



**UNIVERSITY OF GOTHENBURG**  
**SCHOOL OF BUSINESS, ECONOMICS AND LAW**

Master's Degree Project in Accounting and Financial Management

Spring 2022

*Using the advanced methods of financial analysis to  
predict the bankruptcy of companies*

**Authors**

Ahmad Haitham Meslemani

Pai Peng

**Supervisor**

Gert Sandahl

## **Acknowledgments**

First, We thank God Almighty, who enabled us to successfully complete this thesis.

We would like to thank examiner Dr. Ted Lindblom, supervisor Dr. Gert Sandal for his endless support and valuable guidance. Also, we would like to thank Dr. Tylan Mavrok for his observations which contributed to the continued development of this thesis.

We will never forget to acknowledge the moral support given to us by our beloved parents, beloved family, for their always encouraging.

We hope that this thesis will be a guide for future academics in the field of bankruptcy forecasting and a source of inspiration for further studies.

University of Gothenburg  
School of Business, Economics and Law  
Gothenburg, 26th of May 2022

-----  
Ahmad Haitham Meslemani

-----  
Pai Peng

**Abstract:**

Due to the increase in corporate bankruptcy cases worldwide, the need has increased to find a way to protect companies from bankruptcy by finding a scientific model that enables business owners to predict it before it occurs. Therefore, the interest in predicting bankruptcy has recently become one of the most critical topics in accounting, finance, and finance.

This study aims to find the best ways to predict bankruptcy using advanced financial analysis methods. In order to achieve this purpose, the study methodology relied on the use of quantitative analysis methods first, then qualitative analysis methods, and then the combination of quantitative and qualitative methods, in addition to using business evaluation methods, sensitivity analyzing methods, and a credit health panel.

The study began by testing the most critical previous predicting models based on the latest financial data from three years before bankruptcy occurred to ensure that it is still influential today. Then the study established a comprehensive model that could use for all kinds of companies and business sectors in one model. The new model proved that it has a high ability to predict up to 72%. Non-quantitative methods are also used to analyze the annual reports and the CEO's letters to the shareholders. Finally, quantitative, and non-quantitative methods merged into the comprehensive model. Sensitivity analyses proved that the merge increased the model's predictive efficiency to 89%.

This study will increase the ability of companies to protect themselves from bankruptcy by providing them with a modern model for early prediction of bankruptcy before it occurs. In addition, the recommendations resulting from the study will help companies discover weaknesses in their financial structure and fix them before reaching the final stage of bankruptcy.

**Keywords:**

Bankruptcy, predict financial analysis, Corporate evaluation, credit risk management, financial ratio, Failure determinants.

# Contents

1. Introduction .....	1
1.1 Background .....	1
1.2 Problem and Research Question.....	2
1.3 Contribution of the study.....	4
1.4 Importance of the study .....	5
2. Framework of the Study .....	6
2.1 Terms Definitions .....	6
2.2 Review the previous studies and Hypotheses Development.....	6
3. Methodology .....	11
3.1 The Selection of Study Sample .....	12
3.2 Variable selection and definitions .....	16
4. Analyzing and Discussing .....	18
4.1 Analyzing using Quantitative Methods .....	18
4.1.1 Principal Components Analyzing, Eigenvalues, Proportion of variance.....	18
4.1.2 Kaiser-Meyer-Olkin Measure (KMO Test).....	20
4.1.3 Descriptive group Statistics.....	21
4.1.4 Heteroscedasticity, White test, Robust standard errors: .....	21
4.1.5 Analyzing using Cash Flow Ratios .....	23
4.1.6 Altman Z-Score Model Test.....	27
4.1.7 Zmijewski Model Test:.....	32
4.1.8 Springate Model Test.....	38
4.1.9 Grover Model Test.....	43
4.1.10 Meslemani-2022 Model.....	48
4.1.11 Business evaluations Methods.....	52
4.1.12 Sensitivity Analysis Using Tornado Diagram. ....	53
4.1.13 Credit Health Panel (CHP).....	56
4.2 Analyzing using non-quantitative Method.....	59
4.3 Merging Quantitative & Non-Quantitative Methods.....	67
5. The Results of this study .....	70
6. The limitations that this study faced .....	74
7. Recommendations of this Study.....	75
8. Suggestions for subsequent relevant studies .....	77
9. The Conclusion .....	78
10.References .....	79
11.Appendix .....	85
A.1 List of tables.....	85
A.2 Terms Definitions.....	86

# 1. Introduction

---

*The introduction section will provide a brief background about bankruptcy prediction. The section on the problem area will analyze more deeply what is a problem area in the subject of bankruptcy prediction. The Contribution of the study will analyze the added values that this study added to the subject of bankruptcy, predicting more than previous studies; then, before ending the introduction section, it will discuss the importance of the study by presenting real examples from Sweden's statistical studies.*

---

## 1.1 Background

At the beginning of the sixties of the last century, it became apparent to those interested in investment analysis, credit evaluation, and risk analysis that classical analysis using financial ratios could no longer meet their needs. As a result, two main trends have emerged. The first trends consider that the academics will altogether dispense with the classic method of analysis using traditional financial ratios. In contrast, another trend has emerged that calls for bridging the gap instead of severing the links between traditional ratio analysis and analysis methods that rely on advanced analysis methods.

Business failure has been widely studied, especially after the recent world financial crises, as more firms seem to fail now more than ever, so bankruptcy prediction is of increasing importance (Qi Yuan 2013). “Bankruptcy prediction has always been one of the most critical and challenging tasks in finance and accounting” (Evangelos 2021, Pg 166). Predicting corporate bankruptcy is one of the topics that began to appear in the thirties of the last century. Earlier. This topic was not attractive due to its limited effects on the economy. However, it has become more attractive recently, increasing significantly due to the increase in corporate bankruptcies worldwide, which led to economic crises and losses amounting to billions of dollars that affected investors, banks, and public and private bodies. The whole economy, in general, exceeded the local economy's limits, forming global economic crises that crossed continents.

The banking industry sector is the primary supplier of facilities in the economy; he is interested in minimizing the amount of non-performing loans to maximize profit on credit activity; at the same time, banks are interested in reducing their risk of default. Other interests for bankers are capital adequacy and the internal ratings-based approach encouraged by the Basel Accords. Nowadays, many users such as bank managers, investors in the capital

market, and asset managers depend on Bankruptcy prediction models and consider them valuable tools. Users such as investors and asset managers need trusty tools to select appropriate companies for their portfolios.

## **1.2 Problem and Research Question**

The main problem area of this study is that previous models on bankruptcy prediction were old, complex, and challenging for non-specialists to understand. In addition to that, it is unknown if the previous models are still valid until now or not. Due to that, the previous research and models were not helpful to business owners in decision-making. So, the new investors were refraining from investing because they did not have an adequate early warning to signal them about a suitable time for withdrawing from companies before their bankruptcy and saving their rights and money from loss.

At the same time, some companies use financial fraud as a cover-up. For example, WorldCom and Enron seem to be doing very well financially on the surface. However, they rely on financial fraud to whitewash them, such as fake accounts. In 2002 WorldCom, the second-largest long-distance telephone company, like Enron, filed for bankruptcy in New York federal court. The WorldCom bankruptcy filing was a desperate decision after the company's share price plunged to less than USD 1 in the wake of an accounting scandal a month ago. At the time, WorldCom admitted it had mistakenly treated USD 3.85 billion in overheads as a capital expenditure, giving the impression that WorldCom was profitable. Then came the news that WorldCom had misreported another USD 3.3 billion in revenue (Akhigbe et al.,2005, p.48-64) Under heavy pressure from falling stock prices, WorldCom, a significant global telecommunications company with more than 20 million customers, thousands of enterprise customers, and 80,000 employees, has been forced to file for bankruptcy. According to Gil Sadka, WorldCom has used various means to increase its operating income, including the trick of adding stored money to its operating income(Gil Sadka,2006,p 439-475). The WorldCom spurious accounting scandals spread one after another, seriously damaging investor confidence and causing violent shocks to the capital market. In addition to financial fraud, there are other signs of bankruptcy that show up in the financial statements, which will be discussed in detail in 4.2.

So, what are the signs in companies' financial statements before they go bankrupt?

How can the bankruptcy of these companies be expected and detected before it occurs?  
How do we learn from it and avoid falling into the quagmire of bankruptcy?

The fact that no effective practical tools to predict bankruptcy, or in other words, a means of early warning of bankruptcy, led to the loss of shareholders' rights and the loss of their money and led to economic losses at the individual level and the level of the economy as a whole. On the other hand, there is the fact of the development of fraud and financial embezzlement methods that have led to the recurrence of corporate bankruptcies worldwide.

Previous studies have provided complex models for predicting bankruptcy. The complexity of previous models made them difficult to apply; Another gap in the previous studies, in addition to the complexity, is that each model needs special conditions for its application in terms of the type of companies and their economic activity. The inability of previous models to predict bankruptcy effectively based on a mixed sample of American and non-US companies, industrial and non-industrial, makes the efficiency of these models limited and limited to the scope of certain conditions, which constitutes the main incentive for this study towards developing a comprehensive model that unifies all those previous models in One model can predict bankruptcy with high efficiency, regardless of the type of company, whether public or private, industrial or non-industrial, American or non-American.

Accurate financial reports can help predict the company's financial status to help investors avoid risks. However, in the past, financial analysts relied on the simple individual use of financial analysis ratios in the forecasting process. They considered that this method was sufficient to predict the bankruptcy of companies since bankruptcies were limited. It was easy to predict their occurrence by analyzing the annual financial statements of companies listed in the markets (Platt, 1990). Investigations into the most recently discovered corporate bankruptcies have shown that the bankruptcy resulted from a complex series of financial manipulations by a group of people in ways that are difficult to detect or predict using rudimentary financial analysis methods (Andi Silvana, 2020,Pg 122-127). The recent increase in corporate bankruptcy cases and the advanced and organized methods used and causing bankruptcy were reflected in the increased interest of universities and research centers in this subject and in forcing researchers in the field of accounting and financial management. To develop advanced methods that could use in the early prediction of bankruptcy to predict early insolvency of companies. These efforts finally succeed in

creating advanced methods that have a remarkable ability to predict, depending on advanced methods in financial data analysis, financial ratios, forecasting, and business valuation science (Edward I, Małgorzata, Erkki, Arto 2017). The most crucial model was developed by (Altman) and is known as (Z. Model).

In summary, there is a tangible increase in bankruptcy cases using complex methods of embezzlement and financial fraud that result in the loss of shareholders' rights and catastrophic damage to the economy. On the other hand, there is a development in early forecasting methods to detect bankruptcy before it occurs, and accordingly, we ask the following research question:

***How could the advanced methods of financial analysis and Corporate relative evaluation be used to predict the bankruptcy of listed companies?***

The variables used in this study consist of 40 variables, divided into ten groups as follows: Seven variables for Cash Flow model analysis, five variables for Altman model, three variables for Zmijewski model, four variables for Springate model, four variables for Grover model, five variables for Liquidity, five variables for Solvency, two variables for Leverage, four variables for Profitability, two variables for Efficiency.

The complete list of variables with their definitions will present later in section 3.2 of this study.

### **1.3 Contribution of the study**

This study will add five significant contributions to the bankruptcy prediction literature:

First, the study will conduct a test to measure the efficiency of the forecasting method using cash flow ratios and whether it is still effective up to the present time. Second, this study will conduct a more comprehensive examination of the performance of previous core models for predicting bankruptcy, compare their performance in one study, and ensure that they remain adequate. Third, this study will test new methods for predicting bankruptcy, including qualitative factors, business valuation methods, sensitivity analysis, and a credit health panel. Fourth, this study will cover the gap in previous models and design and test a new comprehensive model capable of predicting the bankruptcy of public and private companies, industrial and non-industrial, US and non-US. This model will be more efficient than all previous models. Five: this study will merge quantitative and non-quantitative methods into one model, enhancing our ability to predict.

## 1.4 Importance of the study

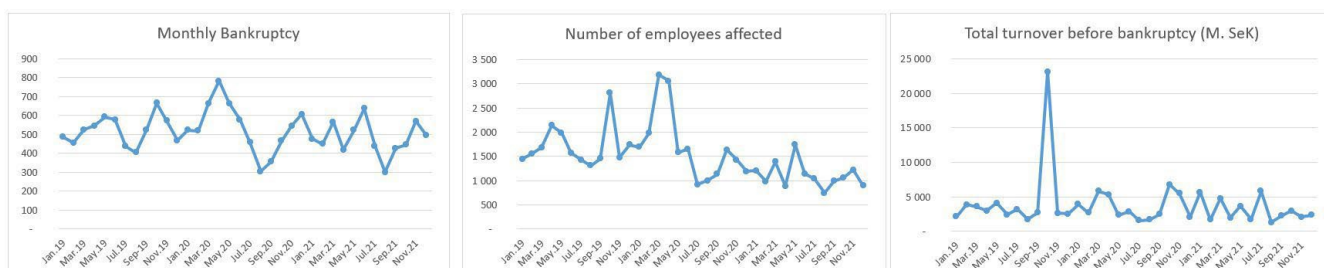
“Bankruptcy prediction , acts as an important role in decision-making of various areas, including: accounting, finance, business ”(Sun, Jie 2014, Pg 41-56).

Moreover, the need is increasing to have a reliable tool to predict Bankruptcy. Early prediction of financial distress, corporate failure, or Bankruptcy is a vital research field for corporate finance (Sun, Jie 2014, Pg 41-56). Bankruptcy prediction predicts whether or not a company will fall into financial distress based on the current financial data (Sun, Jie 2014, , Pg 41-56). Banks and insurance companies need to have an effective bankruptcy forecasting tool to help them decide before granting new loans or signing new insurance contracts for companies. So new loans are issued, or insurance contracts renewed for companies that appear to have good financial solvency only.

In contrast, no loans or insurance contracts will be issued to companies that expect to go into Bankruptcy or financial failure because the risks, in this case, will be much higher than the expected returns to be obtained from these contracts. That could help protect investors, banks, and government and private agencies from the adverse effects of default and the resulting economic crises whose products may extend. Outside the borders and turn into global financial crises. According to the Swedish government credit report site (kreditrapporten.se), The number of companies that went into bankrupt during the years 2019-2020-2021 is 18 463 companies, the number of employees affected is 54 359, Total turnover before bankruptcy 134 006 (Million SEK)

**Table1:** Monthly bankrupt cases of Swedish companies during the last 3 years

<b>Sweden companies that went bankrupt during 2019-2020-2021</b>				
	<b><u>2019</u></b>	<b><u>2020</u></b>	<b><u>2021</u></b>	<b><u>Total</u></b>
Monthly Bankruptcy cases	6 252	6 464	5 747	18 463
Number of employees affected	20 601	20 455	13 303	54 359
Total turnover before bankruptcy (M. SeK)	54 939	42 877	36 189	134 006
Source: kreditrapporten.se				



## 2. Framework of the Study

---

*Theoretical Section by providing a deep Motivating for the study and setting its research question. Theoretical Section will provide definitions of all terms used in the study to enable the reader to understand this study smoothly. Then will move to review the previous studies related to the prediction of bankruptcy, which will be the base of Hypotheses Development. The end of the theoretical Section will provide a deep Motivating for the study and set its research question.*

---

### 2.1 Terms Definitions

Several scientific terms related to the field of bankruptcy prediction have been used in this study. Definitions for all of these terms are provided in the Index section. Therefore, the author recommends reading the definitions of the terms first in order to gain a complete and deep understanding of the content of this study.

### 2.2 Review the previous studies and Hypotheses Development

During the last 50 years, an impressive number of theoretical and empirical research have written about predicting bankruptcy (Evangelos, 2021,Pg 166-180), attempting to provide a valuable solution for the problem. So, a review of previous literature and studies could help us understand the ongoing development in this field.

- Reviewing previous literature and studies related to using Cash Flow Ratios and other financial ratios in predicting bankruptcy:

The detection of a company operating, and financial difficulties is a subject that has been particularly amenable to analysis with financial ratios (Altman, 2000). Academics argue that financial ratios are assumed to be powerful prediction models for assessing a firm's financial distress (Azdanfar,2008). The accounting net profit of listed companies recorded in their financial statements does not reflect their financial status fairly. However, the cash flow ratios can provide a clearer picture of the company's potential to use operating cash flow to pay its obligations. It makes the operating cash flow ratio interesting.

Moreover, the cash flow ratio could predict a company's bankruptcy (M. Sienly, 2020, Pg 114-120). Similarly, (Suwaidan M., 2003) researched The Ratio Model Versus the Cash Flow Model And The Prediction of Bankruptcy. He concluded that the Total Assets Return on Operating cash flow could be used to distinguish between insolvent and non-bankrupt companies. (Alostaz, A.O 2015) wrote research about Predicting Corporate Failure Using Cash Flow Statements. According to this study, the ratio of Cash current debt coverage, Cash interest coverage, operating cash flow margins, and earnings quality can predict bankruptcy in the industrial, insurance, investment, and services sectors. (Jones, S.2016) conducted a study using Cash Flow-Based Model. His study aims to predict Bankruptcy in Australian companies. His study focused on the ratio of total assets return on operating cash flow, and the earnings quality ratio is an optimistic estimate of the company's bankruptcy. The main conclusion of his study is that the higher the value of the ratio, the higher the possibility that the company will not go bankrupt or reduce the likelihood of the company going bankrupt.

No agreement about what information is required to build a bankruptcy prediction model. However, according to previous studies, the essential information for building a bankruptcy prediction model includes the following indices for example:

(Liquidity, solvency, leverage, profitability, asset composition, firm size, growth), cash flow information, and other information on macroeconomic, industry specific, location or spatial and firm specific variables (Qi Yuan, 2013).

The author argues that cash flow ratios are no less important than financial ratios based on accrual accounting. In his opinion about the importance of cash flow ratios, the author relies on an analysis of the reasons for the bankruptcy of the largest American companies based on the size of their assets at the time of bankruptcy. The author found that the common reason for the bankruptcy of the most prominent American companies is the lack of liquidity, which led to their inability to pay their debts or finance their operations, even though the value of their assets on the date of bankruptcy amounted to billions of dollars. The most important examples of these cases are Chrysler Corporation declared bankruptcy in 2009 due to its inability to pay its debts. However, the value of its assets on the date of bankruptcy amounted to 39 billion dollars. MF Global went bankrupt in 2011 due to a debt crisis, although the value of its assets on the date of bankruptcy was 41 billion dollars. CIT Group went bankrupt in 2009 due to a credit crisis, despite having assets of \$71 billion on the date of bankruptcy.

Its assets amounted to \$82 billion at the date of bankruptcy.

(M. Sienly 2020) has used cash flow ratios on a sample of public industrial companies. The research aims to establish a model to predict bankruptcy using the logistic regression method in data analysis. The research results showed that cash flow ratios with operating cash flow margin are considered the most useful in Predicting financial difficulty. (Evangelos 2021,Pg 166-180) created a bankruptcy prediction model consisting of a set of three variables: the quick ratio, cash-flow coverage interest rate, and the economic value added (EVA) ratio, and by using multivariate discriminant analysis (MDA) to analyse the data of this study sample which consist of a group of industrial companies, The study proved that a combination of the three financial ratios achieved a high degree of accuracy in predicting bankruptcy even three years before the bankruptcy. (Joseph 1980,Pg 1001-1016) conducted a study that relied on financial ratios to compare and analyse the characteristics of risks and returns for a sample of bankrupt companies against a similar sample of non-bankrupt companies based on the analysis of capital market data. The study concluded that systemic risks could not be considered a valuable indicator for predicting the bankruptcy of listed companies or the decline in the solvency status of companies over time. (Ramo and Walter 2010,Pg9-29) conducted a study on the use of financial analysis methods in predicting the failure of industrial contribution

companies by using financial ratios predicting the failure of companies. (Bhandari & others, 2013,Pg667-676) conduct a study titled "Predicting business failure using cash flow statement- based measures." His study aims to build a model to predict bankruptcy using cash flow statement- based measures, discriminant analysis techniques, and a data matrix consisting of 100 firms and seven predictor variables. The model classified 83.3 % of original grouped cases correctly.

By reviewing the above previous studies, the first hypothesis of this study has been formulated:

***H1: Cash Flow Ratios are still considered a good tool for predicting the probability of companies' bankruptcy till now.***

- Reviewing previous literature and studies related to use the Altman , Zmijewski , Springate , and Grover Model in predicting bankruptcy:

Altman was the first academic to use multivariate discrimination analysis (MDA) to build a Z-Score bankruptcy prediction model for public industrial companies. He used a sample of 66

American industrial companies had used to build the model. The sample had divided into two groups. The first group included the companies that submitted Already filed for bankruptcy under Chapter 10 of the US National Bankruptcy Law. Heterogeneous companies in terms of the value of assets or the industries they operate. Companies with an asset value lower than one million dollars had excluded from the study sample or small companies for which complete financial data was unavailable.

In contrast, The second group consists of healthy and non-bankrupt companies; as a result of his study, he found that the model, if used correctly, can predict corporate problems early enough to enable management to avoid bankruptcy. (Gerantonis et al. 2009) conducted a study whose purpose was to examine the effectiveness of the Altman Z-Score model in predicting the bankruptcy of companies for three years before the date of the actual bankruptcy. He found that Altman classical Z-Score model correctly predicts up to 66% of actual bankruptcies one year before bankruptcy (t-1), 52% of bankruptcies two years before the date of actual bankruptcy (t-2), and only 39% of bankruptcies three years before the bankruptcy date Actual (t-3). Altman's original Z-Score model relied on the company's market value as one of the model variables, and for this reason, it is only applicable to public companies. Later, Altman re-estimated the model and replaced the book value of the shares with the market value in X4. Where  $X4 = \frac{\text{book value of equity}}{\text{value The book value of the total liabilities}}$ , with the other variables remaining unchanged as they are in the original Altman model. Finally, Altman considered that the modifications he later made to the original model were not scientifically valid.

Later, many studies depended on Altman's classic Z-Score model. Those studies depended on samples of a group of companies selected from a specific country. As Altman (2000) and Bhandari and Iyer (2013), all of these studies used samples from US firms, and Almamy et al. (2016) Based on companies from the United Kingdom. Other studies have emerged depending on companies from a specific industry, such as Bhunia et al. (2011) and Panigrahi (2019), used retail companies. (Andi Silvana 2020) studied Financial Statement Ratio Analysis to Predict Bankruptcy on Companies Registered in BEI -Jakarta using Altman Z-Score and Zmijewski. The goal of this study was to get accurate information about predicting bankruptcy of companies, especially those factors related directly to financial distress.

(S. Balcaen, H. Ooghe) he did a 35-year study on the causes of business failure based on classical statistical methods. Although his study contributed to the literature by highlighting the importance of using statistical methods and their problems, the recent increased focus on

the use of advanced intelligence methods at the expense of statistical methods has diminished the importance of this study. (Wu, Gaunt, Gray, 2010, Pg 34-45) conducted a study in which he examined the empirical performance of a group of bankruptcy prediction models, including the Zmijewski model, using a series of performance measures inside and outside the sample. The result of the study found that the primary accounting information related to profitability, liquidity, and financial leverage is the most Concerning in predicting bankruptcy. The study also found that several other variables help predict bankruptcies, including whether the delayed stock returns are significant and negative or the delayed volatility is relatively high.

By reviewing above previous studies, second hypothesis of this study has been formulated:

***H2: Altman, Zmijewski, Springate, and Grover models are still considered a good tool for predicting the probability of companies' bankruptcy till now.***

### 3. Methodology

---

*The Methodology Section will start by explaining the methodology that used in this study and motivating it, then will move to explain the steps of selection of the multi-samples of the study in detail as well as the resources of data collection, At the end of the methodology section, it will provide a full list of all variables that will use for each model in this study and their definitions.*

---

The methodology used in this study relied on quantitative methods that depended on discriminatory analysis. Multiple differentiation analysis (MDA) is considered by many academics, such as Altman, Taffler, and others, as the best approach for developing and testing the efficiency of bankruptcy prediction models. Accordingly, this method was applied for up to three years prior to the actual bankruptcy date during this study. Also, An almost versatile statistical method had used to classify observations into two or more groups or categories (alchemer.com).

This study also combined univariate and multivariate approaches to calculating the value of the variables that can distinguish between failed and healthy companies during the approaching bankruptcy period. The actual bankruptcy year has a symbol. One year before bankruptcy, T-1. Two years before the bankruptcy of T-2. Three years before the T-3 bankruptcy. Each sample used in this study included two groups of companies, bankrupt companies, and healthy companies. We already know the actual situation of these companies based on their annual financial statements collected up to three years before actual bankruptcy occurred; then, we applied bankruptcy prediction models to them and tested the results. The study examined whether the models succeeded in predicting bankruptcy in the future. Moreover, based on analyzing the results of each model and measuring the number of cases that he succeeded in predicting, we determined the degree of efficiency of each model And the best period in which he can give a warning sign of bankruptcy before it occurs.

This study began by testing the ratios of cash flows before moving on and testing other models. Finally, this study design and test a new comprehensive model for predicting bankruptcy which is able to work under all conditions. The tests began with US public manufacturers before extending the test samples and including other non-US companies. The new model had succeeded in merging quantitative and non-quantitative methods in the same model, which increased the model's prediction level. The result obtained after merging was tested by using the sensitivity analysis method.

In addition to the primary methodology used in this study relying on quantitative methods, secondary techniques were used too , such as business evaluation methods, sensitivity analysis using Tornado chart, credit health panel, and finally, analysis using non-quantitative factors that may lead to bankruptcy.

The final methodology used in this study depends on merging quantitative and non-quantitative methods in one model. This merging enhances the prediction level of the model.

### **3.1 The Selection of Study Sample**

The sample of the study was carefully selected and ensured that it met the conditions required for the success of the bankruptcy prediction models tested in this study to achieve a highly accurate result representing the ability of those models to predict realistically.

The American business environment was chosen as the basis for the formation of the study samples for several reasons: because the American business environment contains a great diversity in terms of the number of bankrupt companies, the distribution of these companies in multiple industries, as well as the abundance of data on bankrupt American companies. These reasons made the US business environment more favorable than others for the selection of the primary study sample.

The study period was chosen to cover before and after the last global financial crisis so that the results of the study would be more realistic and far from bias due to the repercussions of the crisis, so the period from 1997 to 2022 was chosen.

The composition of the study samples passed through several stages as follows:

(1): using data from Standard & Poor's, a comprehensive survey of the business records of US companies that were active in all industries and that went bankrupt from 1997 to 2022 was conducted.

(2): Since the number of bankrupt American companies in all industries during the mentioned period was so large that it is not possible to include and analyze all companies in them during this study, the author decided to focus on one industry.

(3): The selection was made at random for one industry, namely metals and manufacturing industries. Data was collected from Profit Guard database. According to its website " Profit

Guard is the leading provider of credit information to the Industrial Sector in North America and is the only company with a metal and manufacturing industry-specific database of bankruptcy filings”. ([www.eprofitguard.com](http://www.eprofitguard.com)).so that all the companies that were active in this field and then went bankrupt during the period from 1997 to 2022 were surveyed. As a result of the survey, we got an initial sample of bankrupt companies that included 678 bankrupt companies, classified under 31 causes of bankruptcy and distributed over 25 years according to years bankruptcy.

(Table 2: US companies active in the metals and manufacturing industries went bankrupt from 1997-to 2022).

