to the z-score. In particular, X1, X2 and X3. This is in line with the combined correlation analysis. Therefore, it can be assumed that the ratios with the largest impact in the non-manufacturing industry are the liquidity, profitability and Efficiency ratios. This indicates that non-manufacturing firms are mainly focused on investment. This is in terms of what investment the company makes, what the investments generate as well as what is invested into the company.

Further, the ANOVA test showed that the F test value was 109.34 and the P value (0.000) was less than 0.05 which means the variables are significantly related and the model is acceptable.

Finally, the predictor variables of X1 and X2 were found to be significant because their p-values are 0.000. A true association therefore exists between the Z- Score and predictor variables X1 and X2. In general the model correctly classified 64% of non-distressed firms, 4% were categorized as distressed and 32% were difficult to classify. Similarly, for distressed firms, the MDA model correctly classified 71% of them, 12% were classified in the safe zone and 17% were classified in the grey zone. It can therefore be concluded that the MDA prediction model was 64% accurate in

classifying non-distressed corporations and 71% accurate in classifying distressed firms. Thus, this model has been found reliable in predicting financial distress.

### 4.3 Summary Tables of Distressed Firms (in Millions of Kshs )

#### 4.3.1 Mumias Sugar Company

Year s	Liquidity (X1)	Profitability (X2)	Efficiency (X3)	Leverage (X4)	Activity (X5)	Z Score	Zone
2001	0.09339207	0.107978463	0.083406755	0.759885312	0.65188448	1.64564641	Distressec
2002	0.079685039	0.128608924	0.029711286	0.514059417	0.82383202	1.50516562	Distressec
2003	0.096541787	0.261804478	-0.010862337	1.323987488	0.84559965	2.08567724	Grey
2004	0.19416202	0.294522794	0.126161583	4.761588785	1.06756314	4.9851084	Safe
2005	0.214466203	0.349336702	0.194567277	8.049286132	1.0609602	7.27797376	Safe
2006	0.205357143	0.383507412	0.186994609	5.440653532	0.98197439	5.6458057	Safe
2007	0.173114039	0.440714945	0.160275237	2.885582565	0.8711085	3.95523298	Safe
2008	0.083586519	0.293506677	0.117218964	2.050577186	0.84462658	2.97216402	Grey
2009	0.076676585	0.30281529	0.080224308	2.002003765	0.67235065	2.65357408	Grey
2010	0.177048107	0.349296389	0.130522526	1.105672212	0.85185993	2.64660841	Grey
2011	0.15316909	0.339301894	0.122060664	0.852833008	0.68149459	2.25413864	Grey
2012	0.052919708	0.339890511	0.071605839	0.425873587	0.56726277	1.5978693	Distressec
2013	-0.049886372	0.262040906	-0.081482296	0.214640288	0.43831097	0.60475888	Distressec
2014	-0.266604422	0.191401774	-0.144506217	0.18945902	0.55493783	0.13922496	Distressec
2015	-0.543863948	0.044893158	-0.309106058	0.137437811	0.2710743	-1.2565704	Distressec
2016	-0.3309578	-0.087496735	-0.226521398	0.087469466	0.23454349	-0.9803748	Distressec
2017	-0.629322154	-0.363953344	-0.395624922	0.038028712	0.08683741	-2.4607157	Distressec
2018	-1.334837316	-1.472864769	-0.642602949	0.01421334	0.08763345	-5.6883314	Distressec
2019	-0.982079735	-0.918409056	-0.519113935	0.026121026	0.08723543	-4.0745235	Distressec

Table 13: Altman Z-core for Mumias Sugar Company

From the table above, it can be seen that the company began to decline steadily from 2008 and fully began to experience financial distress in 2012. This can be attributed to its overall decrease in working capital and increase in liabilities. This indicates that the company was unable to pay its short term obligations which could result in slow production and overall sales. The above table is also in line with the company history as in 2005, the highest z-score recorded in the 20 year period, the company had the highest sales recorded while in 2012, there was a change in management and the company had a debt surpassing 1.67 million which plunged the company into corporate failure.

