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"Company Bankruptcy Ratios: Testing Financial Ratios as Company's Distress Red Flags"

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Firma dello studente

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RINGRAZIAMENTI

Ringrazio i miei genitori e mia sorella per il loro supporto incondizionato.

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ABSTRACT

This thesis is aimed at identifying financial ratios capable of "predicting" the future failure of a company. The objective is to identify red flags, i.e., indicators of potential bankruptcy.

In order to achieve this goal, an analysis based on financial ratios is implemented.

In particular, after a first phase where the thesis introduces the subject, an analysis based on financial ratios calculation and comparison will be carried out. Through the use of a sample of both failed and not-failed Italian companies (from the provinces of Padua and Vicenza), their statutory financial statements are analyzed using a range of ratios.

Once the analysis is provided, the results obtained using these ratios are interpreted and analyzed in order to underline the ratios that best signal the company's distress.

INTRODUCTION

This introductory chapter has the function to descriptively introduce the bankruptcy phenomenon, both in terms of dimension (numbers of companies that fail every year) and in terms of costs for the society, for the firm itself but also for those externals subjects which have an interest in the business.

Bankruptcy Problem

Every year many Italian companies find themselves in difficult situations, and many of them are facing bankruptcy situations. CRIBIS, a company dealing with business information, realized, in 2018, an analysis of the failed companies in the last ten years. This study shows that even if there is a definite trend compared to the last year, the number of total failed enterprises is exceptionally high (Crif.it, 2018). Furthermore, most of them are located in those regions with a higher number of enterprises. The following table shows these data:

Table 1. Failed Companies Number per Region[1]

Regions	**Total Failures**
Lombardia	25.390
Lazio	12.773
Veneto	10.508
Campania	9.601
Emilia Romagna	8.717
Toscana	8.717
Piemonte	8.159
Sicilia	6.673
Puglia	5.419
Marche	3.926
Abruzzo	2.625
Calabria	2.600
Liguria	2.406
Sardegna	2.278
Friuli Venezia Giulia	2.241
Umbria	1.965
Trentino-Alto-Adige	1.482
Basilicata	516
Molise	418
Aosta	131
ITALY	116.545

[1] Source: (Crif.it, 2018).

As can be seen from the table, the number of businesses affected is exceptionally high. If we consider the total number of failures since 2009, Lombardia, Lazio, and Veneto are those regions that show the highest numbers. Regarding the macro-sectors affected by this phenomenon, the worst hit are:

Table 2. Failed Companies Number per Sector[2]

Sectors	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Trade	2.491	3.800	4.277	4.339	4.851	5.389	5.023	4.493	3.901
Industry	2.124	2.887	2.760	2.736	3.170	3.287	2.859	2.632	2.209
Services	1.312	1.797	2.173	2.314	2.720	3.004	3.023	2.918	2.807
Constructions	1.729	2.307	2.599	2.689	2.953	3.330	3.029	2.749	2.313
Other	1.728	97	31	46	316	326	651	675	709
Total	**9.384**	**10.888**	**11.840**	**12.124**	**14.010**	**15.336**	**14.585**	**13.467**	**11.939**

As can be seen from the table, after the financial crisis of 2007-2008, that negatively influenced the European economies, many sectors in the Italian economy have been affected and started to underperform, leading to business failure. These numerous bankruptcies represent several losses, both for those who manage and own the business and for those who work or have interests in them. For this reason, this thesis wants to focus on the bankruptcy topic, and in particular, on the possibility to prevent it.

From an economic point of view, a company is considered to be insolvent when it is unable to repay its debts. However, many theories describe the concept of bankruptcy and the reason why it happens, defining, in particular, the role of bankruptcies for the company and for the economy itself. According to Cara O'Neill (2019, p.1) (lawyer and author of Bankruptcy themes), "bankruptcy is a powerful tool for debtors." Indeed, Cara describes the theme as a powerful remedy to those facing severe problems. Following this philosophy, declaring bankruptcy can be seen as a way to end a crisis that lasts for years.