**Table.2:** Initial sample of USA Bankrupt Companies which was active in metal and manufacturing industry over the period 1997-2022 classified based on the reason of Bankrupt

Bankrupt Reason	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Grand Total
Assignment for the Benefit of Creditors					1											1					1	1					4
Bank Foreclosure																					1						1
Bankruptcy and Insolvency																1											1
BIA																					1				1		2
CCAA					1		1	1			3	4	1	1	2	3		1					1	1			20
CCAA/Chapter 11							1						1														2
CCAA/Chapter 15															1				1					1			3
Ceased Operations																				1		2	1				4
Chapter 11	2	2	6	14	25	19	24	17	13	7	6	8	37	21	27	31	10	14	21	38	24	23	15	23	20	1	448
Chapter 128/Ch 128 Info														2													2
Chapter 15																		1		2	2				1		6
Chapter 7			1		6	2			1		2		3	1	7	14	3	6	11	15	15	7	11	6	10	3	124
Chapter 7/Chapter11													1														1
Closed																	1	2									3
Dissolved														1													1
Involuntary Bank Liquidation						1																					1
Involuntary Chapter 11	1				1							1															3
Involuntary Chapter 7												1			1	2			1								5
Liquidation						1						1				1			2	8	1	1					15
Liquidation/Closed Doors																			1								1
Pre-Packaged Chapter 11							1																				1
Receiver																						1					1
Receivership						2	1	1						1			1	3	1	1	1	1	1				14
Receivership/Chapter 128																		1	2								3
Recievership																								1			1
Restructuring																			1				1				2
Shut Down Operations					1																						1
Voluntarily Dissolved									1																		1
Voluntary Chapter 11				1																							1
Voluntary Insolvency						1																					1
Voluntary Liquidation	1			1	2							1															5
Grand Total	4	2	7	16	37	26	28	19	15	7	11	16	43	27	38	53	15	28	41	65	47	35	30	32	32	4	678

**Table2:** Included a comprehensive survey of US companies which was active in metal and manufacturing industry and were bankrupt over the period 1997-2022

The initial sample of bankrupt companies included companies that have declared bankruptcy under Chapter 7, Chapter 11, and Chapter 15, and included those companies that failed due to bankruptcy, merger, exchange, or liquidation, and companies that stopped trading due to selling assets to other companies. It also included that companies declared bankruptcy in any other form. Note1: (a definition for the most critical types of bankruptcy has been provided in the theoretical section 2.1). Note2:(According to US National Bankruptcy Code, the merger is considered as a types of bankruptcy)

(4): Since bankruptcy under Chapter 11 is the most common and complex form of bankruptcy according to the US National Bankruptcy Code, this study will concentrate on this type only, accordingly all companies that filed for bankruptcy for reasons other than Chapter 11 bankruptcy were excluded from the initial sample. Accordingly, the total number of companies in the initial sample decreased from 678 companies to 448 companies in the second version of the initial sample.

(5): All non-manufacturers from the second copy of the initial sample were excluded.

(6): All non-public companies were excluded from the second version of the initial sample.

(7): All companies with a total value of less than one million us dollar are excluded from the second version of the initial sample.

(8): All companies with incomplete financial statements for up to three years prior to bankruptcy were excluded from the second version of the initial sample.

(9): As a result, and after excluding all the bankrupt companies that did not meet the conditions, the following samples had been formulated, noting that some non-US companies were later added to all samples except for the Altman sample. The purpose of adding some non-US companies was to test whether the models could predict efficiently using a mixed sample of US and non-US companies, but this inclusion led to a reduction The prediction efficiency of these models, which is the main motivation for developing a comprehensive model capable of predicting based on a mixed sample, as will be explained in detail later.

The following table summarize all samples used in this study, the size of each sample , the period which the sample used :

**Table 3:** Summary of All Samples used in this study allocated by model and period of time

Sample Size & Name & Time	Altman Model	Zmijewski Model	Springate Model	Grover Model	Cash-Flow Model	Meslemani Model
Number of Companies in sample	30	58	58	58	100	120
One year before Bankruptcy (t-1)	Sample# 1	Sample# 4	Sample# 7	Sample# 10	Sample# 13	Sample# 14 & 15
Two years before Bankruptcy (t-2)	Sample# 2	Sample# 5	Sample# 8	Sample# 11		
Three years before Bankruptcy (t-3)	Sample# 3	Sample# 6	Sample# 9	Sample# 12		

Financial data had collected from the following sources:

- Capital IQ
- WRDs (Wharton Research Data Services) provided by Wharton University.
- FRED (Federal Research Economic Data)
- Yahoo Finance

In this study, testing bankruptcy prediction models had extended to three years instead of one year. So, the study began by identifying the year of each company's bankruptcy and giving it the symbol (t), the year before bankruptcy with the symbol (t-1), two years before bankruptcy with code (t-2), and three years before bankruptcy with code (t-3). In addition to that, the software STAT17 has been used to examine the behavior of the variables and analyze the statistical results using quantitative methods.

### 3.2 Variable selection and definitions

Based on both previous and recent literature related to predicting bankruptcy, the most valuable financial variables in predicting bankruptcy consist of forty variables divided into 10 groups, summarized in the following list:

Seven variables for Cash Flow model analysis, five variables for Altman model, three variables for Zmijewski model, four variables for Springate model, four variables for Grover model, five variables for Liquidity, five variables for Solvency, two variables for Leverage, four variables for Profitability, two variables for Efficiency.

**Table 4.** Initial List of variables used in study with Variable Definitions classified by categories

Variable Category	Variable Name	Variable Definition
Cash Flow	(OCF/CL)	Operating cash flow divided by current liabilities
	(OCF + INT + Tax/INT)	Cash flow coverage of interest
	(OCF/Sales)	Operating cash flow margin
	(OCF/Asset)	Operating cash flow return on total assets
	(EBIT/OCF)	Earning quality
	(CA-INV)/CL	Quick ratio or acid-test ratio
	(Sales 3 Yr CAGR)	Three-year sales growth
Altman	WC/TA	Working capital/Total assets
	RE/TA	Retained Earnings/Total assets
	EBIT/TA	Earnings before interest and taxes/Total assets
	MVE/BVD	Market value equity/Book value of total debt
	SA/TA	Sales/Total assets
Zmijewski	EAT/TA	(Profit After Tax / Total Assets)
	TD/TA	(Total Debt / Total Assets)
	CA/CD	(Current Assets / Current Debt )
Springate	WC/TA	Working capital/total assets
	EBIT/TA	EBIT/total assets
	PBI/CL	Profit before tax/current liabilities
	SA/TA	Sales/total assets
Grover	WC/TA	Working capital/total assets
	EBIT/TA	EBIT / Total assets
	NI/TA	Net income / Total assets
Liquidity	Working Capital ratio	Working Capital / Total Assets
	Current ratio	Current Assets / Current Liabilities
	Quick ratio	Quick Assets / Current Liabilities
	Cash ratio	Cash / Current Liabilities
	$\Delta$ (liquidity) ratio	Current ratio $t$ – Current ratio $t-1$
Solvency	OCF / CL ratio	Operating Cash Flow / Current Liabilities
	OCF / CE ratio	Operating Cash Flow / Capital Expenditure
	Interest coverage ratio	Operating Cash Flow / Interest Expense
	Interest coverage ratio	EBIT / Interest Expense
	OCF / TD ratio	Operating Cash Flow / Total Debt
Leverage	Debt ratio	Total Debt / Total Assets
	$\Delta$ (Debt) ratio	Debt ratio $t$ – Debt ratio $t-1$
Profitability	Return on Capital Employed	EBIT / Capital employed
	EBIT margin	EBIT margin / Total Sales
	Basic Earning power (ROI)	EBIT / Total Assets
	Internal growth rate	Retained earnings / Total Assets
Efficiency	Asset Turnover ratio	Total Sales / Total Assets
	Equity Turnover ratio	Total Sales / Total Equity

**Table 4** included the all forty variables used in this study, and their definitions, classified into categories according their usage in this study.

## 4. Analyzing and Discussing

---

*This is the central section of this study. The analysis and discussion section will start with conducting some basic statistical tests on the study sample to ascertain the strength of the correlation between the variables and the susceptibility of the data used for this study. Then will move on to analyze different models that are used in the subject of bankruptcy predicting to prove their efficiency in predicting till the day, starting with the cash flow model, the Altman Model, Zmijewski Model, Springate Model, Grover Model, Business evaluations Methods, Sensitivity Analysis, Credit Health Panel. The analysis of previous models will be our base for developing a comprehensive model called the Meslemani-2022 model that will work under all circumstances, then will move to analyze non-quantitative factors that could lead to bankruptcy. The end of this section will be merge quantitative factors and non-quantitative factors in the same model and will prove that this merging will enhance the predict level of the model.*

---

### 4.1 Analyzing using Quantitative Methods

The analysis and discussion section will start with conducting some basic statistical tests on the study sample to ascertain the strength of the correlation between the variables and the susceptibility of the data used for this type of study. Before starting these tests, it is helpful to highlight that it could be other statistical tests not included in this study. The reason is we include statistical tests that are aligned with the nature of this study and support its objective only. It is also helpful to highlight that the purpose of these statistical tests is not to exclude the variables that show a limited ability from the study. But, the purpose of this tests is to classify these variables correctly according to their ability to predict and allocate them in models later.

#### 4.1.1 Principal Components Analyzing, Eigenvalues, Proportion of variance

**Table 5:** Presents the 19 variables adopted on the principal components analysis, consisting of 236 observations each. By applying the test of correlation, it is possible to see that many of the variables have a high positive correlation to each other, e.g., “EBIT/TA” and “EBT/CL, (0.6674). This high positive correlation score makes the use of PCA reasonable. It is possible to see also that some of the variables have a negative correlation with each other, i.e., that they move in opposite directions to each other, e.g., “EAT/TA and “TD/TA” (-0.2429).

It is helpful to mention that the result of the PCA and Eigenvalue test will be helpful to give us an indicator of which variables have a better ability to predict than others to allocate them correctly in predict models later. Nevertheless, since one of the conditions to use these two tests is to exclude the variables with limited predictability, this excluding is not meeting the general purpose of this study as it will negatively affect these models and maybe stop them, so the PCA test will provide in the descriptive statistics section only and will not repeat in analyzing section.

**Table 5** : Principal Component Analysis of Statical study sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1) Statues	<b>1.0000</b>																		
(2) Earning After Tax / Total Asset	<b>0.3695</b>	<b>1.0000</b>																	
(3) Total Debit/Total Asset	<b>-0.2136</b>	<b>-0.2429</b>	<b>1.0000</b>																
(4) Currunt Asset/Currunt Debit	<b>0.1410</b>	<b>0.2216</b>	<b>0.2649</b>	<b>1.0000</b>															
(5) Working Capital/Total Asset	<b>0.2469</b>	<b>0.5546</b>	<b>-0.1619</b>	<b>0.6510</b>	<b>1.0000</b>														
(6) Earning Before Intrest and Tax/Total Asset	<b>0.4172</b>	<b>0.4126</b>	<b>0.1838</b>	<b>0.3275</b>	<b>0.2541</b>	<b>1.0000</b>													
(7) Earning Before Tax/Currunt Liability	<b>0.3702</b>	<b>0.5690</b>	<b>-0.0881</b>	<b>0.3096</b>	<b>0.2564</b>	<b>0.6674</b>	<b>1.0000</b>												
(8) Total Sales/Total Asset	<b>0.2233</b>	<b>0.1082</b>	<b>0.4575</b>	<b>0.2307</b>	<b>0.0868</b>	<b>0.3317</b>	<b>0.1859</b>	<b>1.0000</b>											
(9) Total Asset/Earning Before Intrest and Tax	<b>0.4623</b>	<b>0.4679</b>	<b>0.1550</b>	<b>0.3421</b>	<b>0.2151</b>	<b>0.8738</b>	<b>0.6474</b>	<b>0.3730</b>	<b>1.0000</b>										
(10) Net Income/Total Asset	<b>0.3711</b>	<b>0.9996</b>	<b>-0.2421</b>	<b>0.2210</b>	<b>0.5533</b>	<b>0.4119</b>	<b>0.5694</b>	<b>0.1095</b>	<b>0.4673</b>	<b>1.0000</b>									
(11) Return Earning/Total Asset	<b>0.3982</b>	<b>0.4328</b>	<b>-0.1076</b>	<b>0.2224</b>	<b>0.3478</b>	<b>0.3759</b>	<b>0.3361</b>	<b>0.1751</b>	<b>0.3705</b>	<b>0.4342</b>	<b>1.0000</b>								
(12) Equity Market Value/Debit Book Value	<b>0.2435</b>	<b>0.2881</b>	<b>-0.0210</b>	<b>0.1777</b>	<b>0.1680</b>	<b>0.3304</b>	<b>0.2311</b>	<b>0.1871</b>	<b>0.3249</b>	<b>0.2891</b>	<b>0.4544</b>	<b>1.0000</b>							
(13) Operating cash flow / Currunt Liability	<b>0.1500</b>	<b>0.0058</b>	<b>-0.1678</b>	<b>-0.1161</b>	<b>-0.0261</b>	<b>-0.0398</b>	<b>-0.0269</b>	<b>-0.1252</b>	<b>-0.0212</b>	<b>0.0064</b>	<b>0.0800</b>	<b>0.0317</b>	<b>1.0000</b>						
(14) Cash flow coverage of interest	<b>0.1554</b>	<b>0.0744</b>	<b>0.0296</b>	<b>-0.0280</b>	<b>-0.0176</b>	<b>0.0524</b>	<b>0.0371</b>	<b>0.0008</b>	<b>0.0491</b>	<b>0.0749</b>	<b>0.1746</b>	<b>0.0090</b>	<b>0.4884</b>	<b>1.0000</b>					
(15) Operating cash flow margin	<b>-0.0702</b>	<b>-0.0686</b>	<b>0.0798</b>	<b>0.1641</b>	<b>0.1768</b>	<b>-0.0976</b>	<b>-0.0908</b>	<b>-0.0873</b>	<b>-0.0951</b>	<b>-0.0685</b>	<b>-0.0138</b>	<b>-0.0223</b>	<b>0.0737</b>	<b>0.0726</b>	<b>1.0000</b>				
(16) Operating cash flow return on total assets	<b>0.2245</b>	<b>0.1433</b>	<b>-0.1444</b>	<b>-0.0604</b>	<b>0.0336</b>	<b>0.0350</b>	<b>0.0228</b>	<b>-0.0730</b>	<b>0.1350</b>	<b>0.1441</b>	<b>0.1447</b>	<b>0.0487</b>	<b>0.8299</b>	<b>0.5673</b>	<b>0.0762</b>	<b>1.0000</b>			
(17) earning quality	<b>-0.0548</b>	<b>-0.007</b>	<b>-0.1273</b>	<b>-0.109</b>	<b>-0.048</b>	<b>-0.047</b>	<b>-0.0212</b>	<b>-0.074</b>	<b>-0.051</b>	<b>-0.0067</b>	<b>-0.011</b>	<b>-0.022</b>	<b>0.0289</b>	<b>0.0041</b>	<b>-0.118</b>	<b>0.0313</b>	<b>1.0000</b>		
(18) quick ratio or acid-test ratio	<b>0.0695</b>	<b>-0.143</b>	<b>-0.3701</b>	<b>-0.180</b>	<b>0.017</b>	<b>-0.28</b>	<b>-0.1705</b>	<b>-0.377</b>	<b>-0.295</b>	<b>-0.1425</b>	<b>-0.039</b>	<b>-0.094</b>	<b>0.3854</b>	<b>0.2521</b>	<b>0.3752</b>	<b>0.2988</b>	<b>0.023</b>	<b>1.0000</b>	
(19) Three-year sales growth	<b>-0.0486</b>	<b>-0.124</b>	<b>-0.1872</b>	<b>-0.214</b>	<b>-0.152</b>	<b>-0.17</b>	<b>-0.1052</b>	<b>-0.111</b>	<b>-0.184</b>	<b>-0.1239</b>	<b>-0.063</b>	<b>-0.08</b>	<b>0.1534</b>	<b>0.2949</b>	<b>0.0000</b>	<b>0.1340</b>	<b>0.1258</b>	<b>0.4129</b>	<b>1.0000</b>

**Table 5** : The first test in statistical descriptive analysis is PCA, Principal Component Analysis of Statical study sample reflect that it is possible to see that many of the variables have a high positive correlation to each other, e.g., “Earning Before Tax/Current Liability” and “Earning Before Interest and Tax/Total Asset”, (0.6674). This high positive correlation score makes the use of PCA reasonable. It is possible to see also that some of the variables have a negative correlation with each other, i.e., that they move in opposite directions to each other, e.g., “Total Debit/Total Asset and “Earning After Tax / Total Asset” (-0.2429).

**Table 6:** Eigenvalue of main statistical study sample

Component	Eigenvalue	Difference	Proportion	Cumulative
Statues	4.9280	1.9771	0.2594	0.2594
Earning After Tax / Total Asset	2.9509	1.1315	0.1553	0.4147
Total Debit/Total Asset	1.8194	0.2440	0.0958	0.5104
Currunt Asset/Currunt Debit	1.5755	0.5203	0.0829	0.5934
Working Capital/Total Asset	1.0552	0.0586	0.0555	0.6489
Earning Before Intrest and Tax/Total Asset	0.9965	0.0102	0.0524	0.7013
Earning Before Tax/Currunt Liability	0.9863	0.1210	0.0519	0.7533
Total Sales/Total Asset	0.8653	0.1040	0.0455	0.7988
Total Asset/Earning Before Intrest and Tax	0.7613	0.0785	0.0401	0.8389
Net Income/Total Asset	0.6828	0.1191	0.0359	0.8748
Return Earning/Total Asset	0.5637	0.1340	0.0297	0.9045
Equity Market Value/Debit Book Value	0.4297	0.0539	0.0226	0.9271
Operating cash flow / Currunt Liability	0.3757	0.0563	0.0198	0.9469
Cash flow coverage of interest	0.3195	0.0237	0.0168	0.9637
Operating cash flow margin	0.2958	0.0995	0.0156	0.9793
Operating cash flow return on total assets	0.1963	0.0731	0.0103	0.9896
earning quality	0.1232	0.0488	0.0065	0.9961
quick ratio or acid-test ratio	0.0744	0.0740	0.0039	1.0000
Three-year sales growth	0.0004	.	0.0000	1.0000

**Table 6:** The second test in statistical descriptive analysis is Eigenvalue, this test present the Components are ranked based on their ability of to explain the variance of the factors within the study sample.

#### 4.1.2 Kaiser-Meyer-Olkin Measure (KMO Test)

**Table 7:** KMO Test of main statistical study sample

Variable	kmo
Statues	<b>0.8282</b>
Earning After Tax / Total Asset	<b>0.7195</b>
Total Debit/Total Asset	<b>0.7196</b>
Currunt Asset/Currunt Debit	<b>0.7257</b>
Working Capital/Total Asset	<b>0.6936</b>
Earning Before Intrest and Tax/Total Asset	<b>0.4894</b>
Earning Before Tax/Currunt Liability	<b>0.5343</b>
Total Sales/Total Asset	<b>0.5738</b>
Total Asset/Earning Before Intrest and Tax	<b>0.8012</b>
Net Income/Total Asset	<b>0.6650</b>
Return Earning/Total Asset	<b>0.8851</b>
Equity Market Value/Debit Book Value	<b>0.7860</b>
Operating cash flow / Currunt Liability	<b>0.6192</b>
Cash flow coverage of interest	<b>0.7282</b>
Operating cash flow margin	<b>0.5064</b>
Operating cash flow return on total assets	<b>0.5886</b>
earning quality	<b>0.7104</b>
quick ratio or acid-test ratio	<b>0.7076</b>
Three-year sales growth	<b>0.6568</b>
Overall	<b>0.6856</b>

**Table 7:** The third test, Overall result of KMO Test indicates that data has reasonably suited for these types of analyses.

### 4.1.3 Descriptive group Statistics

**Table 8.** Descriptive group statistics of main study sample

Variables	Bankrupt firms (53)		Non-bankrupt firms (67)		Total firms (120)	
	Mean	SD	Mean	SD	Mean	SD
Earning After Tax / Total Asset	-0.0294	0.1790	0.0792	0.0886	0.0309	0.1465
Total Debit/Total Asset	0.6175	0.4559	0.4467	0.3276	0.5227	0.3982
Currunt Asset/Currunt Debit	1.0286	1.1025	1.3849	1.3547	1.2263	1.2588
Working Capital/Total Asset	0.0128	0.2620	0.1178	0.1458	0.0711	0.2118
Earning Before Intrest and Tax/Total Asset	0.0158	0.0473	0.0919	0.1027	0.0581	0.0909
Earning Before Tax/Currunt Liability	-0.0677	0.6419	0.4510	0.6559	0.2202	0.6979
Total Sales/Total Asset	0.4171	0.5992	0.7058	0.6521	0.5774	0.6440
Total Asset/Earning Before Intrest and Tax	0.0123	0.0618	0.0970	0.0937	0.0593	0.0913
Net Income/Total Asset	-0.0298	0.1786	0.0792	0.0885	0.0307	0.1463
Return Earning/Total Asset	-0.0688	0.3412	0.2677	0.4200	0.1180	0.4209
Equity Market Value/Debit Book Value	0.1091	0.4346	1.7296	4.3052	1.0086	3.3148
Operating cash flow / Currunt Liability	0.5806	0.2414	0.1510	0.3491	0.1097	0.3088
Cash flow coverage of interest	115.47	654.49	430.29	1205.23	290.22	1008.82
Operating cash flow margin	0.1811	1.4531	0.0439	0.1151	0.1049	0.9729
Operating cash flow return on total assets	0.0011	0.0615	0.0306	0.0656	0.0175	0.0653
earning quality	0.9476	8.3034	0.3338	1.0160	0.6069	5.5836
quick ratio or acid-test ratio	0.4315	0.6985	0.5429	0.8687	0.4933	0.7978
Three-year sales growth	0.7484	2.0657	0.5922	1.1008	0.6617	1.6015

**Table 8:** summarize the Descriptive group statistics functions of main study sample.

### 4.1.4 Heteroscedasticity, White test, Robust standard errors:

Heteroscedasticity is an important and useful test for our data, It refers to the variance of the error terms in a regression model in an independent variable. To do this test first we run the regression and analyzing the result by STATA17, the result will be as following:

	Coefficient	Std. err.	t	P> t	[95% conf. interval]	
Statues	-6.2179	6.2652	-0.9900	0.3220	-18.5662	6.1305
Earning After Tax / Total Asset	-0.4091	0.0975	-4.2000	0.0000	-0.6012	-0.2169
Total Debit/Total Asset	0.0191	0.0364	0.5200	0.6010	-0.0527	0.0909
Currunt Asset/Currunt Debit	-0.0460	0.2447	-0.1900	0.8510	-0.5282	0.4362
Working Capital/Total Asset	0.7207	0.6811	1.0600	0.2910	-0.6217	2.0630
Earning Before Intrest and Tax/Total Asset	-0.0244	0.0615	-0.4000	0.6920	-0.1456	0.0967
Earning Before Tax/Currunt Liability	0.2010	0.0507	3.9700	0.0000	0.1011	0.3008
Total Sales/Total Asset	1.4504	0.6936	2.0900	0.0380	0.0833	2.8175
Total Asset/Earning Before Intrest and Tax	6.3763	6.2677	1.0200	0.3100	-5.9770	18.7296
Net Income/Total Asset	0.1662	0.0775	2.1400	0.0330	0.0134	0.3190
Return Earning/Total Asset	-0.0017	0.0091	-0.1900	0.8510	-0.0197	0.0163
Equity Market Value/Debit Book Value	-0.0297	0.1632	-0.1800	0.8560	-0.3514	0.2919
Operating cash flow / Currunt Liability	0.0000	0.0000	1.0700	0.2870	0.0000	0.0001
Cash flow coverage of interest	-0.0433	0.0312	-1.3900	0.1670	-0.1047	0.0182
Operating cash flow margin	0.4746	0.8323	0.5700	0.5690	-1.1658	2.1150
Operating cash flow return on total assets	-0.0050	0.0047	-1.0600	0.2890	-0.0143	0.0043
earning quality	0.1379	0.0476	2.9000	0.0040	0.0441	0.2317
quick ratio or acid-test ratio	-0.0322	0.0191	-1.6800	0.0940	-0.0698	0.0055
Three-year sales growth	0.4337	0.0651	6.6600	0.0000	0.3054	0.5619

to check heteroscedasticity using the white test, we could check the validity of the null hypothesis vs the alternative hypothesis:

The null hypothesis states that where the error variances are all equal (homoscedasticity).