#### 4.2.2 National Bank of Kenya

Year	Liquidity(X1)	Profitability (X2)	Efficiency (X3)	Leverage (X4)	Z Score	Zone	Classification
2001	0.020909676	-0.252563828	-0.013859687	0.226668192	-0.527426847	Distressed	0
2002	0.002427173	-0.219927867	0.015457176	0.053315604	-0.528138944	Distressed	0
2003	-0.045032602	-0.204251707	0.018982214	0.080250108	-0.734494283	Distressed	0
2004	-0.036745767	-0.160652416	0.024285808	0.096535498	-0.488372315	Distressed	0
2005	0.045887552	-0.132396268	0.026362632	0.139889132	0.198641506	Distressed	0
2006	0.060723085	-0.118733217	0.025856103	0.256722492	0.458065385	Distressed	0
2007	0.00144951	-0.062853141	0.038875743	0.183240727	0.261939514	Distressed	0
2008	-0.105719505	-0.032181001	0.042088252	0.168352889	-0.330552401	Distressed	0
2009	0.070222162	0.001050502	0.042000623	0.179322802	0.930338782	Distressed	0
2010	-0.127449314	0.033434954	0.044946441	0.217530014	-0.190982094	Distressed	0
2011	0.04015146	0.036423214	0.035593097	0.097409301	0.719004152	Distressed	0
2012	-0.016274431	0.038166689	0.017222644	0.085168671	0.221512875	Distressed	0
2013	0.089854791	0.035416397	0.019577337	0.099792986	0.933730948	Distressed	0
2014	-0.02430946	0.027442888	0.010585578	0.062506771	0.066572951	Distressed	0
2015	0.045122768	0.021595982	-0.013058036	0.041181973	0.317896205	Distressed	0
2016	-0.109763931	-0.012204914	0.000713738	0.019167873	-0.727598695	Distressed	0
2017	-0.009629299	-0.032091597	0.007144612	0.029697289	-0.086089606	Distressed	0
2018	-0.020593127	-0.042272897	-0.000740102	0.016718084	-0.256548094	Distressed	0
2019	-0.015288385	-0.048092469	-0.007994569	0.013942401	-0.292354387	Distressed	0

Table 14 :Altman Z-core for National Bank of Kenya

From the above table, it can be noted that the above bank has been in distressed for all the 20 years of the recorded period. This is attributed to the firms low cumulative profitability over time. This means that the firm had a low ability to generate income for reinvestment as well as its inability to use its assets to generate any returns. This is in line with its poor financial history that began in 1998.

### 4.2.3 Kenya Airways Limited

Years	Liquidity (X1)	Profitability (X2)	Efficiency (X3)	Leverage (X4)	Z Score	Zone	Classification
2001	0.214952049	0.216041848	0.12136007	1.156675466	4.11857114	Safe	1
2002	0.172476039	0.226544032	0.094855375	1.483739466	4.041389714	Safe	1
2003	0.071628327	0.229048263	0.058818223	0.274619546	1.882147547	Grey	1
2004	0.016683778	0.205766598	0.032340862	0.484217652	1.492656803	Grey	1
2005	-0.110898596	0.196932955	0.070869907	1.810561651	2.286680089	Grey	1
2006	-0.029851412	0.202378296	0.123153808	1.686747597	3.052254938	Safe	1
2007	0.029353191	0.200594568	0.100441597	0.562023433	2.097790492	Grey	1
2008	0.074268635	0.222417742	0.07730925	0.23588268	1.961677875	Grey	1
2009	0.145956988	0.269277217	0.083840798	0.321236055	2.711115531	Safe	1
2010	-0.026494163	0.211492649	-0.074546914	0.362169014	0.38388662	Distressed	0
2011	-0.037126517	0.234129097	0.036457694	0.179167007	0.941011808	Distressed	0
2012	0.017887997	0.255221567	0.063548125	0.099198159	1.46418246	Grey	1
2013	-0.024834694	0.261907222	0.02771464	0.110207454	0.978637808	Distressed	0
2014	-0.181242358	0.109570392	-0.088253037	0.117882314	-1.296734045	Distressed	0
2015	-0.229521651	0.067739831	-0.032699436	0.060847839	-1.430973247	Distressed	0
2016	-0.223554484	-0.086102064	-0.163196256	0.046533243	-2.776449686	Distressed	0
2017	-0.276274343	-0.268301613	-0.164750813	0.03303972	-3.726782144	Distressed	0
2018	-0.720903924	-0.350446746	-0.042716921	0.362932103	-5.713284095	Distressed	0
2019	-0.743123966	-0.444164703	-0.055535225	0.085787371	-6.534752805	Distressed	0