Another author is Schumpeter (2008). He defines bankruptcy as a process of destruction and creation. According to him, Bankruptcy is part of capitalism, and it is a critical passage that allows the new companies to be born and grow to allow the old economic entities to finish. However, for the players actively involved in the process, with particular reference to those who hold interests in the company's positive performance, the bankruptcy process may be seen as something extremely negative. Indeed, the firm bankruptcy situation is an event producing

[2] Source: (Crif.it, 2018).

notable losses for many stakeholders, such as creditors, employees, and shareholders. Moreover, bankruptcy implies hugely high costs for the company itself.

Generally, bankruptcy generates direct and indirect costs. As regards direct costs, these include expenses for professionals such as lawyers, accountants, and various consultants, while indirect costs include several non-observable opportunity costs, including the loss of key employees or the loss of business opportunities linked to management's exclusive attention to the bankruptcy situation. (Altman and Hotchkiss, 2006). Altman and Hotchkiss, (2006, p.99) describe that 6,2% of the company's value is usually used to pay the direct costs, while 10,5% of the company's value is used to pay the indirect costs of bankruptcy.

Nevertheless, bankruptcy is only the final situation to which a company is exposed after a long period. Indeed, the causes of this "disease" should be found and analyzed during a large part of the company's life cycle and not only in the final stages. Altman and Hotchkiss (2006), consider as the primary business failure's cause the management incompetence to face and prevent bankruptcy. Furthermore, they also underlined the followings as the main reasons that influenced the company distress situation:

Table 3. Company bankruptcy causes[3]

Chronically sick industries (e.g., agriculture, textiles).
Deregulation of key industries (i.e., airlines, financial services)
High real interest rates in specific periods.
International competition.
Overcapacity within an industry.
Increased leveraging of corporate America.
Relatively high new business formation rates in certain periods

Then, it becomes necessary to find a way or a method to prevent this situation. For example, investors and those who see their business as being dependent on the performance of other companies should monitor the company's performance in order to understand if it is the right time to invest or to exit in that business entity. Furthermore, these considerations help manage the risks of losses due to the default of the counterparty.

For these reasons, the aim of this thesis is to identify red flags signaling the company's potential distress situation thanks to the use of financial indicators.

[3] Source: Altman and Hotchkiss, (2006, p.13)

Research Question

In order to achieve the goal previously mentioned, the thesis tries to answer the following question:

• Is it possible to understand through financial indicators whether a company will fail or is failing?

Several authors, which will be cited below, have tried to answer this question. Among these, stands out Altman. One of the principal author who has covered this issue over the years. He, through the use of the "Z-Score," tried to establish the probability of failure of a company. As it is explained in the next chapters, this tool is based on data taken from companies' Financial Statements (such as Revenues, EBIT, Assets values, and many others) in order to "generate" an indicator that describes the proximity of a company or group of companies to bankruptcy. He realized more than one study, updating its works by years and with the help of other authors. Other researchers tried to deepen the theme, but Altman's works are almost always taken into consideration. In particular, most of the time, these authors consider Altman's study as a starting point or as a point of comparison. Among these authors, there are Beaver (1966), Deakin (1972), and Ohlson (1980), which studies are described in the following chapter.

The thesis, starting from the financial statements of many companies, focuses on the financial ratios analysis in order to find financial indicators that signal the company's failure. This analysis is based on a database of failed and not-failed companies provided by the University of Padua. The firms that compose the database come from the provinces of Vicenza and Padova, two of the most industrialized provinces of Veneto.

Starting with the assumption that failed and the not-failed company may show different values not only in the bankruptcy year, the thesis compares the financial ratios trends and value of these two companies categories in the five years before the bankruptcy. The comparison is useful to identify which ratios show a different pattern, and for this reason, they can take the name of "red flags." Indeed with the term red flags, it is intended those indices that signal a potential company's distress with advance.

Thesis Structure

To deeply analyzed the topic illustrated in the previous paragraph, the thesis is structured in the following way:

Chapter 1. Theoretical background: This chapter has the function to introduce the main topics of the thesis. Indeed, Chapter 1 begins with the clarification of what is the Bankruptcy meaning intended in the thesis, and it describes the literature about the company bankruptcy prevention topic. Then, it focuses more on the thesis topic: the financial ratio analysis in the Italian context (the country of the database considered) by defining the financial ratio analysis and the National Council of Accountants and Accounting Experts point of view. Finally, it introduces the bankruptcy topic in the Italian legal system in order to provide a primary legal point of view the companies analyzed are forced to work.