The alternative hypothesis states that the error variances are a multiplicative function of one or more variables (heteroscedasticity).

we use the following command in STATA: **estat imtest, white**

after applying the above command, the following result appeared:

```
. estat imtest, white

White's test
H0: Homoskedasticity
Ha: Unrestricted heteroskedasticity

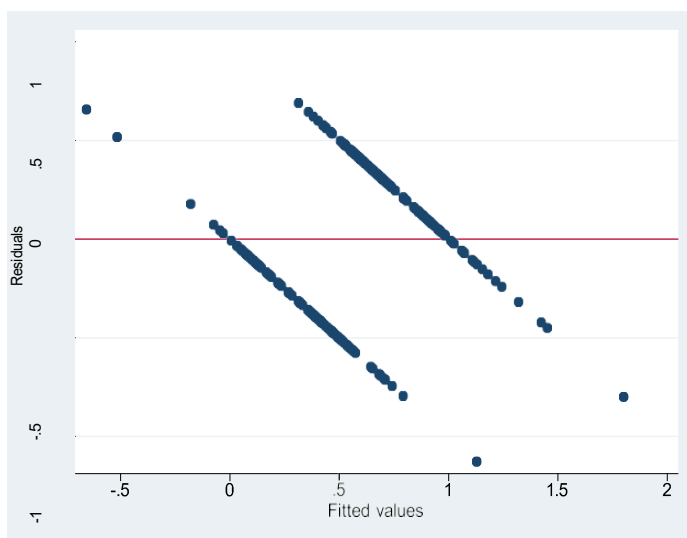
      chi2(139) = 199.42
Prob > chi2 = 0.0006

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	199.42	139	0.0006
Skewness	40.76	18	0.0016
Kurtosis	16.60	1	0.0000
Total	256.78	158	0.0000

, which means The null hypothesis of constant variance can be rejected at 5% level of significance. In another word, the above finding means that there is heteroscedasticity in the residuals due to many reasons such as model misspecifications or errors in measurements

The results of the heteroscedasticity test can depict Graphical as following:



The above figure depicts the results of the heteroscedasticity test Graphical, the residual values are

distributed within the range (-0.5, 0.5) and almost symmetrically around the zero-value axis, with outliers out of range but in general, there is a regular pattern of distribution of values.

There are many consequences of the heteroscedasticity such as standard errors will be unreliable, which will lead to bias in test results and confidence intervals. The positive thing here is that Heteroscedasticity correction is possible by using a robust command in the regression as following:

	Coefficient	Std. err.	t	P> t	[95% conf. interval]
Statues	-6.2179	5.0512	-1.2300	0.2200	-16.1736 3.7378
Earning After Tax / Total Asset	-0.4091	0.0853	-4.7900	0.0000	-0.5773 -0.2408
Total Debit/Total Asset	0.0191	0.0331	0.5800	0.5640	-0.0461 0.0843
Currunt Asset/Currunt Debit	-0.0460	0.2017	-0.2300	0.8200	-0.4435 0.3515
Working Capital/Total Asset	0.7207	0.5519	1.3100	0.1930	-0.3670 1.8084
Earning Before Intrest and Tax/Total Asset	-0.0244	0.0551	-0.4400	0.6580	-0.1331 0.0842
Earning Before Tax/Currunt Liability	0.2010	0.0516	3.9000	0.0000	0.0994 0.3026
Total Sales/Total Asset	1.4504	0.6429	2.2600	0.0250	0.1833 2.7175
Total Asset/Earning Before Intrest and Tax	6.3763	5.1583	1.2400	0.2180	-3.7905 16.5432
Net Income/Total Asset	0.1662	0.0563	2.9500	0.0040	0.0552 0.2772
Return Earning/Total Asset	-0.0017	0.0062	-0.2800	0.7820	-0.0139 0.0105
Equity Market Value/Debit Book Value	-0.0297	0.1710	-0.1700	0.8620	-0.3668 0.3074
Operating cash flow / Currunt Liability	0.0000	0.0000	1.4700	0.1430	0.0000 0.0001
Cash flow coverage of interest	-0.0433	0.0142	-3.0500	0.0030	-0.0712 -0.0153
Operating cash flow margin	0.4746	0.8983	0.5300	0.5980	-1.2959 2.2451
Operating cash flow return on total assets	-0.0050	0.0033	-1.5300	0.1280	-0.0115 0.0015
earning quality	0.1379	0.0434	3.1800	0.0020	0.0523 0.2235
quick ratio or acid-test ratio	-0.0322	0.0166	-1.9300	0.0550	-0.0650 0.0006
Three-year sales growth	0.4337	0.0668	6.4900	0.0000	0.3020 0.5653

The above figure shows us that we got a different result from regression after we correct the heteroscedasticity test in STATA. Thus, the old problem of heteroscedasticity disappeared. This gives robust standards errors, which are completely different from the results of standard errors which we got in the old figure. For example, the robust standard error in the last figure for the variable EATTA is 5.051196, which is different from the result of 6.265156 given in the old figure. Similarly, the standard errors of the variable TDTA become 0.0853455 while its old standard errors value was 0.975019. The same analysis could be applied to the remaining variables.

#### 4.1.5 Analyzing using Cash Flow Ratios

Before starting the analysis using Cash Flow Ratios, it is important to check The multicollinearity between variables by running the multicollinearity test or Variance Inflation Factor (VIF) test:

Source	SS	df	MS	Number of obs	=	100
Model	7.53094867	7	1.07584981	F(7, 92)	=	5.67
Residual	17.4690513	92	.189880993	Prob > F	=	0.0000
				R-squared	=	0.3012
				Adj R-squared	=	0.2481
Total	25	99	.252525253	Root MSE	=	.43575

Variable	VIF	1/VIF
Operating Cash Flow/Currunt Liability	2.98	0.335
(Operating Cash Flow+Intrst+Tax)/Intrest	2.94	0.339
Operating Cash Flow/Total Sales	1.27	0.704
Operating Cash Flow/Total Asset	1.25	0.802
Earning Before Intrest and Tax/Operating Cash Flow	1.09	0.914
(Currunt Asset-Inventory)/Currunt Liability	1.05	0.95
Three-year sales growth	1.03	0.973
Mean VIF	1.66	

The result of the multicollinearity test or Variance Inflation Factor (VIF) test shows a value between 1 and 5 for all variables which indicates moderately and reasonably correlated.

The sample used to predict bankruptcy using cash flow ratios is **Sample# 13**, it consists of 100 companies and seven variables, the sample divided into two groups. The first group includes 50 bankrupt companies. The second group includes 50 non-bankrupt companies. Companies in both groups of approximately the same size in terms of total asset value to ensure that the best possible prediction rate had been obtained when testing the bankruptcy forecasting model using cash flow ratios. MDA was conducted using the Stata17 statistical software, and the following table will provide Descriptive statistics (mean, median, standard deviation) of variables for both bankrupt groups (50 companies) and non-bankrupt groups (50 companies) and for the total sample consisting of (100 companies).

**Table 9.** Descriptive group statistics of cash flow sample model

Variables	Bankrupt firms (50)			Non-bankrupt firms (50)			Total firms (100)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Operating Cash Flow/Currunt Liability	0.1219	0.0276	0.3403	0.3959	0.3831	0.4738	0.2589	0.222	0.4329
(Operating Cash Flow+Intrst+Tax)/Intrest	242.48	-9.36	936.88	1127.35	442.51	1746.97	684.92	74.88	1463.8
Operating Cash Flow/Total Sales	0.3803	0.0197	2.0986	0.1151	0.1253	0.1638	0.2477	0.0662	1.4869
Operating Cash Flow/Total Asset	0.0024	0.0132	0.0896	0.0801	0.0843	0.0858	0.0412	0.0504	0.0956
Earning Before Int and Tax/Operating Cash Flow	1.99	0.5153	12.0091	0.8745	0.9101	1.5021	1.4323	0.8228	8.533
(Currunt Asset-Inventory)/Currunt Liability	0.9061	0.7235	0.7725	1.4224	1.2061	0.8518	1.1643	1.0222	0.8496
Three-year sales growth	1.5716	0.9616	2.7815	1.5515	1.3144	1.3023	1.5616	1.0776	2.1607

**Table 10.** Outline of canonical discriminant functions of cash flow model during period (t-1)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	1.426	19.1	0.4257	2.437	0.3012	43.1	5.67

The low value of Root Mean Squared Error (Root MSE) = 0.4257 is good because it indicates a

low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 2.437 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the value of R<sup>2</sup> is 31% indicates that almost one to three predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 43.1 that is a sign of fatter tails. On the opposite side, negative skew and/or kurtosis may lead to a higher frequency of extreme negative returns.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=5.67 indicates that model has a good predictive capability.

**Table 11:** Standardized and Unstandardized Coefficients of cash flow sample model

Variable	Standardized coefficients	Unstandardized coefficients
Operating Cash Flow/Currunt Liability	-0.1100	-0.1274
(Operating Cash Flow+Intrst+Tax)/Intrest	-0.0290	-0.0001
Operating Cash Flow/Total Sales	-0.2740	-0.0926
Operating Cash Flow/Total Asset	0.4570	2.4018
Earning Before Intrest and Tax/Operating Cash Flow	-0.0590	-0.0035
(Currunt Asset-InVENTORY)/Currunt Liability	0.3800	0.2250
Three-year sales growth	-0.0540	-0.0126
constant		0.2175

According to calculated Discriminant function coefficients in the previous table, the equation form of our Cash flow model could be formulated as:

$$Z=0.2175 -0.1274 X1 - 0.0001 X2 -0.0926 X3 + 2.4018 X4 -0.0035 X5 + 0.2250 X6 -0.0126 X7$$

where:

Z= discriminant score.

X1 = (OCF/CL), operating cash flow / current liabilities

X2 = (OCF + INT +Tax/INT), cash flow coverage of interest

X3 = (OCF/Sales), operating cash flow margin.

X4 = (OCF/Asset), operating cash flow return on total assets

X5 = (EBIT/OCF), earning quality.

X6 = (CA-INV)/CL, quick ratio.

X7 = (Sales 3 yr. CAGR),3-year sales growth.

The Distinctive score in above formula expresses the final calculated value of the prediction model using cash flow ratio.

**Table 12:** The average value of failed & non-failed & Group Centroids of cash flow sample model

Failed Company	Group Center-Point	Healthy Companies
0.3494	0.4995	0.6498

Table 12 provide the average value of failed & non-failed & Group center-point of discriminant scores of all the companies included in the study sample which consist of 100 firms. The average value of failed companies is 0.3494 and the average value of non-failed companies is 0.6206. and the center point for all companies (failed and non-failed) is 0.4850. All companies have a result value less than the group center point value and closer to the average value of failed companies classified as failed companies. All companies have a result value more than the group center point value and closer to the average value of non- failed companies classified as non-failed companies.

**Table 13:** The final result of the Cash Flow Ratios predict model

		Failed	Non-failed	Total
<b>Original</b>				
Count		50	50	100
Percentage		50%	50%	100%
<b>Cross-validated</b>				
Count	Faild	36	42	44
	Non-failed	8	14	56
Percentage	Faild	81.8%	75%	100%
	Non-failed	18.2%	25%	100%

As table 13 present, after applying the cash flow ratios model and analyzing the result, the model successfully predicts 81.8 % of case tested (100 firms).

Finally, It is helpful to refer that most academics nowadays are no more dependent on classical analyses using financial ratios and cash flow ratios. Classical analyses had been replaced by advanced predict bankruptcy models. However, this study does not aim to ignore the role of classical financial analyses. Rather than build a bridge between classical methods and advanced methods together and show both methods' contributions to predicting bankruptcy.

## 4.1.6 Altman Z-Score Model Test

Before starting the analysis using Altman Z-Score Model, it is important to check The multicollinearity between variables by running the multicollinearity or Variance Inflation Factor (VIF) test:

Source	SS	df	MS	Number of obs	=	30
Model	<b>5.73130876</b>	<b>5</b>	<b>1.14626175</b>	F(5, 24)	=	<b>15.85</b>
Residual	<b>1.7353579</b>	<b>24</b>	<b>.072306579</b>	Prob > F	=	<b>0.0000</b>
Total	<b>7.46666667</b>	<b>29</b>	<b>.257471264</b>	R-squared	=	<b>0.7676</b>
				Adj R-squared	=	<b>0.7192</b>
				Root MSE	=	<b>.2689</b>

. vif

Variable	VIF	1/VIF
RetainedE~ts	<b>3.46</b>	<b>0.289253</b>
Workingcap~s	<b>2.33</b>	<b>0.428954</b>
Earningsbe~x	<b>1.89</b>	<b>0.529130</b>
Marketvalu~o	<b>1.33</b>	<b>0.754173</b>
SalesTotal~s	<b>1.17</b>	<b>0.852565</b>
Mean VIF	<b>2.04</b>	

The result of the multicollinearity test or Variance Inflation Factor (VIF) test shows a value between 1 and 5 for all variables which indicates moderately and reasonably correlated.

The analysis and results section of the Altman Z-Score Model Test had been divided into three separate subsections (for three years) because the analysis was conducted individually for each year before bankruptcy.:

### Analyzing and Results in one-year prior bankruptcy (t-1)

The sample used is **Sample# 1**

Descriptive statistics (mean, median, standard deviation) for each selected variable is provided in Table 14 for both bankrupt group of firms, and a non-bankrupt group of firms, and the total sample consists of (30 companies). the MDA was conducted using the Stata17 statistical software:

**Table 14.** Descriptive group statistics of Altman Model during (t-1)

Variables	Bankrupt firms (14)			Non-bankrupt firms (16)			Total firms (30)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/Total assets	-0.1989	-0.0075	0.4907	0.1467	0.1297	0.1116	-0.0146	0.1061	0.3810
Retained Earnings/Total assets	-0.2320	-0.0413	0.5427	0.7242	0.6672	0.3707	0.2780	0.3726	0.6622
EBIT/Total assets	0.0018	0.0022	0.0505	0.1248	0.1308	0.0446	0.0674	0.0681	0.0779
Equity Mark v/Book value of tot deb	0.1045	0.0503	0.2693	4.0781	2.5682	4.6439	2.2237	0.7787	3.9055
Sales/Total assets	0.6453	0.5244	0.5410	0.8665	0.7723	0.3882	0.7632	0.7304	0.4709

**Table 15.** Outline of canonical discriminant functions of Altman Model

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	1.130	1.1	0.2689	-0.078	0.7676	6.4	15.85

The low value of Root Mean Squared Error (Root MSE) = 0.2689 is good because it indicates a low level of prediction errors when compared to actual observed values.

The negative value of Skewness = -0.078 means that distribution is negatively Skewness (skewed to the left), and the standard deviation did not overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 76% indicates that almost 76% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 6.4 that sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=15.85 indicates that model has a good predictive capability.

**Table 16:** Unstandardized and standardized estimates of Altman Model

	b	t	P> t	bStdX	bStdY	bStdXY	SDofX
Working capital/Total assets	0.1123	0.5610	0.5800	0.0430	0.2210	0.0840	0.3810
Retained Earnings/Total assets	0.2204	1.5720	0.1290	0.1460	0.4340	0.2880	0.6620
EBIT/Total assets	3.7572	4.2640	0.0000	0.2930	7.4050	0.5770	0.0780
Equity Market value/Book value of total debt	0.0165	1.1220	0.2730	0.0640	0.0330	0.1270	3.9050
Sales/Total assets	-0.0441	-0.3840	0.7040	-0.0210	-0.0870	-0.0410	0.4710
constant	0.2176	2.2460	0.0340	.	.	.	.

The standardized coefficients in Table 15 provide evidence of the relative importance of each variable in the model of bankruptcy predicting. In the short run, the Profitability factor, specifically Basic Earning power ratio (EBIT / Total Assets) is the most important variable in the bankruptcy prediction model for the one year before actual bankruptcy happened.

In summary, during the period (t-1) one year before bankruptcy. the Altman Z-Score model correctly re- classified 30 out of 30 cases (100%), indicating strong discriminating power with high ability potentiality for bankruptcy prediction.

### Analyzing and Results in Two-year prior bankruptcy (t-2)

The sample used is **Sample# 2**

**Table 17.** Descriptive group statistics of Altman Model during (t-2)

Variables	Bankrupt firms (14)			Non-bankrupt firms (16)			Total firms (30)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/Total assets	0.0734	0.0472	0.1303	0.1573	0.1274	0.1131	0.1181	0.0993	0.1266
Retained Earnings/Total assets	-0.1404	-0.0196	0.5084	0.6848	0.6410	0.3739	0.2997	0.3740	0.6029
EBIT/Total assets	0.0235	0.0301	0.0622	0.1459	0.1426	0.0515	0.0888	0.0879	0.0835
Equity Market v/Book v of total debt	0.2509	0.0000	0.5336	4.4285	2.2348	5.8115	2.4790	1.1901	4.7000
Sales/Total assets	0.7298	0.5872	0.6159	0.9816	0.9494	0.2880	0.8641	0.8587	0.4788

**Table 18** Outline of canonical discriminant functions of Altman Model during (t-2)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	1.065	1.2	0.3022	0.571	0.7065	4.7	11.55

The low value of Root Mean Squared Error (Root MSE) = 0.3022 is good because it indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 0.571 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 71% indicates that almost 71% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 4.7 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test  $R^2$ , and thereby assess if model has a predictive capability, a value of  $F=11.55$  indicates that model has a good predictive capability.

**Table 19:** Unstandardized and standardized estimates of Altman Model during (t-2)

	<b>b</b>	<b>t</b>	<b>P&gt; t </b>	<b>bStdX</b>	<b>bStdY</b>	<b>bStdXY</b>	<b>SDofX</b>
Working capital/Total assets	-0.0272	-0.0500	0.9600	-0.0030	-0.0540	-0.0070	0.1270
Retained Earnings/Total assets	0.3601	3.1560	0.0040	0.2170	0.7100	0.4280	0.6030
EBIT/Total assets	3.1000	3.7620	0.0010	0.2590	6.1090	0.5100	0.0830
Equity Market v/Book value of total debt	0.0046	0.3250	0.7480	0.0210	0.0090	0.0420	4.7000
Sales/Total assets	0.0519	0.3900	0.7000	0.0250	0.1020	0.0490	0.4790
constant	0.0972	0.8040	0.4290	.	.	.	.

The standardized coefficients in Table 19 provide evidence of the relative importance of each variable in the model of bankruptcy predicting. In the medium run, the Profitability factor, specifically Basic Earning power ratio (EBIT / Total Assets) is the most important variable in the bankruptcy prediction model for the one year before actual bankruptcy happened.

In summary, during the period (t-2) two years before bankruptcy. the Altman Z-Score model correctly re- classified 29 out of 30 cases (97%), indicating strong discriminating power with high ability potentiality for bankruptcy prediction.

### Analyzing and Results Three-years prior bankruptcy (t-3)

The sample used is **Sample# 3**.

**Table 20.** Descriptive group statistics of Altman Model during (t-3)

Variables	Bankrupt firms (14)			Non-bankrupt firms (16)			Total firms (30)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/Total assets	0.0781	0.0696	0.1811	0.1457	0.1368	0.1150	0.1142	0.1136	0.1507
Retained Earnings/Total assets	-0.1440	0.0411	0.5615	0.7831	0.7183	0.4044	0.3505	0.3540	0.6688
EBIT/Total assets	0.0489	0.0536	0.0743	0.1609	0.1487	0.0545	0.1086	0.1053	0.0851
Equity Market v/Book v of tot debt	0.4631	0.0139	0.9691	5.6548	3.6863	7.6588	3.2320	1.5582	6.1401
Sales/Total assets	0.7999	0.6015	0.7298	1.0078	0.9458	0.2612	0.9108	0.9241	0.5340

**Table 21.** Outline of canonical discriminant functions of Altman Model during (t-3)

Function	Eigen Value	SD	Root MSE	Skewness	$R^2$	Kurtosis	F
1	1.000	1.52	0.342	0.413	0.622	5.52	7.9

The low value of Root Mean Squared Error (Root MSE) = 0.342 is good because it indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 0.413 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

$R^2$  is a measure of how well a regression fits the data, the result value of  $R^2$  is 62% indicates that almost 62% predicting factors' movements are explained by the market,

while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 5.52 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test  $R^2$ , and thereby assess if model has a predictive capability, a value of  $F=7.9$  indicates that model has a good predictive capability.

**Table 22:** Unstandardized and standardized estimates of Altman Model during (t-3)

	<b>b</b>	<b>t</b>	<b>P&gt; t </b>	<b>bStdX</b>	<b>bStdY</b>	<b>bStdXY</b>	<b>SDofX</b>
Working capital/Total assets	-0.5281	-1.1000	0.2820	-0.0800	-1.0410	-0.1570	0.1510
Retained Earnings/Total assets	0.3701	2.9750	0.0070	0.2480	0.7290	0.4880	0.6690
EBIT/Total assets	2.1561	1.8100	0.0830	0.1830	4.2490	0.3620	0.0850
Equity Mark value/Book value of tot debt	0.0139	1.1690	0.2540	0.0860	0.0270	0.1690	6.1400
Sales/Total assets	0.0045	0.0330	0.9740	0.0020	0.0090	0.0050	0.5340
constant	0.1806	1.3620	0.1860	.	.	.	.

**To summarize the ability of the Altman model to predict bankruptcy within three years:**

**Table 23:** Altman Z-Score test accuracy in (t-1) & (t-2) & (t-3)

	<b>t-1</b>	<b>t-2</b>	<b>t-3</b>	<b>Total</b>
Total case tested	30	30	30	90
Type I Error	0	0	0	0
Type II Error	0	1	3	4
<b>Z-Score Accuracy</b>	<b>100%</b>	<b>97%</b>	<b>90%</b>	<b>96%</b>

1. (t-1) one year before bankruptcy: Altman Z-Score model correctly re-classified 30 out of 30 cases; his predicted accuracy one year before bankruptcy is 100%.
2. (t-2) two years before bankruptcy: Altman Z-Score model correctly re-classified 29 out of 30 cases; his predicted accuracy two years before the bankruptcy is 97%.
3. (t-3) three years before bankruptcy: Altman Z-Score model correctly re-classified 27 out of 30 cases; his predicted accuracy three years before the bankruptcy is 90%.
4. In Average: The Altman Z-Score model correctly re-classified 86 out of 90 cases; his overall predicted accuracy is 96%. This score indicates a solid discriminating power with high ability potentiality for bankruptcy prediction.
5. The Altman Z model could successfully predict bankruptcy over time (t-1, t-2, t-3). Determining the most critical variable is based on the range of its potential effect and contribution degree to the model's final value. When dealing with a potential bankruptcy in the short-run (t-1) and medium run (t-2), the Profitability factor, specifically the Basic Earning power ratio (EBIT / Total Assets), is the most critical variable in the bankruptcy prediction model for the one year before actual bankruptcy

happened. While, when dealing with a potential bankruptcy in the long run ( $t-3$ ), the Profitability factor, specifically the Internal growth rate ratio (Retained earnings / Total Assets), is the most crucial variable in the bankruptcy prediction model for the three years before actual bankruptcy happened. When these two ratios are combined, the Altman Model could successfully predict bankruptcy in 100% of cases for  $t-1$ , 97% of cases for  $t-2$ , and 90% for  $t-3$ . overall prediction level for three years was 96%.

6. Working capital/Total assets: there is a strong positive relationship between Z's value and this element's value. The companies with a low ratio of net working capital had a low value of Z. Because the decrease in the value of the net-working capital is evidence of the lack of liquidity in the company, which means that the company is unable to pay its obligations, which is one of the reasons leading to bankruptcy.
7. Retained Earnings/Total assets: there is a strong relationship between the second component and the value of Z. the companies that suffer from low retained earnings ratio have low Z-value, which leads to bankruptcy. Some companies do not distribute profits to shareholders because of a lack of liquidity or because they have an accumulated deficit.
8. EBIT/Total assets: also called the rate of return on investment; there is a strong positive relationship between the rate of return on investment where the return on investment is noted from It also has a low Z-value, which is one of the reasons leading to bankruptcy since the goal of all companies is to achieve a high rate of return on investment to ensure the continuity of the company.
9. Equity Market value/Book value of total debt: it measures the relationship between shareholders' equity and the company's debts. There is a strong positive relationship between the value of this element and the value of Z, so if the ratio is low, this is evidence that the value of the company's debts is greater than the value of its assets and, therefore, the company will not be able to pay its obligations, which is one of the reasons leading to bankruptcy.
10. Sales/Total assets: the decrease in the value of this percentage is always associated with a decrease in the value of Z. Because the decrease in this percentage indicates the inefficiency of the management of this company is investing its assets to achieve high sales, which is one of the reasons leading to bankruptcy.

#### 4.1.7 Zmijewski Model Test:

Before starting the analysis using Zmijewski Model, it is important to check The multicollinearity between variables by running the multicollinearity or Variance Inflation Factor (VIF) test:

Source	SS	df	MS	Number of obs	=	58
Model	<b>3.06716115</b>	<b>3</b>	<b>1.02238705</b>	F(3, 54)	=	<b>4.90</b>
Residual	<b>11.2776664</b>	<b>54</b>	<b>.208845675</b>	Prob > F	=	<b>0.0044</b>
				R-squared	=	<b>0.2138</b>
				Adj R-squared	=	<b>0.1701</b>
Total	<b>14.3448276</b>	<b>57</b>	<b>.251663642</b>	Root MSE	=	<b>.457</b>

Variable	VIF	1-VIF
Earning After Tax / Total Assets	<b>0.08</b>	<b>0.481</b>
Total Debt / Total Assets	<b>1.86</b>	<b>0.537</b>
Current Assets / Current Debt	<b>1.18</b>	<b>0.845</b>
Mean VIF	<b>1.71</b>	

The result of the multicollinearity or Variance Inflation Factor (VIF) test shows a value between 1 and 5 for all variables which indicates moderately and reasonably correlated. The analyzing and results section of Zmijewski Model Test had been divided into three separate subsections (for three years) because the analysis was conducted individually for each year before bankruptcy. The sample which will be used in Zmijewski Model will consist of 58 companies:

### Analyzing and Results One-year prior bankruptcy (t-1)

The sample used is **Sample# 4**.

Descriptive statistics (mean, median, standard deviation) for each selected variable are provided in Table 24 for both bankrupt (26) and non-bankrupt (32) firms and for all (58) firms of the sample. MDA was conducted using the Stata17 statistical software:

**Table 24.** Descriptive group statistics of Zmijewski Model during (t-1)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Total firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Earning Afr Tax / Tot Assets	-0.0753	-0.0152	0.3246	0.0926	0.0885	0.0656	0.0173	0.0381	0.2359
Total Debt / Total Assets	0.8862	0.8345	0.3793	0.6203	0.6253	0.2099	0.7395	0.7275	0.3238
Current Assets / Current Debt	1.1793	1.0851	0.8560	1.7907	1.5226	0.9440	1.5166	1.3706	0.9488

**Table 25.** Outline of canonical discriminant functions of Zmijewski Model during (t-1)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	0.817	0.50	0.457	0.301	0.214	14.78	4.9

The low value of Root Mean Squared Error (Root MSE) = 0.457 is good because it

indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 0.301 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

$R^2$  is a measure of how well a regression fits the data, the result value of  $R^2$  is 21% indicates that almost 21% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the kurtosis is positive = 14.78 that is sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test  $R^2$ , and thereby assess if model has a predictive capability, a value of  $F=4.9$  indicates that model has a good predictive capability.

**Table 26** : Unstandardized and standardized estimates

	<b>b</b>	<b>t</b>	<b>P&gt; t </b>	<b>bStdX</b>	<b>bStdY</b>	<b>bStdXY</b>	<b>SDofX</b>
Earning After Tax / Tot Assets	0.3300	0.9430	0.3500	0.0780	0.6580	0.1550	0.2360
Total Debt / Total Assets	-0.3557	-1.3200	0.1920	-0.1150	-0.7090	-0.2300	0.3240
Current Assets / Current Debt	0.1043	1.5040	0.1380	0.0990	0.2080	0.1970	0.9490
constant	0.6508	2.4650	0.0170	.	.	.	.

The standardized coefficients in Table 26 provide evidence of the relative importance of each variable in the model of bankruptcy predicting. In the short run, the Leverage factor, specifically Debt ratio (Total Debt / Total Assets) is the most important variable in the bankruptcy prediction model for the one year before actual bankruptcy happened.

In summary, during the period (t-1) one year before bankruptcy. the Zmijewski model correctly re-classified 36 out of 58 cases (62%), indicating above-average discriminating power with the medium ability of potentiality for bankruptcy prediction.

## Analyzing and Results in Two-years prior bankruptcy (t-2):

The sample used is **Sample# 5**

**Table 27.** Descriptive group statistics of Zmijewski Model during (t-2)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Total firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Earning Aft Tax / Tot Assets	-0.0448	-0.0011	0.1069	0.1151	0.0967	0.1193	0.0434	0.0472	0.1385
Total Debt / Total Assets	0.7994	0.8191	0.2359	0.6169	0.6433	0.2187	0.6987	0.7084	0.2425
Current Assets / Current Debt	1.4567	1.1861	0.8507	1.9684	1.4787	1.5148	1.7390	1.3970	1.2772

**Table 28.** Outline of canonical discriminant functions of Zmijewski Model during (t-2)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	1.000	0.6	0.404	1.641	0.386	12.0	11.31

The low value of Root Mean Squared Error (Root MSE) = 0.404 is good because it indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 1.641 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 39% indicates that almost 39% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 12 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=11.31 indicates that model has a good predictive capability.

**Table 29:** Unstandardized and standardized estimates of Zmijewski Model during (t-2)

	b	t	P> t	bStdX	bStdY	bStdXY	SDofX
Earning After Tax / Total Assets	1.8528	4.5800	0.0000	0.2570	3.6930	0.5110	0.1380
Total Debt / Total Assets	-0.4150	-1.6870	0.0970	-0.1010	-0.8270	-0.2010	0.2420
Current Assets / Current Debt	0.0274	0.6110	0.5430	0.0350	0.0550	0.0700	1.2770
constant	0.7136	3.2040	0.0020	.	.	.	.

In summary, during the period (t-2) two year before bankruptcy. the Zmijewski model correctly re-classified 34 out of 58 cases (59%), indicating above-average discriminating power with the medium ability of potentiality for bankruptcy prediction.

### Analyzing and Results Three-years prior bankruptcy (t-3):

The sample used is **Sample# 6**.

**Table 30.** Descriptive group statistics of Zmijewski Model during (t-3)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Total firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Earning After Tax / Tot Assets	0.0012	0.0150	0.1102	0.1166	0.1072	0.0657	0.0649	0.0651	0.1050
Total Debt / Total Assets	0.8081	0.7967	0.3257	0.5914	0.6235	0.2242	0.6885	0.6671	0.2927
Current Assets / Current Debt	1.5179	1.0073	1.4123	1.9103	1.5390	1.2402	1.7344	1.3996	1.3229