Table 15: Altman Z-core for Kenya Airways Limited

From the above, it can be noted that the company gradually began to decline from 2007 but fully began to experience financial distress in 2010. This is attributed to its overall decrease in working capital and increase in liabilities. This indicates that the company was unable to pay its short term obligations which could result in slow operations and overall sales. However, in 2012 there was a slight improvement which could be due to the issued rights worth Kshs.20 billion that were issued to assist in raising capital for expansion purposes. The company however continuously recorded losses even after the expansion.

### 5.3 Conclusions

The study confirms the applicability of Multiple Discriminate Analysis model as a valid tool for predicting financial distress as it correctly classified 71% of the distressed firms which is in line with the findings of Taliani (2010) and Ng'ang'a (2006). The following are the average Z-scores for the 4 main companies in the study listed on the NSE:

Table 17: Average z-score

<b>Firms</b>	<i>Mumias</i>	<i>NBK</i>	<i>KQ</i>	<i>Uchumi</i>
<b>Average Z-score</b>	1.34254909	-0.002887124	0.14423821	-4.63681867
<b>Zone</b>	<i>Distressed</i>	<i>Distressed</i>	<i>Distressed</i>	<i>Distressed</i>

The main indicator ratio based on the analyzed data, is X1 (Working capital/Total Assets), which is the liquidity ratio. The implication made is that this ratio helps stakeholders to understand how much assets are secured within the company's working capital or the amount of funds that are available to meet the company's short term financial obligations. It is possible therefore, to use this ratio in interpreting early warning signs of bankruptcy where companies are unable to pay their creditors and suppliers. As a result of this, production slows down leading to a decrease in sales. This is in line with the conclusion drawn by Deakin and Tuda (Deakin, 1972; Tuda, 2016) It is however a contrast to the observations made by Altman(1968) who found that X1 had the least impact with X3 being his top ratio. X3 is still a top indicator in this study. This ratio implies that a company must maintain the ability to utilize its profits to generate high returns. If it loses this ability, the company will face financial challenges that will lead to corporate failure

Altman(1968) argued that the probability of a company being profitable as it tends towards bankruptcy is close to impossible which was challenged in 2008 by the failure of large corporations like Enron (Mohammad, 2018). This is because as much as the company was bankrupt, it was still profitable. Thus, liquidity is a key ratio as one cannot be insolvent and have the ability to settle obligations. The third ratio that proved to have a high impact is X2(retained earnings/total assets),

this is in line with Gunthalika (2014). The implication made is that, this is an indicator of the firm's ability to generate income to reinvest rather than rely on the alternatives, debt or equity. However, this ratio has been challenged as it is said to be biased towards more established firms. It is said that firms that are just starting their operations rarely have time to generate high earnings that can be used to reinvest (Mohammad, 2018). Therefore, they will have a low x2 ratio which in turn may lead them to being wrongly classified to be in financial distress. Altman therefore argued that a firm has a higher chance of being in financial life in its startup phase than further down its corporate life.

For non-distressed firms, the financial ratio with the largest impact is the leverage ratio X4 (Market value of Equity/total liabilities). This ratio measures how much a company is exposed to debt before it goes into financial distress hence, if the value of this ratio is low, it is said to lie within an aggressive debt policy. This means that if the cost of borrowing "outweighs the return that the company generates on the debt, it could even lead to the possible bankruptcy" (Chieng, 2013).