**Table 31.** Outline of canonical discriminant functions of Zmijewski Model during (t-3)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	0.914	0.57	0.4295	0.620	0.305	10.44	7.91

The low value of Root Mean Squared Error (Root MSE) = 0.429 is good because it indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 0.620 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 30% indicates that almost 30% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 10.44 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=7.91 indicates that model has a good predictive capability.

**Table 32:** Unstandardized and standardized estimates of Zmijewski Model during (t-3)

	b	t	P> t	bStdX	bStdY	bStdXY	SDofX
Earning After Tax / Total Assets	2.4957	3.6070	0.0010	0.2620	4.9750	0.5220	0.1050
Total Debt / Total Assets	-0.0802	-0.3040	0.7620	-0.0230	-0.1600	-0.0470	0.2930
Current Assets / Current Debt	-0.0002	-0.0040	0.9970	0.0000	0.0000	0.0000	1.3230
constant	0.4453	1.7500	0.0860	.	.	.	.

**To summarize the ability of the Zmijewski model to predict bankruptcy within three years:**

**Table 33** : Summary of Zmijewski model accuracy in (t-1) & (t-2) & (t-3)

	<b>t-1</b>	<b>t-2</b>	<b>t-3</b>	<b>Total</b>
Total case tested	58	58	58	174
Type I Error	11	12	12	35
Type II Error	11	12	13	36
<b>Z-Score Accuracy</b>	<b>62%</b>	<b>59%</b>	<b>57%</b>	<b>59%</b>

1. (t-1) one years before bankruptcy: Zmijewski model correctly re-classified 36 out of 58 cases, his predicted accuracy one year before bankruptcy is 62%.
2. (t-2) two years before bankruptcy: Zmijewski model correctly re-classified 34 out of 58 cases, his predicted accuracy two year before bankruptcy is 59%.
3. (t-3) three years before bankruptcy: Zmijewski model correctly re-classified 33 out of 58 cases, his predicted accuracy three year before bankruptcy is 57%.
4. On average, during three years before bankruptcy, Zmijewski model correctly re- classified 103 out of 174 cases, his overall predict accuracy is 59%. this score indicating a medium discriminating power with medium ability potentiality for bankruptcy prediction.
5. When the Zmijewski model is applied In the short run, the Leverage factor, specifically Debt ratio (Total Debt / Total Assets) is the most important variable in the bankruptcy prediction model for the one year before actual bankruptcy happened. While In the medium run and long run, the Performance factor, specifically the After-Tax Return on Assets ratio (Earning After Tax / Total Assets) is the most important variable in the bankruptcy prediction model for the 2 & 3 years before actual bankruptcy happened.
6. Earning After Tax / Total Assets: is the first element in Zmijewski model, it called also return on total assets ratio. This ratio compares between the value of company total asset and the value of the profits generated, which indicates how well a company's investments generate value, there is a strong relationship between this ratio and the calculated value of Zmijewski model, when the Return on total assets ratio is low indicates that company are not good in generating profit from its investments compared to other companies in the same industry which is one of the reasons leading to bankruptcy.
7. Total Debt / Total Assets: is the second element in Zmijewski model, it called Debt ratio. This ratio is classified under Leverage ratios, it measures the proportion of a company's assets that are financed by debt, there is a strong relationship between this ratio and the bankruptcy of the company. When the value of this ratio is greater than 1 that mean a considerable portion of a company's debt is funded by assets and that means that this company has liabilities value more than its asset value which is one of the reasons leading to bankruptcy in case suddenly increased of the interest rates. (Investopedia,2021).
8. Current Assets / Current Debt: The third element of the Zmijewski model is liquidity ratio. It is measuring the ability of the company to pay its debit which due date less than one year. The value of this ratio could indicate to bankruptcy if the company liquidity ratio is lower than the industry average. Also,

a very high liquidity ratio could indicate that management is not using its assets efficiently. This ratio could not be used separately as it calculated in above table, but it needs to be compared with industry average.

#### 4.1.8 Springate Model Test

Before starting the analysis using Springate Model, it is important to check The multicollinearity between variables by running the multicollinearity or Variance Inflation Factor (VIF) test:

Source	SS	df	MS	Number of obs	=	58
Model	<b>8.498014</b>	<b>4</b>	<b>2.1245035</b>	F(4, 53)	=	<b>19.26</b>
Residual	<b>5.84681358</b>	<b>53</b>	<b>.110317237</b>	Prob > F	=	<b>0.0000</b>
				R-squared	=	<b>0.5924</b>
				Adj R-squared	=	<b>0.5616</b>
Total	<b>14.3448276</b>	<b>57</b>	<b>.251663642</b>	Root MSE	=	<b>.33214</b>

The result of the multicollinearity or Variance Inflation Factor (VIF) test shows a value between 1 and 5 for all variables which indicates moderately and reasonably correlated.

#### Analyzing and Results one-year prior bankruptcy (t-1):

The sample used is **Sample# 7**.

Variable	VIF	1-VIF
Working capital/total assets	<b>1.45</b>	<b>0.691</b>
EBIT/total assets	<b>1.31</b>	<b>0.765</b>
Profit before tax/current liabilities	<b>1.15</b>	<b>0.866</b>
Sales/total assets	<b>1.03</b>	<b>0.972</b>
Mean VIF	<b>1.23</b>	

Descriptive statistics (mean, median, standard deviation) for each selected variable are provided in Table 36 for both bankrupt group of firms (26 companies) and non-bankrupt group of firms (32 companies) and for total sample consist of (58 companies).

**Table 34.** Descriptive group statistics of Springate Model during (t-1)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Total firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/total assets	-0.0850	0.0192	0.4238	0.1424	0.1146	0.1574	0.0405	0.0909	0.3244
EBIT/total assets	0.0053	0.0035	0.0432	0.1003	0.1014	0.1102	0.0577	0.0612	0.0985
Profit before tax/current liabilities	-0.0917	-0.0755	0.6178	0.5058	0.4771	0.4782	0.2380	0.1646	0.6177
Sales/total assets	0.4956	0.2252	0.5428	0.9219	0.7723	0.5612	0.7308	0.6199	0.5885

**Table 35.** Outline of canonical discriminant functions of Springate Model during (t-1)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
----------	-------------	----	----------	----------	----------------	----------	---

1	1.100	0.41	0.3321	-0,500	0.592	8,69	19,26
---	-------	------	--------	--------	-------	------	-------

The low value of Root Mean Squared Error (Root MSE) = 0.3321 is good because it indicates a low level of prediction errors when compared to actual observed values.

The negative value of Skewness = -0.500 means that distribution is negative Skewness (skewed to the left), and the standard deviation did not overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 59% indicates that almost 59% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 8.69 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=19.26 indicates that model has a good predictive capability.

**Table 36:** Unstandardized and standardized estimates of Springate Model during (t-1)

	<b>b</b>	<b>t</b>	<b>P&gt; t </b>	<b>bStdX</b>	<b>bStdY</b>	<b>bStdXY</b>	<b>SDofX</b>
Working capital/total assets	0.3928	2.3640	0.0220	0.1270	0.7830	0.2540	0.3240
EBIT/total assets	1.6077	2.8000	0.0070	0.1580	3.2050	0.3160	0.0980
Profit before tax/current liabilities	0.1759	1.8190	0.0750	0.1090	0.3510	0.2170	0.6180
Sales/total assets	0.2920	3.3790	0.0010	0.1720	0.5820	0.3430	0.5880
constant	0.1878	2.2420	0.0290	.	.	.	.

The standardized coefficients in Table 30 provide evidence of the relative importance of each variable in the model of bankruptcy predicting. In the short run, the Efficiency factor, specifically the Asset Turnover ratio (Total Sales / Total Assets) is the most important variable in the bankruptcy prediction model for the one year before actual bankruptcy happened.

In summary, during the period (t-1) one year before bankruptcy. the Springate Model correctly re-classified 50 out of 58 cases (86%), indicating strong discriminating power with high ability potentiality for bankruptcy prediction.

### **Analyzing and Results Two-year prior bankruptcy (t-2):**

The sample used is **Sample# 8**

**Table 37:** Descriptive group statistics of Springate Model during (t-2)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Total firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/total assets	0.0725	0.0187	0.1907	0.1676	0.1403	0.1433	0.1249	0.1046	0.1715
EBIT/total assets	0.0191	0.0164	0.0559	0.1340	0.1209	0.0840	0.0825	0.0715	0.0924
Profit before tax/current liabilities	-0.2964	0.0114	1.0350	0.6131	0.4688	0.6117	0.2054	0.2572	0.9389
Sales/total assets	0.5621	0.2666	0.6157	0.9622	0.8751	0.5816	0.7829	0.7266	0.6249

**Table 38.** Outline of canonical discriminant functions of Springate Model during (t-2)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	0.994	0.5	0.375	0.374	0.4811	7.4	12.28

The low value of Root Mean Squared Error (Root MSE) = 0.375 is good because it indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 0.374 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 48% indicates that almost 48% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 7.4 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=12.28 indicates that model has a good predictive capability.

**Table 39:** Unstandardized and standardized estimates of Springate Model during (t-2)

	b	t	P> t	bStdX	bStdY	bStdXY	SDofX
Working capital/total assets	0.5130	1.7420	0.0870	0.0880	1.0230	0.1750	0.1710
EBIT/total assets	2.7099	3.7510	0.0000	0.2500	5.4020	0.4990	0.0920
Profit before tax/current liabilities	0.0496	0.6990	0.4880	0.0470	0.0990	0.0930	0.9390
Sales/total assets	0.1893	2.3530	0.0220	0.1180	0.3770	0.2360	0.6250
constant	0.1058	1.0910	0.2800	.	.	.	.

The standardized coefficients in Table 42 provide evidence of the relative importance of each variable in the model of bankruptcy predicting.

In summary, during the period (t-2) two years before bankruptcy. the Springate Model correctly re-classified 48 out of 58 cases (83%), indicating strong discriminating power with high ability potentiality for bankruptcy prediction.

## Analyzing and Results Three-year prior bankruptcy (t-3):

The sample used is **Sample# 9**

**Table 40.** Descriptive group statistics of Springate Model during (t-3)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Tot firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/total assets	0.0643	-0.0001	0.2302	0.1723	0.1584	0.1482	0.1239	0.0994	0.1953
EBIT/total assets	0.0395	0.0310	0.0577	0.1421	0.1279	0.1048	0.0961	0.0767	0.1004
Profit before tax/current liab	0.1147	0.0613	0.4085	0.7275	0.4217	0.9286	0.4528	0.3155	0.7979
Sales/total assets	0.6268	0.2565	0.7469	1.0054	0.9264	0.5990	0.8357	0.7753	0.6898

**Table 41.** Outline of canonical discriminant functions of Springate Model during (t-3)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	1.030	0.45	0.424	1.805	0.336	9.37	6.69

The low value of Root Mean Squared Error (Root MSE) = 0.424 is good because it indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 1.805 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 33% indicates that almost 33% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors. Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 9.37 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, a value of F=6.69 indicates that model has a good predictive capability.

**Table 42 :** Unstandardized and standardized estimates of Springate Model during (t-3)

	b	t	P> t	bStdX	bStdY	bStdX Y	SDofX
Working capital/total assets	0.4880	1.6400	0.1070	0.0950	0.9730	0.1900	0.1950
EBIT/total assets	2.4725	2.2940	0.0260	0.2480	4.9290	0.4950	0.1000
Profit before tax/current liab	-0.0450	-0.3410	0.7340	-0.0360	-0.0900	-0.0720	0.7980
Sales/total assets	0.1176	1.3370	0.1870	0.0810	0.2340	0.1620	0.6900
constant	0.1758	1.7340	0.0890	.	.	.	.

The standardized coefficients in Table 46 provide evidence of the relative importance of each variable in the model of bankruptcy predicting. In the Long run, the Profitability factor, specifically the Basic Earning power ratio (EBIT / Total Assets) is the most important variable in the bankruptcy prediction model for the two years before actual bankruptcy happened.

**To summarize the ability of the Springgate model to predict bankruptcy within 3 years:**

**Table 43:** Springgate Model accuracy in (t-1) & (t-2) & (t-3)

	<b>t-1</b>	<b>t-2</b>	<b>t-3</b>	<b>Total</b>
Total case tested	58	58	58	174
Type I Error	2	3	7	12
Type II Error	6	7	4	17
<b>S-Score Accuracy</b>	<b>86%</b>	<b>83%</b>	<b>81%</b>	<b>83%</b>

1. (t-1) one years before bankruptcy: Springgate model correctly re-classified 36 out of 58 cases, his predict accuracy one year before bankruptcy is 86%.
2. (t-2) two years before bankruptcy: Springgate model correctly re-classified 34 out of 58 cases, his predict accuracy two year before bankruptcy is 83%.
3. (t-3) three years before bankruptcy: Springgate model correctly re-classified 33 out of 58 cases, his predict accuracy three year before bankruptcy is 81%.
4. In average, during three years before bankruptcy, Springgate model correctly re-classified 145 out of 174 cases, his overall predict accuracy is 83%. this score indicating a medium discriminating power with medium ability potentiality for bankruptcy prediction.
5. When the Springgate model is applied In the short run, the Efficiency factor, specifically the Asset Turnover ratio (Total Sales / Total Assets) is the most important variable in the bankruptcy prediction model. While In the Medium run and Long run, the Profitability factor, specifically the Basic Earning power ratio (EBIT / Total Assets) is the most important variable in the bankruptcy prediction model.
6. Working capital/total assets is the first element of the Springgate model, is classified within the ratios of liquidity, there is a strong positive relationship between the value of S and the value of this element. The companies with a low ratio of net working capital had a low value of S, Because the decrease in the value of the net working capital is evidence of the lack of liquidity in the company, which means that the company is unable to pay its obligations, which is one of the reasons leading to bankruptcy.
7. EBIT/total assets: the second element of the Springgate model is the ratio of return on investment, there is a strong positive relationship between the rate of return on investment where the return on investment is noted from It also has a low S-value, which is one of the reasons leading to bankruptcy since the goal of all companies is to achieve a high rate of return on investment to ensure the continuity of the company.
8. Profit before tax/current liabilities: The third element of the Springgate model is Profit Before Tax / Current Liability, there are relationship between the value of this ratio and company failure. As long as the value of this ratio decreased could indicates that the company is approaching the barrier of financial failure.

9. Sales/total assets: is the fourth element of the Springgate model, the decrease in the value of this percentage is always associated with a decrease in the value of S. Because the decrease in this percentage indicates the inefficiency of the management of this company in investing its assets in order to achieve high sales, which is one of the reasons leading to bankruptcy.

### 4.1.9 Grover Model Test

Before starting the analysis using Grover Model, it is important to check The multicollinearity between variables by running the multicollinearity or Variance Inflation Factor (VIF) test:

Source	SS	df	MS	Number of obs	=	58
Model	<b>7.02342501</b>	<b>3</b>	<b>2.34114167</b>	F(3, 54)	=	<b>17.27</b>
Residual	<b>7.32140257</b>	<b>54</b>	<b>.135581529</b>	Prob > F	=	<b>0.0000</b>
				R-squared	=	<b>0.4896</b>
				Adj R-squared	=	<b>0.4613</b>
Total	<b>14.3448276</b>	<b>57</b>	<b>.251663642</b>	Root MSE	=	<b>.36821</b>

Variable	VIF	1/VIF
Working capital/total assets	<b>2.1</b>	<b>0.477</b>
EBIT / Total assets	<b>1.99</b>	<b>0.502</b>
Net income / Total assets	<b>1.09</b>	<b>0.918</b>
Mean VIF	<b>1.72</b>	

The result of the multicollinearity or Variance Inflation Factor (VIF) test shows a value between 1 and 5 for all variables which indicates moderately and reasonably correlated.

The analyzing and results section of Grover Model Test had been divided into three separate subsections (for three years) because the analysis was conducted individually for each year before bankruptcy. The sample which will be used in Grover Model will consist of 58 companies:

#### **Analyzing and Results One-year prior bankruptcy (t-1):**

The sample used is **Sample# 10**

**Table 44.** Descriptive group statistics of Grover Model during (t-1)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Total firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/tot assets	-0.0973	0.0113	0.4223	0.1513	0.1146	0.1449	0.0398	0.0849	0.3243
EBIT / Total assets	-0.0089	0.0035	0.0893	0.1188	0.1037	0.0652	0.0616	0.0643	0.0996
Net income / Total assets	-0.0760	-0.0154	0.3259	0.0927	0.0880	0.0655	0.0170	0.0374	0.2368

**Table 45.** Outline of canonical discriminant functions of Grover Model during (t-1)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	1.080	0.22	0.3682	-2.409	0.490	16.21	17.27

The low value of Root Mean Squared Error (Root MSE) = 0.3682 is good because it indicates a low level of prediction errors when compared to actual observed values.

The negative value of Skewness = -2.409 means that distribution is negatively Skewness (skewed to the left), and the standard deviation did not overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 49% indicates that almost 49% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 16.21 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=17.27 indicates that model has a good predictive capability.

**Table 46:** Unstandardized and standardized estimates of Grover Model during (t-1)

	b	t	P> t	bStdX	bStdY	bStdXY	SDofX
Working capital/total assets	0.4487	2.1150	0.0390	0.1460	0.8940	0.2900	0.3240
EBIT / Total assets	3.0054	5.8820	0.0000	0.2990	5.9910	0.5970	0.1000
Net income / Total assets	-0.0346	-0.1160	0.9080	-0.0080	-0.0690	-0.0160	0.2370
constant	0.3494	6.0730	0.0000	.	.	.	.

The standardized coefficients in Table 5 provide evidence of the relative importance of each variable in the model of bankruptcy predicting. In the short run, the Profitability factor, specifically the Basic Earning power ratio (EBIT / Total Assets) is the most important variable in the bankruptcy prediction model for one two years before actual bankruptcy happened.

During the period (t-1) one years before bankruptcy. Springate Model correctly re- classified 44 out of 58 cases (76%), indicating strong discriminating power , high ability potentiality for bankruptcy prediction.

## Analyzing and Results Two-year prior bankruptcy (t-2):

The sample used is **Sample# 11**

**Table 47.** Descriptive group statistics of Grover Model during (t-2)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Total firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/total assets	0.0725	0.0187	0.1907	0.1676	0.1403	0.1433	0.1249	0.1046	0.1715
EBIT / Total assets	0.0191	0.0164	0.0559	0.1340	0.1209	0.0840	0.0825	0.0715	0.0924
Net income / Total assets	-0.0466	-0.0045	0.1062	0.1149	0.0956	0.1193	0.0425	0.0472	0.1387

**Table 48.** Outline of canonical discriminant functions of Grover Model during (t-2)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	0.896	0.1	0.379	0.973	0.4586	7.4	15.25

The low value of Root Mean Squared Error (Root MSE) = 0.379 is good because it indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 0.973 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 46% indicates that almost 46% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 7.4 that is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=15.25 indicates that model has a good predictive capability.

**Table 49:** Unstandardized and standardized estimates of Grover Model during (t-2)

	b	t	P> t	bStdX	bStdY	bStdXY	SDofX
Working capital/total assets	0.4122	1.3650	0.1780	0.0710	0.8220	0.1410	0.1710
EBIT / Total assets	2.2798	3.1210	0.0030	0.2110	4.5450	0.4200	0.0920
Net income / Total assets	0.9747	1.9740	0.0540	0.1350	1.9430	0.2700	0.1390
constant	0.2708	3.5030	0.0010	.	.	.	.

The standardized coefficients in Table 54 provide evidence of the relative importance of each variable in the model of bankruptcy predicting. In the medium run, the Profitability factor,

specifically the Basic Earning power ratio (EBIT / Total Assets) is the most important variable in the bankruptcy prediction model for two years before actual bankruptcy happened. During the period (t-2) two years before bankruptcy. the Grover Model correctly re- classified 38 out of 58 cases (66%), indicating strong discriminating power with high ability potentiality for bankruptcy prediction.

### Analyzing and Results Three-year prior bankruptcy (t-3):

The sample used is **Sample# 12**

**Table 50.** Descriptive group statistics of Grover Model during (t-3)

Variables	Bankrupt firms (26)			Non-bankrupt firms (32)			Total firms (58)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Working capital/tot assets	0.0643	-0.0001	0.2302	0.1719	0.1509	0.1482	0.1236	0.0994	0.1952
EBIT / Total assets	0.0395	0.0310	0.0577	0.1443	0.1279	0.1034	0.0973	0.0824	0.1002
Net income / Total assets	0.0024	0.0125	0.1032	0.1168	0.1064	0.0657	0.0655	0.0651	0.1016

**Table 51.** Outline of canonical discriminant functions of Grover Model during (t-3)

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	0.838	0.13	0.4116	0.353	0.362	9.16	10.21

The low value of Root Mean Squared Error (Root MSE) = 0.4116 is good because it indicates a low level of prediction errors when compared to actual observed values.

The positive value of Skewness = 0.353 means that distribution is positively Skewness (skewed to the right), and the standard deviation overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the result value of R<sup>2</sup> is 36% indicates that almost 36% predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, as the value of kurtosis is positive = 9.16 is a sign of fatter tails.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=10.21 indicates that model has a good predictive capability.

**Table 52:** Unstandardized and standardized estimates of Grover Model during (t-3)

	<b>b</b>	<b>t</b>	<b>P&gt; t </b>	<b>bStdX</b>	<b>bStdY</b>	<b>bStdXY</b>	<b>SDofX</b>
Working capital/total assets	0.2092	0.6850	0.4960	0.0410	0.4170	0.0810	0.1950
EBIT / Total assets	1.3545	1.8210	0.0740	0.1360	2.7000	0.2700	0.1000
Net income / Total assets	1.7269	2.2100	0.0310	0.1750	3.4420	0.3500	0.1020
constant	0.2810	3.5100	0.0010	.	.	.	.

The standardized coefficients in Table 77 provide evidence of the relative importance of each variable in model of bankruptcy predicting. In the Long run, the Performance factor, specifically the After-Tax Return Assets ratio (Earning After Tax / Total Assets) is the most important variable in the bankruptcy prediction model for the three years before bankruptcy happened

**To summarize ability of Grover model within 3years:**

**Table 53:** Grover Model Accuracy in (t-1) & (t-2) & (t-3)

	<b>t-1</b>	<b>t-2</b>	<b>t-3</b>	<b>Total</b>
Total case tested	58	58	58	174
Type I Error	14	20	20	54
Type II Error	0	0	0	0
<b>G-Score Accuracy</b>	<b>76%</b>	<b>66%</b>	<b>66%</b>	<b>69%</b>

1. (t-1) one years before bankruptcy: Springate model correctly re-classified 44 out of 58 cases, his predicted accuracy one year before bankruptcy is 76%.
2. (t-2) two years before bankruptcy: Springate model correctly re-classified 38 out of 58 cases, his predicted accuracy two year before bankruptcy is 66%.
3. (t-3) three years before bankruptcy: Springate model correctly re-classified 38 out of 58 cases, his predicted accuracy three year before bankruptcy is 66%.
4. In average, during three years before bankruptcy, Springate model correctly re- classified 120 out of 174 cases, his overall predicted accuracy is 69%. this score indicating a medium discriminating power with medium ability potentiality for bankruptcy prediction.
5. In the short run and medium run, the Profitability factor, specifically the Basic Earning power ratio (EBIT / Total Assets) is the most important variable in the bankruptcy prediction model for one year and two years before actual bankruptcy happened.
6. In the Long run, the Performance factor, specifically the After-Tax Return on Assets ratio (Earning After Tax / Total Assets) is the most important variable in the bankruptcy prediction model for the three years before actual bankruptcy happened.

#### 4.1.10 Meslemani-2022 Model

After this study had tested the effectiveness of all previous bankruptcy prediction models and presented the most important results for them, the common observation in all previous models is that although they are old, they are still effective in predicting bankruptcy today. However, their ability to predict bankruptcy varies from one model to another. However, they nevertheless suffer from a large gap. Each of these models has special conditions for its application; for example, all companies in the study sample must be American and industrial to apply the Altman model. Public companies and the value of their assets should not be less than one million dollars.

The existence of these special conditions for applying each model constitutes a real obstacle that makes the work of those models restricted within the limits of the sample to which only the conditions of the model apply.

Building a comprehensive model for all the previous models whose performance was examined in this study will provide the most capable prediction for future bankruptcy. Therefore, to overcome this problem and overcome the gap that appeared in the previous models, the author conducted many empirical studies and statistical and mathematical tests to reach a comprehensive model that can work under all conditions and predict the bankruptcy of all types of companies.

Based on the requirements of scientific research, we will use two completely separate samples. There is no overlap or repetition between them, the first sample is (group B), and it will be used to perform all the required tests in this model. It consists of 60

companies divided into 29 bankrupt companies symbolized by it the symbol 0, and 31 non-bankrupt or healthy companies symbolized by the symbol 1. and the second group will be called (group A) consists of 60 companies divided into 29 bankrupt companies symbolized by it the symbol 0, and 31 non-bankrupt or healthy companies symbolized by the symbol 1. No tests will be conducted on group A. However, this group will be used to apply the results of the tests that we have conducted on sample B and ensure its accuracy and efficiency. The number of variables used in the sample is eight quantitative variables. The reason for choosing these variables is that after studying previous models, these variables proved that they have an excellent ability to predict bankruptcy, and these eight variables are:

X1 = Current Assets/ Current Liability

X2 = EBIT/Total assets

X3 = Net Sales/Total assets

X4 = Profit After Tax/Total Assets

X5 = Profit before tax/cur liabili

X6 = Retained Earn/Total assets

X7 = Total Liab/Tot Assets

X8= Workin cap/Tot assets

The sample used is **Sample# 14 & 15**. Descriptive statistics (mean, median, and standard deviation) are provided for each specified variable in Table 54 for both the bankrupt group of companies, non- bankrupt group of companies and for a total sample of (60 companies):

**Table 54.** Descriptive group statistics of Meslemani Model

Variables	Bankrupt firms			Non-bankrupt firms			Total firms (60)		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Current Assets/ Current Liability	1.349	1.283	0.919	1.813	1.640	0.738	1.589	1.391	0.855
EBIT/Total assets	-0.003	0.017	0.104	0.074	0.074	0.073	0.037	0.058	0.097
Net Sales/Total assets	1.097	1.154	0.748	0.855	0.767	0.524	0.972	0.892	0.648
Profit After Tax/Total Assets	-0.164	-0.077	0.294	0.046	0.045	0.105	-0.055	0.000	0.240
Profit before tax/current liabilities	-0.258	-0.118	0.663	0.237	0.259	0.549	-0.002	0.035	0.652
Retained Earnings/Total assets	-0.278	-0.044	0.589	-0.101	0.248	2.063	-0.187	0.017	1.528
Total Liability/Total Assets	1.091	0.923	0.477	0.650	0.641	0.191	0.863	0.789	0.419
Working capital/Total assets	-0.081	0.039	0.432	0.168	0.120	0.136	0.048	0.105	0.337

**Table 55.** Outline of canonical discriminant functions of Meslemani Model

Function	Eigen Value	SD	Root MSE	Skewness	R <sup>2</sup>	Kurtosis	F
1	1.6071	0.597	0.4162	-1.281	0.4102	13.82	4.43

The low value of Root Mean Squared Error (0.4162) is good as it indicates a low level of errors in the model's predictions when compared to actual observed values.

The negative value of Skewness means that distribution is negatively Skewness (skewed to the left), and the standard deviation did not overestimate risk.

R<sup>2</sup> is a measure of how well a regression fits the data, the value of R<sup>2</sup> is 41% indicates that almost half of predicting factors' movements are explained by the market, while the rest of the variability is explained by idiosyncratic factors.

Kurtosis measures the likelihood of extreme values on either side of the mean, or what is known as the degree of fat tails, when the distribution is normal then the value of kurtosis will be zero, if the value of kurtosis is positive (13.82) that is a sign of fatter tails. On the opposite side, negative skew or kurtosis may lead to a higher frequency of extreme negative returns.

The F-value of the regression model can be used to test the goodness of fit test R<sup>2</sup>, and thereby assess if model has a predictive capability, a value of F=4.43 indicates that model has a good predictive capability.

The low value of Root Mean Squared Error (Root MSE) is good because it indicates a low level of prediction errors when compared to actual observed values

**Table 56:** Variance Inflation Factor (VIF) for Meslemani model

<b>Variable</b>	<b>VIF</b>
Current Assets/ Current Liability	4.31
EBIT/Total assets	3.81
Net Sales/Total assets	2.95
Profit After Tax/Total Assets	2.51
Profit before tax/current liabilities	1.75
Retained Earnings/Total assets	1.60
Total Liability/Total Assets	1.18
Working capital/Total assets	1.14
<b>Mean VIF</b>	<b>2.41</b>

The result of the multicollinearity or Variance Inflation Factor (VIF) test shows a value between 1 and 5 for all variables which indicates moderately and reasonably correlated. This means we can distinguish between the individual effects of the independent variables on a dependent variable.

**Table 57:** Kaiser-Meyer-Olkin measure (KMO Test):

<b>Variable</b>	<b>kmo</b>
Current Assets/ Current Liability	0.5619
EBIT/Total assets	0.6215
Net Sales/Total assets	0.6901
Profit After Tax/Total Assets	0.6707
Profit before tax/current liabilities	0.7382
Retained Earnings/Total assets	0.7089
Total Liability/Total Assets	0.8025
Working capital/Total assets	0.6445
<b>Overall</b>	<b>0.680</b>

Table 57 presents the result of the Kaiser-Meyer-Olkin measure (KMO Test), has overall result value is 0.68 which indicates that the data has reasonably suited for these types of analyses.

**Table 58:** Standardized and Unstandardized Coefficients of Meslemani model

<b>Variable</b>	<b>Standardized coefficients</b>	<b>Unstandardized coefficients</b>
Current Assets/ Current Liability	0.0590	0.0347
EBIT/Total assets	0.2580	1.3492
Net Sales/Total assets	-0.0020	-0.0013
Profit After Tax/Total Assets	-0.1610	-0.3372
Profit before tax/current liabilities	0.1980	0.1530
Retained Earnings/Total assets	-0.1570	-0.0519
Total Liability/Total Assets	-0.4700	-0.5649
Working capital/Total assets	0.1200	0.1800
constant	.	0.8643

According to calculated Discriminant function coefficients in the previous table, the equation form of the Meslemani-2022 model could be formulated as:

$$M=0.8643 +0.0347X1+1.3492X2-0.0013X3-0.3372 X4+0.1530 X5-0.0519 X6-0.5649X7+0.1800 X8$$

where:

Z= discriminant score presents the total value of the model based on its variables

X1 = Current Assets/ Current Liability

X2 = EBIT/Total assets

X3 = Net Sales/Total assets

X4 = Profit After Tax/Total Assets

X5 = Profit before tax/cur liability

X6 = Retained Earn/Total assets

X7 = Total Liability/Tot Assets

X8= Working capital/Tot assets

The Distinctive score in above formula expresses the final calculated value of the prediction model. The fixed values express the relative importance of the variables used to reach the calculated result of the model.

**Table 59:** The average value of failed & non-failed & Group Centroids of Meslemani model

Failed Company	Group Center-Point	Healthy Companies
0.3048	0.5167	0.7150

All companies have a result value less than the group center point value and closer to the average value of failed companies will re-classified as failed companies. Similarly, all companies have a result value more than the group center point value and closer to the average value of non-failed companies will re-classified as non-failed companies.

**Table 60:** The result of Meslemani predict model using Quantitative Method

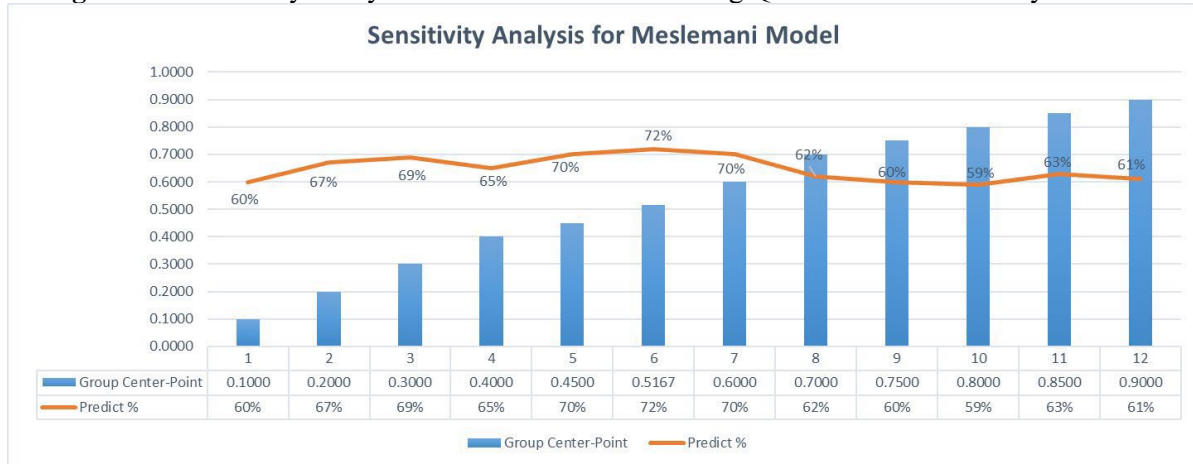
		Failed	Non-failed	Total
<b>Original</b>				
Count		29	31	60
Percentage		48%	52%	100%
<b>Cross-validated</b>				
Count	Faild	20	8	28
	Non-failed	9	23	32
Percentage	Faild	71%	29%	100%
	Non-failed	28%	72%	100%

As table 60 present, Meslemani model successfully predicts 72% of cases tested (60 firms), which consider a high rate of predicting.

To ensure that the model has measured the highest value of the prediction and that the value it presented to distinguish between failed firms and successful firms is the highest possible, we will conduct a sensitivity analyses test with the what-if formula. Let us remember that at the group-

center point value of 0.5167, the model's predictive ability reached up 72%, now we will assume different values for the group-central point and will run the model to see his predict level at each of these supposed points.

**Figure 61:** Sensitivity Analysis for Meslemani Model using Quantitative Factors only



As we can see from the previous graph, we applied sensitivity analyses using 12 different assume values starting from 0.1 to 0.9, and we ran the model one time for each assumed value, which in total 12 times for all the different hypothesized points and recorded the corresponding prediction value for each point. Sensitivity analysis shows that at test number 6: the 0.5167 group center point calculated by the model corresponds to the highest prediction level at 72%, while all the assumed group center points have alower prediction value. This is evidence that the model works effectively and produces the best level of prediction.

## 4.1.11 Business evaluations Methods

### 4.1.11.1 The Price-to-Earnings Ratio (P/E Ratio)

After the definition of the P/E Ratio as one of the most widely used of all Relative Valuation tools for companies for determining the stock valuation. In addition to showing whether a company's stock price is overvalued or undervalued its formula had been provided in the theoretical section, a real example will be presented in this analysis section to get a deeper understanding of this ratio:

The following data were extracted for X company which active within the Tele industry:

Growth Rate (Expected)=7.16%, Beta=0.72 , Risk-Free Rate=0.82% , Risk premium=5%,Cost of Equity=4.42% ,Payout ratio=20%, average P/E Ratio of Tele industry = 12.77, EPS 2019=1.7 , EPS 2018 = 0.74 , EPS 2017 = 2.24 , EPS 2016 =0.86.Telia company stock price 2020= 35.30 SEK.

Based on the above-given information, the P/E Ratio for X company = 30.43, and this value means that

when any investor selects to invest his money in X company, he will pay 30.43 SEK to get 1 SEK of X profit.

The P/E Ratio of X company means nothing unless compared with the average ratio of the others competitors within the same industry which is for the same year ( 12.77 ), this value calculated based on the following info for the top 10 competitors in same industry for the year:

Telekom Austria AG=12.76, Vodafone = -21.8 , United Internet AG = 21.36 , Telia = 30.76 , Tele2= 10.88 , Orange= 5.893 , BT Group = 10.05 , Deutsche = 14.13 , Swisscom= 17.06 , Telenor = 26.97.

As the X company P/E Ratio (30.43) is higher than the average industry ratio (12.77), then we could conclude that stock price of X company is overvalued and that could lead to bankruptcy.

X company fair value per share = Average of EPS \* Average P/E ratio of competitors. Thus, X company fair value per share = 1.385 \* 12.77 = 17.68 SEK.

#### 4.1.11.1 Price/Earnings to Growth Ratio (PEG Ratio)

After the definition of the Price/Earnings to Growth Ratio had been provided in the theoretical section, an example will be presented next to get a deeper understanding of how this ratio works in predicting. By going ahead with the previous example:

after getting the value of the Price/Earnings ratio (30.43). The next step is calculating Earnings growth rate over five years:

<i>Fiscal Period</i>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<i>Earning growth rate over five years</i>
<i>Growth Rate</i>	12.6%	23.2%	18.3%	31.0%	23.5%	21.7%

Next, PEG Ratio formula is applied:

PEG Ratio = (P/E) / Earning growth rate over five years

<i>Fiscal Period</i>	<i>P/E Ratio</i>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<i>Earning growth rate over five years</i>	<i>PEG Ratio</i>
<i>Growth Rate</i>	30.43	12.6%	23.2%	18.3%	31.0%	23.5%	21.7%	1.40

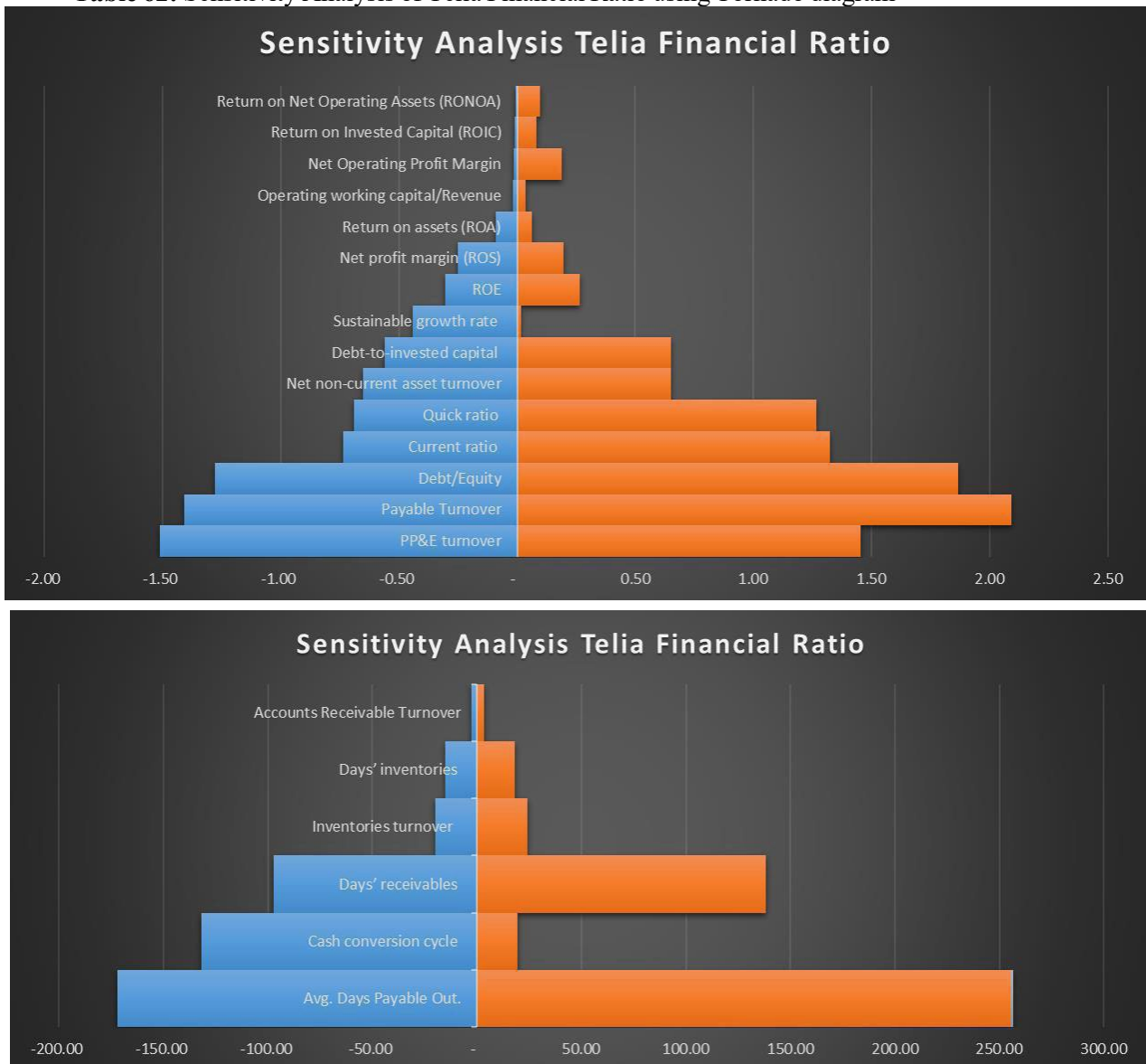
As the PEG ratio value is higher than 1, this indicates that the stock of X company is overvalued, which means unhealthy company that could lead to bankruptcy.

#### 4.1.12 Sensitivity Analysis Using Tornado Diagram.

After a definition of sensitivity analysis using a tornado diagram had provided in the theoretical section, an example will give a deeper understanding of how this method works.

Sensitivity analysis measures the strength of the correlation between the company's primary financial ratios and indicators. It examines the extent to which these indicators are affected due to a possible change in one of them. Table 88 shows a sensitivity analysis of Telia's company financial ratios using the Tornado diagram method.

**Table 62:** Sensitivity Analysis of Telia Financial Ratio using Tornado diagram



**Table 62:** Sensitivity Analysis of Telia Company Financial Ratio using Tornado diagram. **Source: (Meslemani,2021).**

The zero value is the common axis for all financial ratios and indices.

Whenever the distribution of the values of the financial indicators or the financial ratios is symmetrically around the zero axis, this indicates the strength of the correlation between those basic financial ratios and indicators and an increase in the impact of these indicators from the possible change in one of them, which reflects their flexibility, and thus indicates that the company are in a healthy state. When the

company are in a healthy statue so it is not required from the management to take any action to protect the company against any expected bankruptcy or financial failure. From Table 88, we find that the indicators that have a high correlation strength, for example, are:

- PP&E Turnover
- net turnover of non-current assets
- Debt to venture capital
- ROE
- Accounts Receivable Turnover
- Inventory of days
- Inventory turnover

On the other hand, if the values of the indicators or financial ratios are distributed asymmetrically around the axis, this indicates a weak correlation between the company's fundamental financial ratios and indicators and the low impact of these indicators as a result of these indicators a possible change in one of them.

Therefore, it indicates an unhealthy situation, and the management of the company must take urgent action to protect the company from the risks of financial failure or bankruptcy. From Table 88, we find that the indicators that have weak correlation strength, for example, are:

- Fast rate
- Current Ratio
- Payable turnover
- Payment days
- The cash transfer cycle

Sensitivity analysis has highly trusted by financial analysts, business owners, and investors because it provides a visual insight that includes all independent financial variables that depend on the strength of the correlation between its financial indicators. An advantage that other bankruptcy forecasting methods do not provide. It provides strategic information required by corporate decision-makers. This strategic information is used to avoid early bankruptcy after identifying where improvements are needed in the companies' financial structure and provides a reasonable basis for decision-makers to make appropriate investment decisions after understanding the interrelationship between financial indicators.

#### 4.1.13 Credit Health Panel (CHP)

After introducing the definition of Credit Health Panel and its financial matrix in the theoretical section, we will present below two examples of two companies using CHP, the first example is related to a healthy company and the second is to a bankrupt company, and why they are presented. There are two examples to give a deeper understanding of how this method works.

The credit health panel measures the financial indicators of the company based on a financial matrix specially designed for this method, then it compares the calculated value of each of these indicators with the industry average, then the calculated values of these indicators are summarized in three main groups: operational indicators, solvency indicators, liquidity indicators. Finally, the company's financial health score is obtained based on the calculated values of these three groups together and compared to its equivalent credit ratings.

As with sensitivity analysis, the Credit Health Panel method has been trusted by financial analysts, business owners, and investors because it provides visual insight into the most important independent and dependent financial variables. An advantage that other bankruptcy forecasting methods do not provide. It provides strategic information required by corporate decision makers. This strategic information is used to avoid early bankruptcy after identifying where improvements are needed in the companies' financial structure and provides the appropriate basis allowing decision makers to make appropriate investment decisions.

**Table 63** : Example of Failed company using Credit Health Panel:

1 Top 2 Above Average 3 Below Average 4 Bottom

LTM Period Ending:		Aug-31-2021		
Weight (%)	Metric	Score	Company Group Mean*	
<b>Operational (SEK mm)</b>				
2.78	Total Revenue	1	194,703.00	91,634.79
2.78	Total Equity	1	64,409.00	28,063.47
2.78	Return on Capital (%)	3	9.82	12.37
2.78	Recurring Earnings/Total Assets (%)	4	6.96	11.46
2.78	Net Working Capital/Revenue (x)	3	(0.00)	0.03
2.78	Asset Turnover (x)	4	1.05	1.23
2.78	Intangible Assets/Revenue (x)	2	0.05	0.09
2.78	Net Working Capital/Total Assets (x)	3	(0.00)	0.05
2.78	Payables/Receivables (x)	N/A	-	4.89
2.78	Management Rate of Return (%)	3	16.36	19.60
2.78	Gross Margin (%)	1	51.89	41.82
2.78	EBITDA Margin (%)	2	11.55	11.40
<b>Solvency</b>				
4.76	FFO Interest Coverage (x)	2	39.83	27.94
4.76	EBITDA/Interest Exp. (x)	3	29.02	36.92
4.76	FFO to Total Debt (x)	1	0.70	0.41
4.76	Net Debt/EBITDA (x)	2	0.92	1.38
4.76	Total Debt to Capital (%)	2	50.95	64.11
4.76	Total Debt/Total Liabilities (%)	3	55.35	56.56
4.76	Total Debt/Revenue (x)	2	0.34	0.35
<b>Liquidity</b>				
6.67	(FFO + Cash) to Short Term Debt (x)	1	6.42	4.28
6.67	FFO to Gross Profit (x)	1	0.47	0.26
6.67	Basic Defense Interval (days)	2	93.14	93.02
6.67	Current Ratio (x)	3	1.35	1.61
6.67	Quick Ratio (x)	3	0.76	0.87

Company Relative Credit Health Score		Methodology
Overall Score	Financial Panel	Score
Above Average	Operational	Above Average
	Solvency	Above Average
	Liquidity	Above Average

Source: Standard & Poor's Financial Services LLC

The overall Credit Score is: **BBB**, credit status is: Stable, as of 29-Jan-2021. The result of Credit Health Panel's classification for this company is identical to its actual status as (healthy company)

**Table 64** : Example of Non-Failed company using Credit Health Panel :

1 Top 2 Above Average 3 Below Average 4 Bottom				
LTM Period Ending:			Sep-30-2021	
Weight (%)	Metric	Score	Company Group Mean*	
<b>Operational (USD mm)</b>				
2.78	Total Revenue	3	20,144.00	24,926.33
2.78	Total Equity	3	20,727.00	28,497.10
2.78	Return on Capital (%)	3	3.89	5.90
2.78	Recurring Earnings/Total Assets (%)	4	2.56	4.10
2.78	Net Working Capital/Revenue (x)	2	0.04	0.03
2.78	Asset Turnover (x)	4	0.19	0.32
2.78	Intangible Assets/Revenue (x)	N/A	-	0.19
2.78	Net Working Capital/Total Assets (x)	3	0.01	0.01
2.78	Payables/Receivables (x)	3	0.77	0.87
2.78	Management Rate of Return (%)	3	3.70	8.27
2.78	Gross Margin (%)	3	29.45	29.61
2.78	EBITDA Margin (%)	2	30.19	27.26
<b>Solvency</b>				
4.76	FFO Interest Coverage (x)	4	1.31	5.88
4.76	EBITDA/Interest Exp. (x)	4	3.75	8.48
4.76	FFO to Total Debt (x)	4	0.05	0.21
4.76	Net Debt/EBITDA (x)	3	7.16	5.84
4.76	Total Debt to Capital (%)	4	65.12	52.27
4.76	Total Debt/Total Liabilities (%)	3	53.46	56.51
4.76	Total Debt/Revenue (x)	4	2.20	1.54
<b>Liquidity</b>				
6.67	(FFO + Cash) to Short Term Debt (x)	4	0.34	2.69
6.67	FFO to Gross Profit (x)	4	0.36	1.20
6.67	Basic Defense Interval (days)	2	150.85	144.13
6.67	Current Ratio (x)	4	0.65	0.92
6.67	Quick Ratio (x)	3	0.47	0.60
<b>Overall Score</b>	<b>Financial Panel</b>	<b>Score</b>		
<b>Bottom</b>	Operational	<b>Bottom</b>		
	Solvency	<b>Bottom</b>		
	Liquidity	<b>Bottom</b>		

Source: Standard & Poor's Financial Services LLC

The overall Credit Score is **-BB**, credit status is: Negative, as of 15-Jun-2020. The result of Credit Health Panel's classification for this company is identical to its actual status as (Bankrupt company)

## 4.2 Analyzing using non-quantitative Method

This section aims to establish non-quantitative red flags as a prerequisite and complement to the quantitative research in the previous section. When we find significant changes in the industry related to the company, such as changes in objective factors such as policies, laws and regulations, technology or markets, or even unavoidable factors such as natural disasters, we can first use the red flags provided in this part to judge the screening, and then analyze them through the quantitative model mentioned in the previous part, which can greatly improve the efficiency of predicting company bankruptcy.

Argenti believes that the main methods to study the causes and symptoms of corporate failure are as follows: (1) Document analysis (2) Interview analysis (Argenti, 1976, pp. 116 - 117). Since COVID-19 still imposes certain restrictions on social communication, the document analysis method is mainly used in this work. The annual reports published by companies contain important information. This information can explain many firm attributes and organizational outcomes, and the document analysis method can extract this information. We select three representative companies from different industries to study, and we will rely on information obtained from their annual reports issued prior to bankruptcy and signals captured in CEO letters to shareholders in the years prior to bankruptcy to build a list of Red Flag Items to derive any signals that can be used to predict the occurrence of future bankruptcies. In this way, annual reports' voluminous and complicated data is simplified to the most critical red flags for predicting impending bankruptcy. In recent years, there has been a large amount of research on non-quantitative factors for bankruptcy prediction. A review of previous literature and research can provide ideas and references for addressing non-quantitative factors of corporate insolvency.

Godbillon-Camus and Godlewski, in their investigation of the role of information processing in bank intermediation, found that soft information generated in the banking relationship, which is qualitative and unverifiable, is therefore actionable but produces more accurate estimates of the quality of the debtor. According to their findings, having access to soft data helps bankers to lower capital allocation for value-at-risk coverage. (Godbillon& Godlewski,2005).

Purda and Skillicorn developed a data generation tool based on the language used in the management discussion and analysis parts of annual and interim reports to discern between fraudulent and genuine reporting. Through a comparison of various samples, they found that this approach was useful for distinguishing between fraudulent and authentic companies as well as for identifying fraudulent reports from a series of reports issued by a single company (Purda&Skillicorn,2011). This shows that non-quantitative information plays an active role in distinguishing fraudulent reports and that the analysis of non-quantitative information is a

meaningful complement to traditional quantitative methods.

Tetlock et al. examine whether accounting surpluses and stock returns of individual firms can be predicted using simple linguistic measures. They find that other difficult-to-quantify aspects of firm fundamentals can be captured through the language of financial reports (Tetlock et al.,2007). This suggests that stock prices incorporate qualitative information that represents difficult-to-measure aspects of business fundamentals, despite the fact that negative information appears to be underreacted to by investors. (Tetlock et al.,2007).

Engelberg examines the role of information processing costs on post earnings announcement drift, and his study finds that qualitative information has greater predictability for long-term returns (Engelberg,2008).

However, through their review of research, we found that non-quantitative information is not always easy to capture and usually requires higher capital investment or cost. The purpose of this case study is to identify red flags through document analysis, which can effectively overcome this difficulty. Using the red flags list is straightforward to check whether and how many warning signs are present in the check text rather than checking the tone of the text. Red flags are defined by Lundstrom (2009) as a set of circumstances that are unusual in nature or different from normal activity and raise professional suspicion on the part of the auditor, internal auditor or fraud examiner. Since these warning signs indicate problems with risk-taking based on financial statements, red flags is applicable to assessing investment risk(Loughran&McDonald,2009). Brazel et al. provide examples to demonstrate the importance of red flags as an investor analysis tool. They indicate that investors who prioritize fraud risk assessments employ fraud red flags more frequently to avoid potentially fraudulent investments. Non-specialist investors may achieve higher market returns by considering red flags in their investment decisions(Brazel& Warne,2010). With the help of this part, non-professional investors can also make automatic, fast and simple hazard judgments at low cost and then proceed to the next step of evaluation.

**General Motors** went bankruptcy on June 1, 2009.

In order to analyze the non-quantitative factors of GM's bankruptcy, we analyzed GM's annual reports for the last ten years before its bankruptcy, trying to discover its pre-bankruptcy marks and provide information and reference for predicting other companies' bankruptcy in the future:

- 1.The bankruptcy of General Motors has long been a clue, through the 2005 GM annual report, in 2005, GM's auto business had a high debt of \$168.1 billion, with a debt ratio of 104%. The group's total debt was \$480.5 billion, with a debt ratio of 96.7%. This high level of indebtedness also resulted in large annual interest charges, which amounted to \$15.8 billion in 2005, or 8.19% of

operating income. As a result, GM continues to sell assets to ensure the continued operation of its core business (GM, 2006). This shows that GM's huge debt has caused GM to be at risk, but is financial distress the only sign that can be found by analyzing GM's annual reports?

2. In 2000, GM spent \$2.4 billion to acquire a 20% stake in Fiat to form an alliance with it. In 2002, General Motors bought South Korea's Daewoo for about \$300 million (GM, 2003). However, not every expansion project will generate revenue. The 2005 annual report shows that after spending \$2.4 billion to acquire Fiat shares in 2000, G.M. Paid \$2 Billion to Sever Ties to Fiat in 2005, in addition to billions spent on joint projects between the two companies that did not yield any results (GM, 2006). After spending billions of dollars to acquire Saab and invest in new car research and development, Saab has only been profitable for one year since 2000. By analyzing the annual report, we found that the general strategy of global expansion was not successful, it can be said to be over-expansion. The companies acquired by GM are scattered in various places and lack effective resource integration of production and R&D centers.

3. GM's 2007 annual report shows that GM lost \$38.7 billion in 2007, the largest annual loss in the company's 100-year history (GM, 2008). MacDuffie stated that GM was going to continue to develop large vehicles (MacDuffie et al., 2018). But the fact is that the demand for small cars was steadily increasing at this stage due to economical considerations. Due to GM's misjudgment of market demand and focus on large cars and SUV products at the expense of small car development, GM's products were out of balance and outdated again when gas prices began to rise and consumer preferences shifted to small cars again (MacDuffie et al., 2018). According to Micheline Maynard, GM has lagged behind the changes in market consumption in terms of product innovation over the past 20 years (Maynard, 2008). A comparison with Toyota's annual report reveals that GM's misjudgment of market demand and failure to adequately consider market needs has resulted in losing the competition with Japanese cars. As global oil prices continued to rise, GM successively lost its competitive position in Europe and the U.S. mainland, and its market share continued to decline. This failure is also reflected in the 2008 annual report. In 2008, GM Hummer sales were 27,485 units, down 51% from 2007 (GM, 2009).

4. A review of GM's 2008 annual report shows that GM posted a huge loss in 2008, amounting to \$30.9 billion. GM's sales in the U.S. fell 23% in 2008 and 31% in 2009 (GM, 2009&2010). 2007 saw the onset of the subprime mortgage crisis, which tightened credit and made it difficult to borrow money to purchase a car. 2008 saw a sharp spike in gas prices, which caused sales of the U.S. manufacturer, which relies on pickup trucks and SUVs, to plummet. The decline in sales directly led to reduced economies of scale and higher costs (Xue, 2012). It can be seen that GM's

bankruptcy was also related to the world economic environment at that time.

5. By analyzing GM's 2006 annual report, it can be found that the average hourly wage of GM employees in 2006 was \$73.26, including \$39.68 in cash wages and \$33.58 in various benefits and various allowances (GM, 2007). A comparison of the average wages of its competitor, Toyota, which also has plants in the United States, reveals that the average hourly wage is only \$48 (MacDuffie et al., 2018). Retired workers and the benefits they pay are several times the number of active employees, placing a heavy burden on GM. According to GM's 2006 annual report, in 2006, GM spent an average of \$1,635 on employee health insurance for each vehicle produced (GM, 2007). This compares with \$215 for Toyota. Over the past 15 years, GM has spent as much as \$103 billion on pensions and health insurance, averaging about \$7 billion per year (MacDuffie et al., 2018). This has resulted in an increase in GM's cost per vehicle of \$1,600 to \$1,800, making it difficult for GM to compete on price. On average, they earned \$2,400 less than Toyota per car (JAMES B. TREECE, 2005). Because of this, John MacDuffie, a manufacturing expert at the Wharton School of the University of Pennsylvania, argues that of all of GM's failures, including the failure to control small cars, the failure to cut costs, the failure to be tough on the UAW, and the failure to improve fuel efficiency, the biggest failure may have been a failure of management (MacDuffie et al., 2018). The emergence of the subprime mortgage crisis, overlaid with GM's large liabilities and pension liabilities, eventually left GM insolvent with an equity account deficit of \$86.2 billion (GM, 2010). In 2009, GM to file for bankruptcy in New York court under Chapter 11 of the U.S. Bankruptcy Code. This shows that heavy labor costs were also one of the non-quantifiable factors that led to GM's bankruptcy that cannot be ignored. Robert J. Dewar once said that if we were to identify the most important cause of GM's bankruptcy, I think it would be the high cost of labor (Dewar, 2009).

In general, the non-quantitative factors of GM's bankruptcy are: market changes, economic crisis and other objective reasons, risky global expansion strategy, failure to correctly grasp the trend of automobile consumption and consumer demand, and high management costs, especially high labor cost.

**Lehman Brothers** went bankrupt in 2008.

What exactly caused the bankruptcy of Lehman Brothers? This part will analyze the annual reports of Lehman Brothers in the years before its bankruptcy, capture the signs of its bankruptcy, and provide help for other companies and other financial institutions in bankruptcy prediction:

1. Lehman Brothers implemented a multi-role business model (Carlsson, 2015). By analyzing the annual reports of Lehman Brothers from 2003 to 2006, it was found that the fixed income segment