From the summary tables of distressed firms, it is noted that the main indicator ratios of financial distress are the liquidity ratio, the efficiency ratio and the profitability ratio. For manufacturing companies, represented in this study by Mumias, the two main ratios are X1 and X3 which are the liquidity and efficiency ratio respectively. For the banking industry, represented by NBK, the main indicator is X2 is the profitability ratio. For the two commercial and services industry companies, represented by Uchumi and Kenya Airways, the two main ratios are X1 and X3 which are the liquidity and efficiency respectively. The implication made is that a decrease in working capital, an increase in liabilities, a low ability to generate income for reinvestment or an inability to utilize assets to generate any returns leads to an increased chance of a company being classified as 'undergoing financial distress'.

#### **5.4 Limitations of the Study**

The first limitation is the study's use of four companies as a sample representation of the larger population of the different industries. The study being limited to these four companies could result in inconclusive results in terms of reflecting the true validity of the Altman model as well as reflecting the true nature of the ratios that are key in each industry.

Another limitation would be the study's use of international companies as the more profitable firms due to the lack of similar companies in Kenya. This may have led to disparities in the choice of ratio importance to the industries. As the more profitable firms mainly focused on x4 (leverage ratio) whose main focus is on the company's market value. This study relied majorly on quantitative data. In reality other non-quantifiable circumstances could lead to financial distress and failure such as political unrest, poor management and high competition in the market among others. Another limitation of this study is that it only focused on one statistical model (MDA) to predicting financial distress. However, comparative analysis can be done using other statistical models such as logit, probit and hazard models to determine the best predictor models for financial distress and bankruptcy.

## **5.5 Recommendations**

### **5.5.1 Policy Recommendations**

The outcome of this study suggests that stakeholders in a firm can predict failure before it occurs by paying close attention to liquidity, profitability and Efficiency ratios. This will enable stakeholders in a firm avoid the losses associated with failures by taking appropriate actions in advance. The stakeholders however should not stop there but should further seek other distress models to look into the cause of distress as the MDA model acts simply as an indicator. As a financial distress company cannot successfully recover based on one single strategy but through a combined number of restructuring factors.

The CMA should exercise its mandate and ban companies that are going through prolonged financial distress in order to protect investors so as to avoid incidences like that of Mumias whereby public investors lost thousands of shillings due to the delisting of the company which would have been prevented had such accountability measures been exercised. According to Omoro (2015), "it is disappointing to see firms that once faced financial distress being relisted at the NSE." The government should also put in place policies that can effectively monitor companies that they have bailed out to avoid their repeated failure such as that of the companies in this study. This is because, from the history of this companies, they are bound to fail even after financial assistance from the government. This therefore becomes a waste of financial resources by the government in

the wake of a developing economy where monetary resources are scarce as they are being utilized to develop different sectors in the economy so as to improve the citizens' standards of living.

### **5.5.2 Suggestions for Further Research**

The following are suggestions for any future research based on the perception made from this research:

More studies based on financial distress should be conducted on different industries. It has been noted that most studies focus on one industry such as the banking industry or one company such as Uchumi which limits the impact that the model could make if proven to be valid in different industries. Most financial distress prediction studies have focused on quantitative financial data. A major drawback of financial data is that it is susceptible to manipulation by management. Therefore, one of the solutions is to base studies on qualitative factors such as firm size, age of the company, management characteristics and government's influence.

It has been noted that most studies carry out the analysis based on a period that ranges from an average of two to five years due to lack of time, financial resources or lack of data. However, studies on financial distress would be more credible, and conclusive if the period of study was increased.

Further research can be done to investigate the applicability of other statistical models such as logit, probit and hazard analysis in forecasting financial distress in State Corporations. Non-statistical financial distress prediction models such as chaos theory can also be used to determine the best predictor model of financial distress. There is also a need to further explore the Altman's Z score, and its alternative formulas, as it is necessary to refine this potentially useful tool in order to develop a predictive collection of tools that are useful in predicting not only bankruptcy, but financial distress in a variety of firms in a variety of contexts in due time to correct the company's health before its demise.

Aside from that, most studies have majorly focused on publicly listed companies, a suggestion therefore would be to research on State Corporations as there is little research on the same. It would

also be useful for future authors to study non-distressed firms as most studies by Kenyan researchers often ignore this process which goes against the model which is based on discriminative analysis.

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