accounts for about half of Lehman Brothers' total revenue each year and its average annual growth is around 25% (LEHMAN BROTHERS, 2004&2007). However, according to the 2007 annual report, after the subprime mortgage crisis in 2007, the performance of Lehman Brothers' once proud fixed income division dropped by 29%, the capital markets division grew by only 2%, and the investment banking and investment management divisions grew by 24% and 28%, respectively (LEHMAN BROTHERS, 2008a). Therefore, it can be seen that after the outbreak of the crisis, the investment banking segment and the investment management segment continued to grow, but the real problem lies in the fixed income segment. Lehman's so-called diversified growth is concentrated diversification or cross-border operation. The so-called diversification of three departments actually generates half of the profits from the fixed income segment, and holds most of the assets belong to the fixed income segment (CSIMarket). Therefore, when capital market problems occur, its assets will be greatly shrunk, coupled with the high financial risk formed by the double-high operating model, the business formed by holding a huge risk position in cross-border operating areas. Thus, it can be seen that the instability of Lehman Brothers' multi-role business model makes Lehman Brothers' ability to regulate risk much weaker, which is the most fundamental reason for the collapse of Lehman Brothers.

2. Looking at the 2007 balance sheet, Lehman Brothers had only \$22.49 billion in net assets out of its \$691.063 billion in assets (LEHMAN BROTHERS, 2008a). According to Lehman Brothers' balance sheets in 2008 and 2007, Lehman Brothers business was highly concentrated in derivative financial instruments such as debt collateral, credit default swaps, etc. that were highly correlated with real estate and failed to reasonably diversify risk through the portfolio (LEHMAN BROTHERS, 2008a&c). Brad Hintz, former chief financial officer of Lehman Brothers, stated that the value of Lehman Brothers' hard-to-value securitized assets was about 2.5 times its net worth (Allan & Roddy, 2008). The shortcomings of Lehman Brothers' investment strategy were fully exposed during the subprime mortgage crisis. By comparing the balance sheets of Lehman Brothers in 2007 and 2008, it was found that Lehman Brothers' leverage increased from 27.67 times in May 2007 to 30.65 times in March 2008, and its position in financial instruments increased by more than \$30 billion (LEHMAN BROTHERS, 2008a&b). Lehman Brothers has limited capital, and its business needs capital. Due to profit pressure, Lehman Brothers adopted a highly leveraged profit model. While this model increases profitability, it also multiplies risk. Through the 2007 annual report of Lehman Brothers, it can be seen that its short-term debt ratio is relatively high (LEHMAN BROTHERS, 2008a). After the crisis, the assets such as real estate mortgage loans and other assets held by it were greatly impaired and difficult to realize, which caused serious problems in the short-term liquidity of the company, and was also one of the important reasons for its final bankruptcy. Thus, it can be seen that the financial structure of

Lehman Brothers is unreasonable, the leverage ratio is too high and it relies too much on short-term financing. This is also reason why Lehman Brothers went bankrupt.

3. Annual reports of Lehman Brothers five years before cording to the bankruptcy, it was found that Lehman Brothers' risk management department was not independent. The risk management department of Lehman Brothers was intended to be separate from the revenue-generating department, yet it is intrinsically impossible for the risk management department to survive without the revenue-generating department. Executive compensation at Lehman Brothers was based on short-term securities trading profits, and CEO severance pay was routinely in the tens of millions of dollars. Driven by attractively high salaries, Lehman's elites pursued huge short-term returns, opted for "toxic securities," engaged in financial risk, and abandoned credit standards. High-paying incentives that leave reasonable boundaries enable executives to take risks and focus only on returns (Ball, 2018). It can be seen that good risk management is also essential for enterprises. Businesses with poor risk management can also become hidden dangers of bankruptcy.

To sum up, the main non-quantitative factors for the bankruptcy of Lehman Brothers were a failed multi-role business model, a highly leveraged operating and investment strategy, and a failed risk management. The multi-role cross-border business model of Lehman Brothers has greatly increased the risk position. In a period of increased market risk, due to the increasing leverage of Lehman Brothers, it has greatly increased the difficulty of adjusting the asset structure and increased the risk of bankruptcy. Of course, it was because of the failure of risk management that Lehman Brothers turned to this model.

**Kodak** had declared bankruptcy in 2012.

1. According to Fuji's 2011 annual report, the total world demand for colour film has declined sharply from 1994 to 2011. Global film sales peaked in 2001, and after that, the market slowly began to shrink, then accelerated, and finally plummeted by 20 or 30 percent a year. In 2010, global demand for photographic film fell to less than a tenth of what it was a decade earlier (Fuji, 2012). It can be seen that changes in the market have a certain impact on the failure of Kodak.
2. With the popularity of the Internet and personal computers in the 1990s, consumers began to buy digital cameras (Trenholm, 2021). But the problem wasn't selling cameras, Kodak sold a lot of digital cameras. According to Kodak's 2004 annual report, Kodak's digital camera sales volume

is the second largest in the North American market. In 2004, Kodak digital cameras sold 8.71 million units, ranking third in the global market (Kodak, 2005). Kodak's 2005 annual report showed that in 2005, Kodak captured 21.3 percent of the US market and was ahead of its Japanese rivals in digital cameras. That year, Kodak's sales increased by 15 percent (Kodak, 2006). But according to Ernest Scheyder, by 2001, Kodak was losing \$60 per digital camera sold (Ernest, 2012). It can be seen that the main problem is that Kodak did not make money with digital cameras. This problem is evident in Kodak's financial reports. According to Kodak's 2000 annual report, although Kodak's photographic division had operating income of \$1.4 billion in 2000, profits quickly disappeared (Kodak, 2001). Film sales generated just \$34 million in revenue in 2011, while the digital camera division lost 10 times as much (\$349 million), according to Kodak's 2011 annual report, the year before its bankruptcy (Kodak, 2012). By analyzing Kodak's financial statements, it can be found that Kodak's profit margin was only 2% towards the world-popular digital cameras. Profit margins were so low that they simply could not support Kodak's survival needs. Compared with the 70% gross profit margin of Kodak film, it is no wonder that low profit margins have become one of the reasons for Kodak's bankruptcy.

3. However, for Fujifilm, which is the same film industry giant as Kodak, it also faced the huge impact of the digital storm, but Fujifilm not only overcame the crisis, but also thrived in this challenging environment. According to Fuji's 2009 annual report, in 2009, 16% of Fuji's total global sales of US\$19.4 billion came from the imaging field represented by photographic film, color cameras, and digital cameras, and 41% came from the information business field, mainly medical, printing and liquid crystal displays. The cultural processing business, which is dominated by document processors, copiers, and printers, accounted for 43% (Fuji, 2010). The 2013 annual report shows that Fuji's sales revenue was 24.4 billion US dollars and operating profit was 1.408 billion US dollars, of which the medical system, pharmaceuticals, life sciences and other business areas achieved sales revenue of 9.339 billion US dollars, accounting for 38% of the total revenue. The traditional film business only accounts for 1% of its sales revenue (Fuji, 2014). Fujifilm appears to have weathered the crisis thanks to a large-scale reorganization and diversification plan. As for Kodak, according to Kodak's annual reports in recent years, has always invested about 6% of Kodak's annual turnover in research and development. Kodak has also made many attempts to transform, trying to reverse the declining market trend. But according to Clark Gilbert & Joseph L. Bower, Kodak established businesses that failed in traditional markets and did not find new ones (Clark & Joseph, 2002). In fact, Kodak had long recognized that film was a doomed business and wanted to capture new markets with a completely different portfolio. According to Kodak's 2003 annual report, in order to accelerate the development of the digital product market, Kodak reorganized its business units and integrated its internal business into five

major sectors: digital and film imaging, commercial printing, display and components, medical imaging and commercial imaging (Kodak, 2004). Compared with Fujifilm's commitment to diversification, Kodak's strategic transformation has a huge gap in both depth and breadth, because Kodak has made the wrong analysis and insisted on the declining photography industry. At the same time, Kodak gave up as long as it encountered difficulties in the transformation process. For example, Kodak entered the pharmaceutical, chemical and other industries. But later, in order to focus on the imaging industry, Kodak sold all the pharmaceutical companies and chemical companies (Kodak, 2008). Therefore, Kodak's diversification strategy was a failure, and it was the lack of diversification that caused Kodak to go bankrupt.

4. Kodak did not invest in an alternative to photographic film because Kodak made the wrong decision. Poor decisions are ultimately a management problem. By analyzing Kodak's annual reports over the years, it is clear that Kodak's leadership was constantly changing, resulting in a discontinuous corporate strategy. In addition, Kodak's satisfaction with the market share and monopoly position of traditional film products, lack of forward-looking analysis of the market, and the absence of a clear idea of development also reflect Kodak's management's overly conservative management philosophy, which seriously affects the strategic transformation of the company and hinders its innovative development. Therefore, conservative and changeable management philosophy is another important reason for Kodak's bankruptcy.

Thus, it can be seen that the non-quantitative factors of Kodak's bankruptcy are not only the economic crisis and changes in market demand, but also Kodak's unreasonable diversification and slow strategic transformation. In fact, it is Kodak's management problem, and its conservative and changeable business philosophy bears inescapable responsibility for Kodak's bankruptcy.

In conclusion, by analyzing these three representative companies, it can be seen that the main non-quantitative factors for the enterprise falling into bankruptcy crisis are the poor internal management of the enterprise, the lack of flexibility of the enterprise, the corporate strategy failures, the risk management failures, the inability to respond to changes in the external environment in a timely manner, or the sudden major changes in the external environment of the enterprise.

Through the above analysis of non-quantitative factors, we can find that these companies showed certain signs of business management and financial status before bankruptcy, and we use this to build red flag list, as shown in Table 65

**Table 65:** Non-quantitative red flag list.

Ser	Reason
1	Financial fraud
2	Acquisitions by other companies
3	Risky expansion strategies
4	Failed multi-role business model
5	High production costs and competition
6	Merge with other companies
7	Serious mistakes in corporate strategic decision-making
8	Serious Lack of innovation or products development
9	Poor capital operation and scheduling
10	Poor corporate financial structure
11	Failed risk management
12	Poor capital invested in research and development

### 4.3 Merging Quantitative & Non-Quantitative Methods

Now, after we had completed the analysis using quantitative methods and had demonstrated using sensitivity analysis that the computed predicted value is the best possible value and no higher value can be provided by using the quantitative methods only, and then after we completed reviewed the analysis by using the non-quantitative methods, we will set the following Hypothesis:

***Merging the quantitative methods with non-quantitative methods in the same model will enhance our ability to predict bankruptcy.***

The rationale for motivation merging quantitative methods with non-quantitative methods into a single prediction model is that bankruptcy is the final stage of a firm's failure. Companies do not reach bankruptcy and liquidation before they go through multiple successive stages of failure. The first stages begin with the emergence of some problems in the company's performance as a whole or some of its divisions. Then comes the stage of economic failure, which is characterized by reduced sales and increased inventory volume - which leads to increased production costs and reduced profits. Then the financial stumbling stage begins, characterized by the beginning of a decline in liquidity and profitability. After the stage of financial failure, the company begins the stage financial failure. At this stage, it becomes clear that the administrative and financial efficiency of the company is weak in the performance of all or some of its economic activities. The imbalance in the financial structure of the company increases its dependence on loans. The short period of financing its activities, then the stage of technical failure, which is characterized by the company's failure to keep pace with technical

development, and then the stage of legal failure before the company reaches the stage of formal filing for bankruptcy.

Based on the results generated from the chapter 4.2-Analyzing using non-quantitative factors that could lead to bankruptcy, we could divide the non-quantitative factors into two groups:

1. Dangerous non-quantitative factors that lead to bankruptcy
2. Non-Dangerous non-quantitative factors that do not lead to bankruptcy (reduce the profitability, market share, net profit, ext but not lead to bankruptcy).

By back to our sample (group B ) and sorting the companies that the model had failed to predict their bankruptcy using quantitative factors, we assume that these companies went into bankruptcy due to non-quantitative factors.

Using the method of analyzing the annual reports and CEO letters to shareholders published in the years before actual bankruptcy happened, we can specify the non-quantitative reason that led to the bankruptcy of each company. If the reason is classified as secondary factors that do not lead to bankruptcy. In that case, no action is required for this company because its non-quantitative factors are not dangerous and did not lead to failure. However, If the reason is classified as Majors factor that leads to bankruptcy and included in the table (72 ). In that case, this non-quantitative reason must be taken into account and calculated its value in predict model.

To calculate the weighted value of primary non-quantitative reason and enter it into predict model, we use the following formula:

$$QFWV=IF (S=1, CP-MCV) *1.1$$

where:

QFWV: Qualitative Factor Weighted value

S: Actual status of the company, S=1 for Healthy company or S=0 for failed company.

CP: Center-Point value calculated by the model

MCV: Calculate Value by model for this company using quantitative factors only.

1.1: Constant amount.

after calculating the Qualitative Factor Weighted value for the companies that have a major non-quantitative factor, we rerun the model, it will generate the following result:

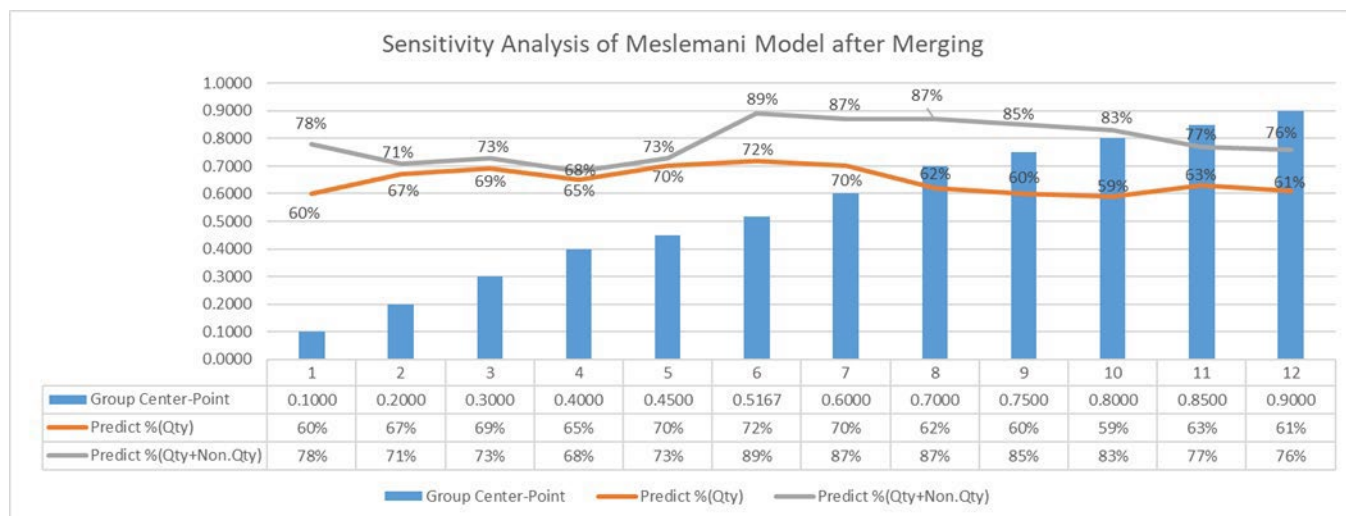
**Table 66:** Result of Meslemani Model predict after Merging Qty & Qualitative Methods

		Failed	Non-failed	Total
<b>Original</b>				
Count		26	26	52
Percentage		50%	50%	100%
<b>Cross-validated</b>				
Count	Fail	29	8	37
	Non-failed	0	23	23
Percentage	Fail	78%	22%	100%
	Non-failed	0%	100%	100%

As we can see, merging quantitative factors with non-quantitative factors in the same model increased the prediction ability to 89% (the average of 78% and 100% , after it was 72% using quantitative only).

Now let us do sensitivity analyses for the model after merging the quantitative factors with non-quantitative factors in the same model:

**Figure 67:** Sensitivity Analysis after merging Quantitative & Non-quantitative factors



In a conclusion: the sensitivity analysis result is shown in the above figure. The Merging of the quantitative methods with non-quantitative methods in the same model increases the ability to predict bankruptcy from 72% to 89%.

**Figure 68:** Meslemani-2022 Model

Meslemani-2022 Model to predict financial bankruptcy of Companies						
Input s		M=0.8643 +0.0347X1+1.3492X2-0.0013X3-0.3372 X4+0.1530 X5-0.0519 X6-0.5649X7+0.1800 X8+NQF				
Description	value	Variable	Independent Variables	Variable Value	Factore	Weighted Values
Current Assets	308		<b>Quantitative Factors:</b>			
Currunt Liability	126	X1	Current Assets/ Current Liability	2.4500	0.0131	0.0321
EBIT	16	X2	EBIT/Total assets	0.0193	1.8371	0.0354
Net Sales	931	X3	Net Sales/Total assets	1.1519	0.0182	0.0210
Profit After Tax	- 328	X4	Profit After Tax/Total Assets	-0.4057	0.0372	-0.0151
Profit before Tax	- 333	X5	Profit before tax/current liabilities	-2.6509	0.1218	-0.3229
Retained Earnings	82	X6	Retained Earnings/Total assets	0.1014	-0.034	-0.0034
Total Assets	809	X7	Total Liability/Total Assets	1.0908	-0.2465	-0.2689
Total Liability	882	X8	Working capital/Total assets	0.2253	0.2289	0.0516
Please fill the inputs value here			Constant			0.5653
			<b>Non-Quantitavie Factors(NQF)</b>			0.0020
			<b>If M value :</b>			<b>0.0971</b>
			If M Model value is More 0.5167... The company is Healthy		>0.5167	
			If M Model value is less 0.5167...The company will went to Bankruptcy		<0.5167	
			<b>Final Result</b>			<b>Bankrupt</b>

## 5. The Results of this study

*This section will present the main results that concluded by this study*

The study achieves many important and significant results, which could be summarized as follows:

- 1) The Principal Components Analyzing shows a high positive correlation score between most of the components, which makes PCA use reasonable. In addition, the result of the PCA test gave us an indicator of which variables have a better ability to predict than others. The Eigenvalues test shows that most components have a high ability to describe the variance of the factors within the study sample. The overall result of the Kaiser-Meyer-Olkin Measure (KMO Test) indicates that the data is reasonably suited for these analyses. The problem of heteroscedasticity disappeared after correcting the heteroscedasticity test in STATA. The multicollinearity test or Variance Inflation Factor (VIF) test results for all variables indicate moderately and reasonably correlated. The negative value of Skewness means that distribution is negatively Skewness, and the standard deviation did not overestimate risk.

**Table 69:** Summary of All Bankruptcy Models Average Predicting Accuracy %

	Meslemani Model (Qty)	Meslemani Model (Qty+Non.Qty)	C ash-Flow Model	Altman Model	Zijewski Model	Springate Model	Grover Model	Average All Models
Number of Companies	120	120	100	30	58	58	58	
t-1	72%	89%	81.8%	100%	62%	86%	76%	81%
t.2				97%	59%	83%	66%	76%
t-3				90%	57%	81%	66%	74%
Average Accuracy %	72%	89%	81.8%	96%	59%	83%	69%	79%

- 2) This study succeeded, after analyzing previous prediction models and doing a lot of empirical studies, in establishing and designing a comprehensive model (**Meslemani-2022 Model**) for predicting bankruptcy that unifies all previous bankruptcy prediction models together. The results of the tests that were carried out on this comprehensive model showed that it has a high ability to predict bankruptcy, amounting to 72%, and it can be used for forecasting with high efficiency in all markets, all economic activities, and all types of public and private companies. In addition, to predicting using quantitative factors, this study successfully merged the quantitative factors of bankruptcy with non-quantitative factors in the Meslemani-2022 model. This merging enhanced the predicting level of the model and enabled it to achieve a higher prediction level (after the merging, the prediction level had increased to 89% after it was 72% before merging).
- 3) This study succeeded in achieving very positive results in testing previous bankruptcy prediction models and proving that although they are old models, they are still effective in predicting until now, albeit to varying degrees, and succeeded in creating an early warning signal that warns of bankruptcy three years before it occurs.
- 4) This study proved the validity of the first hypothesis by conducting the multi discriminant analysis on a sample consisting of 100 companies and using seven **cash flow** variables. The cash flow ratios succeeded in predicting the bankruptcy of 81.8 % of cases tested.
- 5) This study succeeded in proving the validity of the second hypothesis by conducting the multi discriminant analysis on a sample consisting of 30 companies and using **Altman's model** with five variables. During the period (t-1), one year before bankruptcy. The Altman Z-Score model correctly re-classified 30 out of 30 cases (100%), indicating discriminating solid power with high ability potentiality for bankruptcy prediction. During the period (t-2) two years before the bankruptcy. The Altman Z-Score model correctly re-classified 29 out of 30 cases (97%), indicating discriminating solid power with high ability potentiality for bankruptcy prediction. During the period (t-3) three years before the bankruptcy. The Altman Z-Score model correctly re-classified 27 out of 30 cases (90%), indicating discriminating solid power with high ability potentiality for bankruptcy prediction. When dealing with a potential bankruptcy in the short-run (t-1) and medium run (t-2). the Profitability factor, specifically the Basic Earning power ratio (EBIT / Total Assets), is the most critical variable in the bankruptcy prediction model for the one year or two years before actual bankruptcy happened. While, when dealing with a potential bankruptcy in the long run (t-3), the Profitability factor, specifically the Internal growth rate ratio (Retained earnings / Total Assets), is the most critical variable in the bankruptcy prediction model for the three years before actual bankruptcy happened. When these two ratios are combined, the Altman Model could successfully predict bankruptcy in

100% of cases for t-1, 97% for t-2, and 90% for t-3. overall prediction level for three years was 96%.

- 6) By using **the Zmijewski model** which consist of three variables. During the period (t-1) one year before bankruptcy. The Zmijewski model correctly re-classified 36 out of 58 cases (62%), indicating above-average discriminating power with the medium ability of potentiality for bankruptcy prediction. During the period (t-2) two years before the bankruptcy. The Zmijewski model correctly re-classified 34 out of 58 cases (59%), indicating above-average discriminating power with the medium ability of potentiality for bankruptcy prediction. During the period (t-3) three years before the bankruptcy. the Zmijewski model correctly re-classified 33 out of 58 cases (57%), indicating above-average discriminating power with the medium ability of potentiality for bankruptcy prediction. When the Zmijewski model applies In the short run, the Leverage factor, specifically the Debt ratio (Total Debt / Total Assets), is the most critical variable in the bankruptcy prediction model for the one year before actual bankruptcy happened. While In the medium run and long run, the Performance factor, specifically the After-Tax Return on Assets ratio (Earning After Tax / Total Assets), is the most critical variable in the bankruptcy prediction model for two and three years before actual bankruptcy happened.
- 7) By using **the Springate model** which consists of four variables. During the period (t-1) one year before bankruptcy. The Springate Model correctly re-classified 50 out of 58 cases (86%), indicating discriminating solid power with high ability potentiality for bankruptcy prediction. During the period (t-2) two years before the bankruptcy. The Springate Model correctly re-classified 48 out of 58 cases (83%), indicating discriminating solid power with high ability potentiality for bankruptcy prediction. During the period (t-3) three years before the bankruptcy. The Springate Model correctly re-classified 47 out of 58 cases (81%), indicating discriminating solid power with high ability potentiality for bankruptcy prediction. When the Springate model applies In the short run, the Efficiency factor, specifically the Asset Turnover ratio (Total Sales / Total Assets), is the most critical variable in the bankruptcy prediction model. While In the Medium run and Long run, the Profitability factor, specifically the Basic Earning power ratio (EBIT / Total Assets), is the most critical variable in the bankruptcy prediction model.
- 8) By using **the Grover Model**, with consists of three variables. During the period (t-1) three years before the bankruptcy. The Springate Model correctly re-classified 44 out of 58 cases (76%), indicating discriminating solid power with high ability potentiality for bankruptcy prediction. During the period (t-2) three years before the bankruptcy. The Springate Model correctly re-classified 38 out of 58 cases (66%), indicating discriminating solid power with high ability potentiality for bankruptcy prediction. During the period (t-3) three years before the bankruptcy. The Springate Model correctly

re-classified 38 out of 58 cases (66%), indicating medium discriminating power with medium ability potentiality for bankruptcy prediction. When the Grover model applies in the short run and medium run, the Profitability factor, specifically the Basic Earning power ratio (EBIT / Total Assets), is the most critical variable in the bankruptcy prediction model for one year two years before actual bankruptcy happened. While in the Long run, the Performance factor, specifically the After-Tax Return on Assets ratio (Earning After Tax / Total Assets), is the most critical variable in the bankruptcy prediction model for the three years before actual bankruptcy happened.

- 9) The **Corporate relative evaluation Methods** and how they can be used in predicting corporate bankruptcy has been clarified by introducing two of the most important methods of business relative valuation. After identifying the two methods, the mechanism of their work was explained through two examples, and it was concluded that if the company's share price is evaluated above its fair value, or if the company itself is more than its fair value, this is considered an indication that the company's financial position is unhealthy and may mean that the company will turn towards bankruptcy.
- 10) The method of **sensitivity analyzes using Tornado diagram** and how it can be used in predicting corporate bankruptcy has been clarified by providing a graphic example for Telia's financial ratios. This strategic information is used to avoid early bankruptcy after identifying where improvements are needed in the companies' financial structure and provides an appropriate basis that allows decision makers, after understanding the interrelationship between financial indicators, to make appropriate investment decisions.
- 11) The method of the **credit health panel** and how it can be used in predicting corporate bankruptcy is illustrated by providing two examples of two companies, the first example of a sound company and the second example of a bankrupt company. As in sensitivity analysis, this method has been trusted by financial analysts, business owners, and investors because it provides a visual view of the most important variables Independent and affiliated finance. It provides the information required by corporate decision-makers. This strategic information can be used to avoid early bankruptcy after identifying where improvements are needed in the companies' financial structure and providing the appropriate basis for allowing decision-makers to make appropriate investment decisions.
- 12) This study succeed for the first time in **merging the quantitative factors of bankruptcy with non-quantitative factors in the Meslemani-2022 model**, this merging enhanced the predicting level of the model and enable it to achieve a higher prediction level ( after the merging, the prediction level had increased to 89% after it was 72% before merging )

13) Using document analysis, this study also analyzes non-quantitative factors that may lead to corporate bankruptcy, as a complement to quantitative methods. Through the analysis, it can be found that there are certain signs in the operation and financial status of the enterprise before going bankrupt, thus we have established a non-quantitative red flags list. The establishment of the non-quantitative red flags list greatly overcomes the problem of the excessive cost of capturing non-quantitative factors from company annual reports and other materials and improves the efficiency of predicting corporate bankruptcy

Based on above results, this study succeeds through its hypotheses in providing a sufficient answer to the main study question.

## 6 The limitations that this study faced

---

*In this section, we will present the limitations and difficulties that are faced by this study*

---

During its preparation, this study encountered several limitations and obstacles that can be summarized as follows:

1. Some previous bankruptcy models are old, for example, since 1968, so the related references are also old and sometimes challenging to find. Although the author tried to use recent references, sources, and articles as much as possible, he sometimes found himself having to rely on Some old references because they are considered essential sources in predicting bankruptcy.
2. Each model has unique and different conditions for running in the sample. That imposes the use of multiple samples in the study instead of a single sample.
3. Uncomplete data of some companies three years before the date of bankruptcy of some companies led to the exclusion of some companies from the study sample.
4. The special conditions to use some statistical tests had set limitations in front of this study. In addition, the limitation of time makes it difficult to restrict multi samples.
5. Documents such as company annual reports may be inaccurate and subjective and cannot fully document or reflect the actual situation of a company objectively.
6. In the document study of this paper, the three representative companies selected also have the subjectivity of the authors, and the non-quantitative factors derived are prone to

generalization because the non-quantitative causes of corporate bankruptcy are the result of multiple factors combined, with different factors interacting with different companies, some of which are hidden and cannot be fully reflected in the annual reports and other materials.

## 7 Recommendations of this Study

---

*In this section, we will present the recommendations and advises that companies must adhere to avoid bankruptcy*

---

In order to avoid bankruptcy, companies must adhere to the following recommendations

1. The first recommendation from this study to business owners to adopt the comprehensive (Meslemani-2022 model) after it has proven its success in predicting bankruptcy with a high degree of efficiency in all business sectors and for all types of companies.
  - a. Companies must increase their ability to pay off short-term obligations because the probability of a company's bankruptcy increases as the value of its operating cash flow ratio divided by its current liabilities decreases.
2. Companies must increase their ability to cover interest obligations on debt. The higher the ratio of operating cash flows, interest, and taxes divided by the value of interest, the less likely the company will default on interest.
3. Companies should increase their ability to monetize their sales by increasing the operating cash flow margin ratio.
4. Companies should increase their cash-generating capacity for all assets, i.e., assets provided by both creditors and shareholders of the company, by increasing the ratio of operating cash flow return to total assets.
5. Companies should raise their liquidity ratio because the low value indicates that the company is under pressure.
6. Businesses should raise their Sales by a three-year compound annual growth rate because a decline in the average value of Sales at a three-year compound annual growth rate is an indicator of bankruptcy.

7. Companies should increase their Profitability factor. Specifically, the Basic Earning power ratio because as the ratio of (The value of Earning before interest and tax divided by total assets) decreases, the probability of a company's bankruptcy increases.
8. Companies should increase their Profitability factor. Specifically, the Internal growth rate ratio, because as the ratio of Retained earnings divided by total Assets decreases, the probability of a company's bankruptcy increases.
9. Companies should increase the ratio of working capital to total assets Because the decrease in the value of the networking capital is evidence of the lack of liquidity in the company, which means the company is unable to pay its obligations, which may lead to bankruptcy.
10. Business Owners should take attention to the level of retained earnings. Some companies do not distribute profits to shareholders because of a lack of liquidity or because they have an accumulated deficit, which leads to bankruptcy.
11. Companies should increase the ratio of the market value of shareholders' equity. The importance of this element is because it measures the relationship between shareholders' equity and the company's debts, so if the ratio is low, this is evidence that the value of the company's debts is greater than the value of its assets. Therefore the company will not be able to pay its obligations, which is one of the reasons leading to bankruptcy.
12. Business Owners should pay attention to the ratio of sales to assets. Because the decrease in this percentage indicates that the company management's inefficiency in investing its assets to achieve high sales, which is an important reason leading to bankruptcy.
13. Business owners should pay attention to the Return on total assets ratio, which measures how well a company's investments generate value. When the Return on total assets ratio is low, it indicates that the company is not good at generating profit from its investments compared to other companies in the same industry, which leads to bankruptcy.
14. Business owners should pay attention to the Debt ratio. This ratio measures the proportion of a company's assets financed by debt. When the debt ratio value is greater than 1, that means assets fund a considerable portion of a company's debt. That means that this company has liabilities value more than its asset value which is one of the reasons leading to bankruptcy in case suddenly increased of the interest rates. (Investopedia,2021)
15. Business owners should pay attention to the liquidity ratio. It measures the ability of the company to pay its debt, which is due to a date of less than one year. The value of this ratio could indicate bankruptcy if the company liquidity ratio is lower than the industry average. Also, a very high liquidity ratio could indicate that management is not using its assets efficiently.
16. Business owners should pay attention to the Rate of Return on investment because the low rate of Return on investment is one of the reasons leading to bankruptcy, given that the goal of all

companies is to achieve a high rate of Return on investment to ensure the continuity of the company's business.

17. Business valuation methods are useful because it detects whether the company's stock price is higher than its fair value. Similarly, a sensitivity analysis test is useful because it analyses the strength of links between the company's financial indicators and reveals areas that need improvement within its financial structure to avoid bankruptcy.
18. Companies should realize the importance of risk management from a strategic perspective and improve the risk management model from a dynamic point of view so that potential risks can be detected promptly. Besides, enterprises should choose a proper operation and management model. Conducting environmental analysis using Porter's Five Forces and other methods, making strategic decisions based on environmental analysis, corporate vision, and mission, determining strategic goals, and using the strategic goals as a guide to determine the appropriate operation and management mode for the enterprise. The risk management system also needs to be improved. Enterprises should recognize the importance of risk management from a strategic perspective and implement a comprehensive three-dimensional evaluation, that is, to weigh the balance between growth, profit, and risk (Martin,2021). Finally, businesses must improve their risk early warning system in order to make crisis management the standard. Enterprises should enhance early warning theory, choose early warning instruments, recruit and develop risk early warning management expertise, improve the early warning system, and make crisis management the norm. (Lukason& Laitinen,2016).
19. Enterprises should promote innovative ideas and enhance the competitiveness of enterprises. And innovative ideas mean not only attention to product innovation, but also management innovation, increased investment in scientific research funds, the introduction of talent, and continuous development of new products and high-quality services, in order to attract more consumer groups and enhance the company's market share. Companies also should shift development attention to structural improvement, strengthen market development strategy, keep pace with the trend of market changes, and carefully plan a strategic plan in line with their development.

## **8. Suggestions for subsequent relevant studies**

After the success of this study in building a comprehensive model used to predict bankruptcy in all business sectors and markets and for all types of public or private companies, this comprehensive model proved to have a high predictive ability in 72% of the companies that It has been tested. The predicted level increased to 89% after the model's success in merging quantitative methods and non-quantitative methods in one model.

Due to the importance of the subject of bankruptcy prediction, and its continuous need for more research and studies, Our suggestion to researchers to conduct more future studies on the subject of bankruptcy prediction is to do more studies about the merging of quantitative methods and non-quantitative methods in one product model in order to enhance the ability of the model from 89% to 100% of tested companies.

## **9. The Conclusion**

The cases of corporate bankruptcies worldwide are increasing and becoming more and more complex. Moreover, the demand for an effective model for predicting bankruptcy before it occurs is increasing simultaneously.

The author argues that this study is not intended to test previous bankruptcy prediction models, but to demonstrate that previous bankruptcy prediction models are still effective in predicting bankruptcy to date.

This study succeeded in demonstrating that previous bankruptcy prediction models are still effective in predicting bankruptcy to this day, albeit to varying degrees. The big gap in the previous models is that each model has special conditions regarding the type of firms it can predict, the type of industries, and the legal form of these firms. These special conditions make the effectiveness of these models limited. They work within the small corporate standard samples. The author considers this gap to be a loophole that must resolve.

The author considers the main contribution of this study to be that it successfully bridged the gap in previous models by designing a new bankruptcy prediction model, a comprehensive model capable of uniting all previous models together. In addition, this comprehensive model can predict the bankruptcy of industrial and non-industrial firms, public and private.

Experimental studies applied to this new model have proven great effectiveness in predicting bankruptcy, reaching 72% by using quantitative factors after applying it to 120 industrial and non-manufacturing companies, American and non-American, public and private. This model has successfully merged the quantitative and non-quantitative factors in the same model. This merging increased his prediction ability from 72% to 89%. This result was tested using sensitivity analyses, and the result proved that the given result generated by the model is the best.

The author also argues that another significant contribution of this study is to successfully

test the effectiveness of all quantitative models for forecasting in a single study and highlight the importance of other non-quantitative methods. These methods include business assessment, sensitivity analysis, credit health panel, and analysis of non-quantitative factors that may lead to bankruptcy. Explaining the role of these methods in predicting bankruptcy is a new contribution to this study that was not present in previous studies.

Thus, by its significant contributions and success in substantiating the validity of the study hypotheses, this study reasonably and adequately answered the main study question.

## 10. References

- Al-Rifai. (2017). Using the Altman model to predict the distress of industrial companies listed on the Amman Stock Exchange. Middle East University, Department of Accounting and Finance.
- (Arminian, 2016, pp. 208–214) Arminian A. (2016). Investigate the Ability of Bankruptcy Prediction Models of Altman and Springate and Zmijewski and Grover in Tehran Stock Exchange, 7(4).
- Alostaz, A.O. (2015). Predicting Corporate Failure Using Cash Flow Statement Based Measures “ An Empirical Study on The Listed Companies in The Palestine Exchange. Thesis, Master of Business Administration, Islamic University of Gaza, Gaza.
- (Altman ,1968,p.589–609)E.I. Altman. (1968). Financial ratios, discriminant analysis and the prediction of corporation bankruptcy, J. Finance 23
- Aziz. (1988, September). Bankruptcy Prediction - an Investigation of Cash Flow Based Models, *Journal of Management Studies* 25:5. ([accountingtools.com](http://www.accountingtools.com)) <https://www.accountingtools.com/articles/the-altman-z-score-formula.html>
- (Accounting Tools Z score definition), <https://www.accountingtools.com/articles/the-altman-z-score-formula.html>
- (Altman Z Score Formula), <https://www.accountingtools.com/articles/the-altman-z-score-formula.html>
- Altman. (2020) "Predicting Financial Distress of Companies": REVISITING THE Z- SCORE AND ZETA® MODELS. Stern.nyu.edu: 15–22.
- (Argenti,1976, p.116-117) John Argenti. (1976) Corporate collapse: the causes and symptoms, John Argenti, McGraw-Hill, London , 1976, 9 (6).
- (Azdanfar ,2008) Darush Yazdanfar. (2008, November). The bankruptcy determinants of Swedish SMEs, Mid Sweden University, Institute for Small Business& Entrepreneurship.
- (Akhigbe et al.,2005, p.48-64) Aigbe Akhigbe, Anna D. Martin& Ann Marie Whyte.(2005). Contagion effects of the world's largest bankruptcy: the case of WorldCom, Aigbe, Department of Finance, College of Business Administration, University of Akron, USA. The quarterly review of economics and finance,1.
- (Allan & Roddy, 2008) Allan Sloan& Roddy Boyd.(2008, JULY 3). How Lehman lost its way. [https://money.cnn.com/2008/07/02/news/companies/lehman\\_sloan\\_boyd.fortune/](https://money.cnn.com/2008/07/02/news/companies/lehman_sloan_boyd.fortune/)
- (Balcaen& Ooghe,2006) S. Balcaen& H. Ooghe. (2006). 35 years of studies on business failure: an overview of the classical statistical methodologies and their related problems, British Account. Rev. 38 ,63–93.
- (Biafore,2010) Bonnie Biafore. (2010). Spot Hanky Panky with Cash Flow Analysis. <https://www.oreilly.com/library/view/on-line-investing-hacks/0596006772/ch04s19.html>
- (Bhandari et al., 2013, p.667-676) Bhandari.(2013,July 1). Predicting business failure using cash flow statement- based measures, Vol.39 (7),. Emerald Group Publishing, Ltd Managerial finance.
- (Brooks&Chris, 2014) Brooks&Chris. (2014). *Introductory Econometrics for Finance. Third Edition. Cambridge University Press, UK.*
- (Ball,2018 ) Laurence M. Ball.(2018). The Fed and Lehman Brothers: setting the record straight on a financial disaster .Cambridge, United Kingdom; New York, NY: *Cambridge University Press.*
- (Brazel& Warne,2010)Brazel, J., K. Jones and R.

- Warne. (2010). Investor Perceptions about Financial Statement Fraud and Their Use of Red Flags. [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1460820](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1460820), accessed 28 February, 2012
- F. Colline. (2020). Bankruptcy Prediction Analysis: A Case Study of Retail Companies in Indonesia, Universitas Kristen Krida Wacana, Indonesia, *Advances in Economics, Business and Management Research*, volume 151.
- (Clark & Joseph, 2002) Clark Gilbert & Joseph, L. Bower. (2002, May). Disruptive Change: When Trying Harder Is Part of the Problem. *Harvard Business Review*. <https://hbr.org/2002/05/disruptive-change-when-trying-harder-is-part-of-the-problem>
- (CSIMarket) CSIMarket. <https://csimarket.com/stocks/segments.php?code=LEH>
- (Damodaran, 2012) Damodaran, A. (2012). Investment valuation: Tools and techniques for determining the value of any asset (Vol. 666). John Wiley & Sons.
- (Dewar, 2009) Robert J. Dewar. (2009). A Savage Factory: An Eyewitness Account of the Auto Industry's Self-Destruction. Author House
- (Dan Bigman, 2013) Dan Bigman. (2013, October 30). How General Motors Was Really Saved: The Untold True Story Of The Most Important Bankruptcy In U.S. History.
- (Davey & Walsh, 2013) Monica Davey & Mary Williams Walsh Billions. (2013, July). in Debt, Detroit Tumbles Into Insolvency. New York Times. Retrieved September 2, 2020, from <https://www.nytimes.com/2013/07/19/us/detroit-files-for-bankruptcy.html>
- (Deakin, 1972) Deakin. (1972). A Discriminant Analysis of Predictors of Business Failure.
- (David, 1994) George S., David J. 1994. Wharton On Dynamic Competition Strategy [M].
- (Dechow et al., 2007) Dechow, P., W. Ge, C. Larson, & R. Sloan. (2007, July) "Predicting Material Accounting Manipulations," Working Paper.
- (Edward I et al., 2017) Edward I. Altman, Małgorzata Iwanicz-Drozdowska, Erkki K. Laitinen & Arto Suvas. (2017). Financial Distress Prediction in an International Context: A Review and Empirical Analysis of Altman's-Score Model. *Journal of International Financial Management & Accounting* 28:2 2017 ©2016 John Wiley & Sons Ltd.
- (Evangels, 2021) Evangels Sfakianakis. (2021). Bankruptcy prediction model for listed companies in Greece. Investment Management and Financial Innovations.
- (Ernest, 2012) Ernest Scheyder. (2012). Focus on past glory kept Kodak from digital win. <https://www.reuters.com/article/us-kodak-bankruptcy-idUSTRE8011N020120119>
- (Engelberg, 2008) Engelberg, J. (2008). Costly Information Processing: Evidence from Earnings Announcements. [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1107998](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1107998), accessed 28 February, 2012)
- (Financial Ratios Formula), Wharton University of Pennsylvania. -USA, <https://wrds-www.wharton.upenn.edu/documents/78/Financial-Ratios-Formulae.pdf>
- (Fredy, 2018, pp. 52–62) Fredy H. (2018) 'THE PREDICTION OF BANKRUPTCY IN THE PULP AND PAPER INDUSTRY COMPANY LISTED IN INDONESIA STOCK EXCHANGE ON 2011-2016 PERIOD USING Z-SCORE'. *South East Asia Journal Of Contemporary Business, Economics and Law*, 15(5).
- (Fuji, 2012) FujiFilm. (2012). Fujifilm Annual Report 2011 [https://ir.fujifilm.com/en/investors/ir-materials/integrated-report/main/010/teaserItems1/01/linkList/0/link/ff\\_ar\\_2011\\_all.pdf](https://ir.fujifilm.com/en/investors/ir-materials/integrated-report/main/010/teaserItems1/01/linkList/0/link/ff_ar_2011_all.pdf)
- (Fuji, 2010) FujiFilm. (2010). Fujifilm Annual Report 2009 [https://ir.fujifilm.com/en/investors/ir-materials/integrated-report/main/012/teaserItems1/01/linkList/0/link/ff\\_ar\\_2009\\_all.pdf](https://ir.fujifilm.com/en/investors/ir-materials/integrated-report/main/012/teaserItems1/01/linkList/0/link/ff_ar_2009_all.pdf)
- (Fuji, 2014) FujiFilm. (2014). Fujifilm Annual Report 2013 [https://ir.fujifilm.com/en/investors/ir-materials/integrated-report/main/08/teaserItems1/02/linkList/0/link/ff\\_ar\\_2013\\_all.pdf](https://ir.fujifilm.com/en/investors/ir-materials/integrated-report/main/08/teaserItems1/02/linkList/0/link/ff_ar_2013_all.pdf)
- (Glen, 2016). Kaiser-Meyer-Olkin (KMO) Test for Sampling Adequacy. Statistics How To <https://www.statisticshowto.com/kaiser-meyer-olkin/>
- (Germantonet et al., 2009) Germanton's, N., Verges, K. & Christopoulos A. (2009). Can Altman Z-Score Model Predict Business Failure in Greece? *Research Journal of International Studies*, 12, 1-11.
- (Godbillon & Godlewski, 2005) Godbillon-Camus, B. and C. Godlewski. (2005). *Credit Risk Management in Banks: Hard Information, Soft Information and Manipulation*. <http://papers.ssrn.com/sol3/papers.cfm?abstractid=882027>
- (GM, 2008) GM 2007 Annual Report. (2008). [https://www.annualreports.com/HostedData/AnnualReportArchive/g/NYSE\\_GM\\_20](https://www.annualreports.com/HostedData/AnnualReportArchive/g/NYSE_GM_20)

17.pdf

(GM,2006)GM.(2006).General Motors Corporation 2005 Annual Report. [https://www.annualreports.com/HostedData/AnnualReportArchive/g/NYSE\\_GM\\_2005.pdf](https://www.annualreports.com/HostedData/AnnualReportArchive/g/NYSE_GM_2005.pdf)

(GM,2007)GM.(2007).General Motors Corporation 2006 Annual Report. [https://www.annualreports.com/HostedData/AnnualReportArchive/g/NYSE\\_GM\\_2006.pdf](https://www.annualreports.com/HostedData/AnnualReportArchive/g/NYSE_GM_2006.pdf)

(GM,2009)GM.(2009).General Motors Corporation 2008 Annual Report. <https://www.sec.gov/Archives/edgar/data/40730/000119312509045144/d10k.htm>

(GM,2010)GM.(2010).General Motors Corporation 2009 Annual Report. <https://www.sec.gov/Archives/edgar/data/1467858/000119312510078119/d10k.htm>

(Gil Sadka,2006,p 439-475) Gil Sadka.(2006).The Economic Consequences of Accounting Fraud in Product Markets: Theory and a Case from the U.S. Telecommunications Industry (WorldCom).Columbia Business School Columbia University; American Law and Economics Review, 3.

(Grove et al.,2010) Hugh Grove ,Tom Cook ,Eric Streeper&Greg Throckmorton.(2010). *Bankruptcy and Fraud Analysis: Shorting and Selling Stocks. Journal of Forensic & Investigative Accounting Vol. 2,Issue 2.*

(Higgins & Walker ,2019) Colin Higgins & Robyn Walker.(2019,February 28).Ethos, logos, pathos: Strategies of persuasion in social/environmental reports. Accounting Forum. Published online, ISSN: 0155-9982 (Print) 1467- 6303 (Online) <https://www.tandfonline.com/loi/racc20>.

(Hossari & Rahman, 2005), Hossari G&Rahman,S.(2005). "A comprehensive formal ranking of the popularity of financial ratios in multivariate modeling of corporate collapse", *Journal of American Academy of Business*, 6(1), 321-327.

(Henderson,1970) Bruce Henderson.(1970). Boston Matrix Product Portfolio Model <https://www.tutor2u.net/business/reference/boston-matrix-and-product-portfolios>"

( Hornyak,2019)Tim Hornyak.(2019,July 18). How Canon, Nikon and other Japanese camera companies are fighting for survival in the Smartphone era. CNBC.

(Hambrick, 1988) Hambrick,D.C. & D'Aveni,R.A. (1988) . Large Corporate Failures as Downward Spirals. *Administrative Science Quarterly*, 33, No. 1.

(Investopedia.com) <https://www.investopedia.com/terms/v/variance-inflation-factor.asp>

(ITPS, 2007)ITPS.(2007). Bankruptcies and hearings on compositions without bankruptcy 2007, S2008:002, Östersund, Sweden.

(Investopedia) Price-to-Earnings (P/E) Ratio Definition –, [tps://www.investopedia.com/terms/p/price-earningsratio.asp](https://www.investopedia.com/terms/p/price-earningsratio.asp)

(Investopedia), Analysis Definition –, <https://www.investopedia.com/terms/s/sensitivity-analysis.asp>

(Investopedia,2021)Kopp. (2021).Multiple Discriminant Analysis (MDA),<https://www.investopedia.com/terms/m/multiple->

(Investopedia,2021)Haye.(2021). Debt Ratio. <https://www.investopedia.com/terms/d/debtratio.asp>

(Jardin, 2016) Philippe du Jardin.(2016,October 1).A two-stage classification technique for bankruptcy prediction. *European Journal of Operational Research*, 254, 236-252.

(Judicial Conference of the UnitedStates,2020)Judicial Conference of the United States. (2020, February). Revision of Certain Dollar Amounts in the Bankruptcy Code Prescribed Under Section 104(a) of the Code. Federal Register, 84 FR 3488 . Retrieved August 10, 2020, from <https://www.federalregister.gov/d/2019-01903>

(Joseph et al., 1980, p.1001-1016) JOSEPH; JONES, CHARLES P, SWARY&ITZHAK.(1980,September).An Analysis of Risk and Return Characteristics of Corporate Bankruptcy Using Capital Market Data AHARONY, Oxford, UK: Blackwell Publishing Ltd *The Journal of finance (New York)*, 35 (4).

(Jones,2016,P.23-38).Jones, S. (2016).A Cash Flow Based Model of Corporate Bankruptcy in Australia. *JAMAR*, 14(1), 23-38.

(Jardin ,2007)P.D. Jardin.(2007). Préviation de la défaillance et réseaux de neurones: léapport des méthodes numériques de sélection de variables (Ph.D. thesis), Université de Nice-Sophia-Antipolis.

(Jaki & Cwiek ,2020)Jaki & Cwiek..(2020).*Bankruptcy Prediction Models Based on Value Measures, Journal of Risk and Financial Management*,2021, 14, 6.

(Jardin, 2009, pp. 39–46)du Jardin, P.(2009).Bankruptcy prediction models: How to choose the most relevant variables(pp. 39–46).`Bankers, Markets & Investors.

(JAMES B. TREECE, 2005) JAMES B. TREECE(2005,March 31).Japan's health care

gives Toyota edge: country picks up tab for automaker's retirees. AUTOMOTIVE NEWS.

(Kumar&Ravi ,2007)P. Kumar,&V. Ravi. (2007).Bankruptcy prediction in banks and firms via statistical and intelligent techniques – a review, Eur. J. Oper. Res. 180 (1),1–28,Kreditrapporten , <https://kreditrapporten.se/>

(Kodak ,2008 ) Kodak.(2008). Kodakb2007 annual report. <https://investor.kodak.com/static-files/49c2166d-4a65-4e28-b70e-b5e6f4ace723>

(Kodak, 2001) EASTMAN KODAK.(2001). EASTMAN KODAK COMPANY 2000 ANNUAL REPORT [https://www.annualreports.com/HostedData/AnnualReportArchive/e/NASDAQ\\_KODK\\_2000.pdf](https://www.annualreports.com/HostedData/AnnualReportArchive/e/NASDAQ_KODK_2000.pdf)

(Kodak, 2004). EASTMAN KODAK..(2004). EASTMAN KODAK COMPANY 2003 ANNUAL REPORT <https://investor.kodak.com/static-files/905f2cfe-ba83-406e-87de-315b43e24631>

(Kodak, 2005) EASTMAN KODAK .(2005). EASTMAN KODAK COMPANY 2004 SUMMARY ANNUAL REPORT <https://investor.kodak.com/static-files/a16b9904-4716-415b-97f6-30461898f6ca>

(Kodak, 2006) EASTMAN KODAK.(2006). EASTMAN KODAK COMPANY 2005 ANNUAL REPORT [https://www.annualreports.com/HostedData/AnnualReportArchive/e/NASDAQ\\_KODK\\_2005.pdf](https://www.annualreports.com/HostedData/AnnualReportArchive/e/NASDAQ_KODK_2005.pdf)

(Kodak, 2010) Eastman Kodak.(2010). Eastman Kodak 2009 Annual Report. <https://www.annualreportowl.com/Kodak/2012/Annual%20Report?p=2>

(Kodak, 2012) EASTMAN KODAK.(2012). EASTMAN KODAK COMPANY 2011 ANNUAL REPORT

(Kodak, 2013) Eastman Kodak.(2013). Eastman Kodak. 2012 Annual Report. <https://investor.kodak.com/static-files/fb96e5f1-1a6f-4cc7-87c7-f4224828cc17>

(KMIA,2018) OLIVER KMIA.(2018,October 19) Why Kodak Died and Fujifilm Thrived: A Tale of Two Film Companies. <https://petapixel.com/2018/10/19/why-kodak-died-and-fujifilm-thrived-a-tale-of-two-film-companies/>

(Lukason& Laitinen,2016) Lukason, O. & Laitinen, E.K.(2016).Failure Processes of Old Manufacturing Firms in Different European Countries.Investment Management and Financial Innovations,13, (2-2).

(LIOUDIS,2021) NICK

LIOUDIS.(2021,January,30). The Collapse of Lehman Brothers: A Case Study. <https://www.investopedia.com/articles/economics/09/leh-man-brothers-collapse.asp>"

(Lin et al.,2012,p. 421– 436)W.-Y. Lin, Y.-H.Hu&C.-F.Tsai.(2012)Machine learning in financial crisis prediction: a survey, IEEE Trans. Syst. Man Cybernet. — Part C: Appl. Rev. 42 (4).

(LEHMAN BROTHERS, 2004) LEHMAN BROTHERS.(2004). LEHMAN BROTHERS 2003 Annual Report. <https://sec.report/Document/0001047469-04-005692>

(LEHMAN BROTHERS, 2007) LEHMAN BROTHERS.(2007). LEHMAN BROTHERS 2006 Annual Report. <https://sec.report/Document/0001104659-07-010272/>

(LEHMAN BROTHERS, 2008 a) LEHMAN BROTHERS.(2008). LEHMAN BROTHERS 2007 Annual Report. [http://mattmg83.github.io/cynicalcapitalist/documents/\[Lehman\]%20Lehman%20Brothers%202007%20Annual%20Report.pdf](http://mattmg83.github.io/cynicalcapitalist/documents/[Lehman]%20Lehman%20Brothers%202007%20Annual%20Report.pdf)

(LEHMAN BROTHERS,2008b)LEHMAN BROTHERS.(2008,October 1).LEHMAN BROTHERS REPORT OF PRELIMINARY THIRD QUARTER RESULTS AND STRATEGIC RESTRUCTURING 2008. [https://www.sec.gov/Archives/edgar/data/806085/000110465908057829/a08-22764\\_2ex99d1.htm](https://www.sec.gov/Archives/edgar/data/806085/000110465908057829/a08-22764_2ex99d1.htm)

(LEHMAN BROTHERS,2008c ) LEHMAN BROTHERS.(2008,May 31).LEHMANBROTHERS SECOND QUARTERLY REPORT, For the quarterly period ended May. [https://www.sec.gov/Archives/edgar/data/806085/000110465908045115/a08-18147\\_110q.htm](https://www.sec.gov/Archives/edgar/data/806085/000110465908045115/a08-18147_110q.htm)

(Laitinen, 1991 ) Laitinen,E.K. (1991).*Financial Ratios and Different Failure Processes. Journal of Business Finance & Accounting, vol. 18.*

(Loughran&McDonald,2009)Loughran, T. and B. McDonald .(2009).When is a Liability not a Liability? Textual Analysis, Dictionaries, and 10-Ks', *Journal of Finance, Vol.66, No.1 (February), pp. 35-65.*

(MacDuffie et al.,2018) John Paul MacDuffie, Kent Smetters& Morris Cohen.(2018, September 12)The Auto Bailout 10 Years Later: Was It the Right Call? <https://knowledge.wharton.upenn.edu/article/auto-bailout-ten-years-later-right-call>

(Meslemani ,2021)Meslemani.(2021).Financial Statement Analysis and Corporate Valuation, Telia Company AB.Göteborg University.

- (Minhas ,2020,p.252-268)Minhas.(2020).Altman's Z- score analysis: a case of Nahar Spinning Mills Limited (The Nahar Oswal Group).Rajinder Inderscience Publishers (IEL) *International journal of critical accounting*, 11 (3).
- (Mattias,2008)Mattias.(2008,November).The bankruptcy determinants of Swedish SMEs.Institute for Small Business & Entrepreneurship, Belfast, N. Ireland
- (Megagame&Paramita,2020)Megagame&Paramita a.(2020).Analysis Financial Distress Prediction With Model Altman Z-score, Zmijewski, And Grover In The Sub Sector Retail Listed On The Indonesian Stock Exchange 2014-2018 Period
- (Maynard,2008)Micheline Maynard.(2008,December 5).At G.M., Innovation Sacrificed to Profits .The New York Times.
- (Martin,2021) Marci Martin.(2021,December 17). How Porter's Five Forces Can Help Small Businesses Analyze the Competition. <https://www.businessnewsdaily.com/5446-porters-five-forces.html>
- (Platt&Harlan, 1990,p.1183-1194) Platt&Harlan D.(1991). *A note on the use of industry-relative ratios in bankruptcy prediction*. Marjorie Amsterdam: Elsevier B.V, *Journal of banking & finance*,15 (6).
- (Prihadi,2010)Prihadi, T.(2010).Analisis Laporan Keuangan: Teori & Aplikasi. Cetakan I, PPM, Jakarta.
- (ProfitGuard,2022, <https://www.eprofitguard.com/index.php/resources/bankruptcy-list>)
- (Purda&Skillicorn,2011)Purda, L. and D. Skillicorn.(2011) Identifying Fraud from the Language of Financial Reports <http://ssrn.com/abstract=1670832>
- (Qi et al., 2013) Qi Yuan, Yoan Michael, Eric Séverin&Amaury Lendasse.(2013).Bankruptcy prediction using Extreme-learning-Machine And Financial expertise. Elsevier B.V.
- (Ramo & Watar, 2010) Ramo & Al-Watar,.(2010).The use of financial analysis methods in predicting the failure of Industrial Contribution companies. College of Administration and Economics - Mosul University, Rafidain Development
- (Rashad,2019, p 309-328) Rashad Abdel-khalik.(2019).How Enron Used Accounting forPrepaid Commodity Swaps to Delay Bankruptcy for One Decade: The Shadowy Relationships With Big Banks Rashad Abdel-khalik, *Journal of accounting, auditing & finance*,2.
- ( Sun et al.2014, p.41-56)Sun, Jia; Li, Hui; Huang,Qing-Hua; He, Kai-Yu & Elsevier B.V.(2014,February).*Predicting financial distress and corporate failure: A review from the state-of-the-art definitions, modelling, sampling, and featuring approaches*, *Knowledge-based systems*, 57.
- (Sienly,2020,p.115-123) M. Sienly Veronica I.(2020,August).Using Cash Flow Ratios To Establish A Manufacturing Bankruptcy Prediction Model(Vol.20 (2)). Maranatha Christian University, Bandung, West Java, Indonesia, *Journal management Indonesia*.
- (Silvana ,2020) Andi Silvana.(2020).*Financial Statement Ratio Analysis to Predict Bankruptcy on Company Registered in BEI -Jakarta.*, *Hasanuddin Economics and Business Review*,.03:3 , 122–127.
- (Suwaidan,2003,p.89-104) Suwaidan, M.(2003).*The Ratio Model Versus The Cash Flow Model And The Prediction of Bankruptcy: An Empirical Examination*. *Abhath Al-Yarmouk Journal*, 19(2B).
- (Sinarti&Sembiring,2015,p. 354-359)Sinarti&Sembiring.(2015.)*Bankruptcy Prediction Analysis of Manufacturing Companies Listed in Indonesia Stock Exchange*, *International Journal of Economic and Financial Issues*,5(Special Issue).
- (Schilit,2003)Schilit, H.(2003) Financial Shenanigans.Center for Financial Research Analysis.
- (Trenholm, 2021) Richard Trenholm .(2021, May 31).History of digital cameras: From '70s prototypes to iPhone and Galaxy's everyday wonders. CNET. <https://www.cnet.com/tech/computing/history-of-digital-cameras-from-70s-prototypes-to-iphone-and-galaxys-everyday-wonders/>
- (Tetlock et al.,2007)Tetlock, C., M. Saar-Tsechansky and S. Macskassy. (2007).More Than Words: Quantifying Language to Measure Firms' Fundamentals. <http://papers.ssrn.com/sol3/papers.cfm?abstractid=923911>
- (U.S. Courts,2020)U.S. Courts.(2020, July).2019-2020 Bankruptcy Filings. Bankruptcy Filings Fall 11.8% for Year Ending June 30, 2020. Retrieved August 11, 2020, from <https://www.uscourts.gov/news/2020/07/29/bankruptcy-filings-fall-118-percent-year-ending-june-30>
- (United States Congress,2016)United States Congress. (n.d.). (2016).The Puerto Rico Oversight, Management, and Economic Stability Act . PROMESA; H.R. 5278, S. 2328. Retrieved September 2, 2020, from <https://fas.org/sgp/crs/row/R44532.pdf>
- (Wang et al., 2014,p.2353-2361) Gang Wang, Jian

Ma&Shanlin Yang.(2014).An improved boosting based on feature selection for corporate bankruptcy prediction, School of Management, Hefei University, China, Expert system with applications 41.

(Wu et al.,2010)Wu, Gaunt&Gray.(2010). *A comparison of alternative bankruptcy prediction models, Journal of Contemporary Accounting & Economics 6 (2010) 34–45*, Clive

Gaunt, Stephen Gray, UQ Business School, University of Queensland, Australia.  
<https://www.bankruptcydata.com/>

(Xue,2012) Xue Bai.(2012).The Effects of the 2007-2009 Economic Crisis on Global Automobile Industry.State University of New York College at Buffalo, Buffalo State College.<https://core.ac.uk/download/pdf/230661682.pdf>

# 11. Appendix

## A.1 List of tables

Table #	Description
Table 1	Monthly bankruptcy cases of Swedish companies during the last 3 years
Table 2	Initial sample of USA Bankrupt Companies 1997-2021 classified based on the reason of Bankrupt
Table 3	Summary of All Samples used in this study allocated by model and period of time
Table 4	Initial List of variables namused in predictor
Table 5	Principal Component Analysis of main Statical study sample
Table 6	Eigenvalue of main statical study sample
Table 7	KMO Test of main statical study sample
Table 8	Descriptive group statistics of main study sample
Table 9	Descriptive group statistics of cash flow sample model
Table 10	Outline of canonical discriminant functions of cash flow model during period (t-1)
Table 11	Standardized and Unstandardized Coefficients of cash flow sample model
Table 12	The average value of failed & non-failed & Group Centroids of cash flow sample model
Table 13	The final result of the Cash Flow Ratios predict model
Table 14	Descriptive group statistics of Altman Model during (t-1)
Table 15	Outline of canonical discriminant functions of Altman Model during (t-1)
Table 16	Unstandardized and standardized estimates of Altman Model during (t-1)
Table 17	Descriptive group statistics of Altman Model during (t-2)
Table 18	Outline of canonical discriminant functions of Altman Model during (t-2)
Table 19	Unstandardized and standardized estimates of Altman Model during (t-2)
Table 20	Descriptive group statistics of Altman Model during (t-3)
Table 21	Outline of canonical discriminant functions of Altman Model during (t-3)
Table 22	Unstandardized and standardized estimates of Altman Model during (t-3)
Table 23	Altman Z-Score test accuracy in (t-1) & (t-2) & (t-3)
Table 24	Descriptive group statistics of Zmijewski Model during (t-1)
Table 25	Outline of canonical discriminant functions of Zmijewski Model during (t-1)
Table 26	Unstandardized and Standardized estimates of Zmijewski Model during (t-1)
Table 27	Descriptive group statistics of Zmijewski Model during (t-2)
Table 28	Outline of canonical discriminant functions of Zmijewski Model during (t-2)
Table 29	Unstandardized and standardized estimates of Zmijewski Model during (t-2)
Table 30	Descriptive group statistics of Zmijewski Model during (t-3)
Table 31	Outline of canonical discriminant functions of Zmijewski Model during (t-3)
Table 32	Unstandardized and standardized estimates of Zmijewski Model during (t-3)
Table 33	Summary of Zmijewski value in (t-1) & (t-2) & (t-3)
Table 34	Descriptive group statistics of Springate Model during (t-1)
Table 35	Outline of canonical discriminant functions of Springate Model during (t-1)
Table 36	Unstandardized and standardized estimates of Springate Model during (t-1)
Table 37	Descriptive group statistics of Springate Model during (t-2)
Table 38	Outline of canonical discriminant functions of Springate Model during (t-2)
Table 39	Unstandardized and standardized estimates of Springate Model during (t-2)
Table 40	Descriptive group statistics of Springate Model during (t-3)

Table 41	Outline of canonical discriminant functions of Springate Model during (t-3)
Table 42	Unstandardized and standardized estimates of Springate Model during (t-3)
Table 43	Springate Model accuracy in (t-1) & (t-2) & (t-3)
Table 44	Descriptive group statistics of Grover Model during (t-1)
Table 45	Outline of canonical discriminant functions of Grover Model during (t-1)
Table 46	Unstandardized and standardized estimates of Grover Model during (t-1)
Table 47	Descriptive group statistics of Grover Model during (t-2)
Table 48	Outline of canonical discriminant functions of Grover Model during (t-2)
Table 49	Unstandardized and standardized estimates of Grover Model during (t-2)
Table 50	Descriptive group statistics of Grover Model during (t-3)
Table 51	Outline of canonical discriminant functions of Grover Model during (t-3)
Table 52	Unstandardized and standardized estimates of Grover Model during (t-3)
Table 53	Grover Model accuracy in (t-1) & (t-2) & (t-3)
Table 54	Descriptive group statistics of Meslemani Model
Table 55	Outline of canonical discriminant functions of Meslemani Model
Table 56	Variance Inflation Factor (VIF) for Meslemani model
Table 57	Kaiser-Meyer-Olkin measure (KMO Test) for Meslemani Model
Table 58	Standardized and Unstandardized Coefficients of Meslemani model
Table 59	The average value of failed & non-failed & Group Centroids of Meslemani model
Table 60	The final result of Meslemani predict model
Table 61	Sensitivity Analysis for Meslemani Model using Quantitative Factors only
Table 62	Sensitivity Analysis of Telia Financial Ratio using Tornado diagram
Table 63	Example of Failed company using Credit Health Panel
Table 64	Example of Non-Failed company using Credit Health Panel
Table 65	Non-Quantitative red flag list
Table 66	Result of Meslemani Model predict after Merging Qty & Qualitative factors
Table 67	Sensitivity Analysis for Meslemani Model after merging Qty & Quality Factors
Table 68	Meslemani-2022 Model
Table 69	Summary of All Bankruptcy Models Average Predicting Accuracy %

## A.2 Terms Definitions

During this study, The following terms will use , following will explain the definitions of this terms to enable the reader of this study to understand it smoothly:

**Type I Error:** this is an error that arises because the prediction tool indicates that the company is not bankrupt, but the company is bankrupt. This causes high costs because it is predicted that it will not go bankrupt so that investors will invest, and in fact, the company will go bankrupt, and investors will lose some asset value (Prihadi, 2010), this term will be used in testing all models using quantitative methods.

**Type II Error:** is an error that happens when investors predict a bankrupt company and then there is no investment. It turns out that the company is not bankrupt. In this case, the investor misses the opportunity to make a profit. Finally, Type II Error is lower cost than Type I Error" (Prihadi, 2010), this term will be used in testing all models using quantitative methods.

**Multiple Discriminant Analysis (MDA):** is a statistical technique commonly used by financial analysts, financial planners, and investment advisors to predict the companies' bankruptcy or evaluate potential investments when multi variables have been used. The Multiple Discriminant Analysis is practical to classify different data sets by setting a rule or selecting a value that will provide the most meaningful separation. (Investopedia,2021)

**Variance Inflation Factor (VIF):** A statistical concept indicates the increase in the variance of a regression coefficient because of collinearity. (CFI)

The results of this test could be explained as follows:

If VIF = One, no multicollinearity

If VIF is more than one and less than Five = moderately correlated. This means we can distinguish between the personal effects of the independent variables on a dependent variable.

If VIF is more than Five: the high correlation is cause for concern. The high value of VIF (more than 5) could be a problem since it means we would not be able to distinguish between the personal effects of the independent variables on the dependent variable, this term will be used in testing all models using quantitative methods.

**Kaiser-Meyer-Olkin measure (KMO Test):** is "a measure measures how well the data is suited for these types of analyses. The input variables and the model are assigned a value between 0 and 1 as follows:

0.00 to 0.49 unacceptable.0.50 to 0.59 miserable.0.60 to 0.69 mediocre.0.70 to 0.79 middling.

0.80 to 0.89 meritorious.0.90 to 1.00 marvelous (Glen, 2016), this term will be used in testing all models using quantitative methods.

The multicollinearity test is necessary to measure the correlations between two or more independent variables in a regression model. A high level of Multicollinearity is not preferred because it indicates a problem in a regression model. After all, a high level of Multicollinearity will not allow the researcher to distinguish between the personal effects of the independent variables on the dependent variable. this term will be used in testing all

models using quantitative methods.

**Principal component analysis (PCA)** is a technique used to reduce the dimensionality of a data set consisting of many highly correlated explanatory variables (Brooks, 2014). This term will be used in statistical descriptive before starting analyses using quantitative methods.

**Corporate failure:** is an economic term that happens due to financial failure in most cases, which occurs when the company becomes in a position where it cannot pay all or some of its financial obligations. This term will be used almost in different sections in this study.

**Bankruptcy prediction:** Bankruptcy prediction predicts whether or not a company will fall into financial distress in the future based on the current financial data (Sun, Jie 2014), this term will be used almost in different sections in this study.

**A public company:** is "a company that has a public ownership and distributed among the shareholders ." (Edward I, Majorzata, Erki, Artau 2017), this term will be used to analyze Altman model section in this study.

According to USA law, **bankruptcy under Chapter 7** is one of the Bankruptcy types. Under Chapter 7, the owner or group of owners surrender their property to a legal guardian who sells the bankrupt person's property to pay his debts. The bankrupt cannot sell his property himself; the legal guardian cannot sell all the property belonging to the bankrupt but can sell only the unprotected property. The process of selling and paying the obligations to creditors takes six months. At the end of the liquidation process, all the obligations registered on the bankrupt person shall be written off after he has paid the proceeds from the sale of his property to the creditors. This term is used in the Selection of Study Sample section.

According to USA law, **bankruptcy under Chapter 9** is one of the Bankruptcy types. This type of bankruptcy allows municipalities and taxing districts to restructure their financial obligations. Bankruptcy procedures under Chapter 9 allow the bankruptcy applicant to propose a payment plan to deal with its obligations. This term is used in the Selection of Study Sample section.

According to USA law, **bankruptcy under Chapter 11** is one of the most common Bankruptcy types. And is the most expensive and complex form of a bankruptcy proceeding.

The procedures for this type of bankruptcy are long. Therefore, usually trading courts help companies set their own plan to restructure their debts and obligations. The bankrupt company can not make critical decisions without court approval such as selling some of its capital assets or taking new loans. Bankruptcy under Chapter 11 has many advantages compared to other types of bankruptcy. It protects the financially troubled company from the legal claims of creditors during the period it takes to study the bankruptcy application, which allows the troubled company to negotiate with creditors and arrange its troubled assets and operations. In most cases, the two parties reach an agreement for the re-settlement of creditors' debts on the one hand and to ensure that the troubled company continues to carry on its commercial activity without interruption on the other hand. This term used in the Selection of Study Sample section.

According to USA law, **bankruptcy under Chapter 13** is one of the Bankruptcy types. This type of bankruptcy is used in bankruptcy cases of individual small businesses owned by one person. When the owner of a small business file Bankruptcy under Chapter 13, he protects his personal property from liquidation; because Chapter 13 of the Bankruptcy Act protects the personal property of a bankrupt from being included in the liquidation and sale to pay the debts of creditors, Chapter 13 works to establish a plan to pay the bankrupt person's debts commensurate with the size of Debt and ability to repay. This term used in the Selection of Study Sample section.

According to USA law, **bankruptcy under Chapter 15** is one of the Bankruptcy types. Bankruptcy under Chapter 15 deals with bankruptcy applications filed in non-US courts by individuals or companies who have assets or liabilities within the boundaries of US territory. Bankruptcy under Chapter 15 is considered an affecting way of cooperation between US and non-US courts to resolve disputes between them due to adjudicating their joint bankruptcy applications. This term used in the Selection of Study Sample section.

**Skewness:** is a measure of asymmetry called skew uses the ratio of the average cubed deviations from the average, called the third moment, to the cubed standard deviation to measure asymmetry or “skewness” of a distribution (Bodie, Kane, Marcus). This term used in all models analyzing using quantitative methods.

**kurtosis:** is a deviation from normality, concerns the likelihood of extreme values on either side of the mean at the expense of a smaller likelihood of moderate deviations. (Bodie,

Kane, Marcus). This term used in all models analyzing using quantitative methods.

**Altman Z Score Model:** is one of the most important tools to predict the likelihood that a company will go bankrupt within the next three years. The strength of this measurement is that it depends on multi factors such as sales activity, liquidity, profitability, leverage, solvency. (Z score definition)

Altman Model formula is:

$$Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 0.999X5$$

Where:

X1 = Working Capital / Total Asset

X2 = Retained Earning / Total Asset

X3 = Earnings Before Interest and Tax / Asset Value

X4 = Equity Market Value / Total Liability Book Value

X5 = Total Sales / Total Asset

(Accounting Tools Z score definition)

The coefficients mentioned before the variables in the model formula indicate the relative importance of each variable and the degree of its impact on the final value of the model. The values of these transactions were reached based on empirical studies that proved that they are the best values that can be used to predict bankruptcy.

The result of the Z score could understand as follows:

- If Z-Score > 2.99, the company is considered safe from bankruptcy.
- If Z-Score < 1.81, the company is at risk of bankruptcy.
- If 1.81 < Z-Score < 2.99, the company is in the gray area, but the possibility of bankruptcy depends on the discretion of the management company's decision as decision-makers. (Accounting Tools Z score definition)

**Zmijewski Model** is an empirical test conducted on a financial distress model that requires a sample of companies that experience financial pressure and companies that do not. (Andi Silvana 2020), Zmijewski Model formula is:

$$Z = -4.3 - 4.5 X1 + 5.7X2 - 0.004X3$$

Where:

X1= (Profit After Tax / Total Assets)

X2= (Total Debt / Total Assets)

X3= (Current Assets / Debt Current)

The coefficients mentioned before the variables in the model formula indicate the relative importance of each variable and the degree of its impact on the final value of the model. The values of these transactions were reached based on empirical studies that proved that they are the best values that can be used to predict bankruptcy. The cut-off used in this model is 0 (zero). Wherein if the result of the X-score is positive, then the company is said to be unhealthy. Meanwhile, if the result of the X-score is negative, then the company is said to be healthy. (Andi Silvana 2020).

**Springate Model** is a test that use the ratio of multiple discriminant analysis (MDA), and it include four financial ratios related to the bankruptcy of the company to determine the possibility of bankruptcy. Springate Model developed by Gorgon LV Springate who choose 4 ratios out of 19 financial ratios that were popular in the literature. (Sinarti, Sembiring 2015), Springate model formula are:

$$Z=1.03 S1 + 3.07 S2 + 0.66 S3 + 0.4 S4$$

Where:

S1 = Working Capital / Total Asset

S2 = EBIT / Total Asset

S3 = Profit Before Tax / Current Liability

S4 = Sales /Total Asset

The coefficients mentioned before the variables in the model formula indicate the relative importance of each variable and the degree of its impact on the final value of the model. The values of these transactions were reached based on empirical studies that proved that they are the best values that can be used to predict bankruptcy. “This model has a standard calculation in which the company has a value  $S > 0.862$  classified as a healthy company, while companies with a value of  $S < 0.862$  are classified as potential company bankrupt” (F. Colline. 2020)

**Grover Model:** is a method used to predict bankruptcy. Founded by Jeffrey S. Grover by developing the Altman Z-Score method. The sample used was 70 companies with 35 companies that went bankrupt and 35 companies that did not go bankrupt (Fredy, 2018). The Grover model formula according to (Aminian, 2016) is:

$$G = 1,650 X1 + 3,404 X2 - 0,016 ROA + 0,057$$

Where:

X1 = Working capital / Total assets

X2 = Total assets / Earnings before interest and taxes

X3 = Net income / Total assets

The coefficients mentioned before the variables in the model formula indicate the relative importance of each variable and the degree of its impact on the final value of the model. The values of these transactions were reached based on empirical studies that proved that they are the best values that can be used to predict bankruptcy.

The classification of healthy and bankrupt companies is:

- a. If  $G \leq -0.02$ , the company is a category of financial distress/bankruptcy,
- b. If  $G \geq 0.01$  the company is included in the healthy category.

**P/E Ratio:** "The price-to-earnings ratio "is one of the most widely used and misused of all Relative Valuation tools for companies for determining the stock valuation. In addition to showing whether a company's stock price is overvalued or undervalued".

The formula for this Ratio is:

$$P/E \text{ Ratio} = \text{Market value per share} / \text{Earnings per Share}$$

A high P/E ratio could mean that a company's stock is overvalued, and the investors are overvaluing the company more than its fair value, which could be considered an indicator that the company's financial status is not healthy. Alternatively, investors expect higher growth rates than the average industry growth rate in the future. (Damodaran, A, 2012, pp468-469). This term used in

**PEG Ratio:** Price/Earnings to Growth Ratio is one of the business evaluation methods used to determine the company stock's value by taking into consideration the company's expected earnings growth. This Ratio provides a clearer picture than the more standard P/E Ratio by adding expected earnings growth into the calculation. The formula for PEG Ratio is:

$$PEG \text{ Ratio} = (P/E) / \text{Earning growth rate over five years}$$

If the PEG ratio value is higher than 1 indicates that the stock is overvalued, which means an unhealthy company that could lead to bankruptcy. If the PEG ratio value is lower than 1 indicates that the stock is undervalued. (Damodaran, A, 2012. pp 487-497).

**Sensitivity analysis:** could define as a financial model that measures the strength of the correlation between the ratios and the fundamental financial indicators of the company and examines the extent to which these indicators are affected as a result of a possible change in

one of them. Therefore, it is considered one of the methods for predicting the future financial position of the company and a means to help decision-makers take early measures to avoid bankruptcy.

Sensitivity could measure by two methods: using the Tornado diagram method or the what-if analysis which is known as the simulation method. This term used in Sensitivity Analysis Using Tornado Diagram section. This term used in Business evaluating methods section.

**Credit Health Panel (CHP):** is a “credit risk assessment tool, developed by S&P Capital IQ. This tool provides a quick, simple, and transparent way to analyze the credit quality of a company as compared to a broad set of its competitors” (S&P Capital IQ).

The credit health panel is designed as a financial matrix, consisting of multi-independent financial variables, the value of each variable is measured quantitatively for the studied company and the value is compared with the average value of competitors for the same industry. and because of the measurement and comparison, a score is given to each variable: 1: Top score, 2: above average score, 3: below average score, 4: bottom score. Then these 24 independent variable scores are classified into 3 main groups: operating, solvency and liquidity. Finally, the company's final overall credit score is classified based on the score of these 3 main groups. This term used in Credit Health Panel (CHP) section.

**(Operating Cash Flow/Current Liability):** This ratio measured the company operating cash flow divided by its current liabilities. This ratio is important because the probability of the company going bankrupt increases as the value of this ratio decreases. Previous studies recommended using this ratio to measure the company's ability to pay short-term liabilities (Dennis 1994) and (Figlewicz and Zeller 1991). This term used in analyzing using Cash Flow ratios section.

**(Operating Cash Flow+ Interest +Tax/Interest):** This ratio measures a firm's ability to cover interest obligations on a debt. This ratio is important because as the value of this ratio increases, the probability of the company defaulting on interest payment becomes less. Previous studies recommend using this ratio to predict companies' bankruptcy, such as White et al (1998) and Fraser and Ormiston (2001). This term used in analyzing using Cash Flow ratios section.

**(Operating Cash Flow /Total Sales):** This ratio had called operating cash flow margin. This ratio is important because it measures its ability to transfer its sales into cash. According to previous studies, this ratio is more valuable than the accrual accounting-based profit margin ratio (Dennis 1994) and (Figlewicz and Zeller 1991). This term used in analyzing using Cash Flow ratios section.

**(Operating Cash Flow /Total Asset):** This ratio is called operating cash flow return on total assets. This ratio is important because it measures the company's cash-generating ability of all the assets, i.e., assets provided by both creditors and stockholders of the company. Many previous studies recommended using this ratio, such as (Figlewicz and Zeller 1991) and (Fraser and Ormiston 2001). This term used in analyzing using Cash Flow ratios section.

**(Earnings Before Interest and Tax/ Operating Cash Flow):** This ratio is called Quality of earning. According to White et al. (1998, p. 956)," the Quality of earnings usually refers to the degree of conservatism in a firm's reported earnings.". This term used in analyzing using Cash Flow ratios section.

**(Current Asset-Inventory)/Current Liability:** This ratio is called a quick ratio. It is calculated by dividing the current assets' value after excluding inventories and divided by current liabilities. This ratio is important because it measures the liquidity of the company. The low value of this ratio indicates that the company is under distress. This term used in analyzing using Cash Flow ratios section.

**(Three-year sales growth rate):** This ratio is essential for predicting bankruptcy because just as an increase in the value of sales is an indicator of a company's growth, a decline in the average sales value for three years can be an essential indicator for predicting bankruptcy. This term used in analyzing using Cash Flow ratios section.

## End of the Study