Chapter 2. Empirical analysis: This chapter describes the empirical analysis realized.

Starting from the explanation of the database considered, it defines the sample of companies analyzed, and the reasons behind the choice of this sample. After that, the financial ratios used are analysed. In particular, the chapter describes the reason behind the choice of particular ratios, the formula applied, and the interpretation used. This description sets the basis for the discussion of chapter three. Finally, it explains the analysis realized in terms of further modifications to the database, type of analysis applied, and deeper considerations.

Chapter 3. Discussion: This chapter describes the results coming from empirical analysis.

In particular, starting from the more general analysis (that consider all the companies composing the database) to the sector-specific one (that consider the four leading sectors that composing the database), the chapter interprets and compares, between Bankruptcy and No Bankruptcy firms, those financial ratios that seemed to be more significant, considering as a period of observation the five years before the bankruptcy. Finally, the chapter introduces some discussion points for additional and future considerations.

Conclusion: This final chapter underlines the results obtained, giving a further and reflexive explanation.

CHAPTER 1. Theoretical Background

1.1 Introduction

The business crisis has been compared several times to a situation similar to that of a disease, for which the sick person (the company) needs diagnosis and treatment in order to heal his/her health. This procedure requires constancy in following what the “company doctors" prescribe (Leonardo Dorini, 2019, p.1). Otherwise, as happens with people, even companies cease to exist, mainly in hostile environments and under inefficient management.

The chapter has the function of highlighting and analyzing what is the background both for the company and the analysts dealing with distress situation, in order to provide the fundamental point to the analysis of the next chapter.

This chapter is divided into three parts. The first one describes the models developed over the years that emerged from the literature about the bankruptcy prevention’s theme. This paragraph aims to identify the most used financial ratios in the literature, describing which are the principal authors, and how their models work. Furthermore, this paragraph underlines which are the methods used to predict the company’s bankruptcy. This analysis is useful to know the considerations that influenced the choices of factors rather than others in the next chapters.

The second part introduces the financial ratios analysis, which is the principal analysis used in this thesis. This description anticipates the analysis developed in the second chapter.

These first two parts have the common goal to describe the wide range of technics an analyst may use to check the company’s financial health and which are more adequately useful for the dataset considered.

The last part describes the legal environment that characterizes the bankruptcy situation. A necessary description in order to understand, from a legal point of view, what are the options and the consequences a company may take in these situations. Indeed, the existence and the features of different legal procedures can influence the decision of a company that takes the street to the failure.

Before going into details, a necessary clarification is needed: what is meant by the term bankruptcy. To realize this explanation, Altman & Hotchkiss (2006) work “Corporate Financial Distress and Bankruptcy” has been taken into account. These authors described how the bankruptcy concept might be misleading when associated with other terms. Indeed, following these two authors, four main terms are often used in literature as synonyms when discussing firms’ bankruptcy but which technical meanings are different. These terms are a Failure, Insolvency, Default, and Bankruptcy.

Regarding the concept of failure, Altman & Hotchkiss, (2006, p.4), taking into consideration Dun & Bradstreet institution, describe it as "businesses that cease operation following assignment or bankruptcy; those that cease with loss to creditors after such actions or execution, foreclosure, or attachment; those that voluntarily withdraw, leaving unpaid obligations, or those who have been involved in court actions such as receivership, bankruptcy reorganization, or arrangement; and those that voluntarily compromise with creditors." Following this definition, a company's failure happens when a company closure is leaving losses to its creditors.

As for insolvency, this is another term to describe negative company performance. According to Altman & Hotchkiss (2006, p.5), "Technical insolvency exists when a firm cannot meet its current obligations, signifying a lack of liquidity" while "insolvency in a bankruptcy sense is more critical and usually indicates a chronic rather than a temporary condition." Following this definition, Insolvency usually seems to happen when the liabilities of the company are higher than the assets in a chronical way.

Another term used to highlight the adverse situation of corporate performance is the word Default. It concerns two main subjects: the debtor (the company) and the creditor (the one who has credits to the company). A default may occur either when the debtor breaches a condition described in the contract and when the debtor fails to pay the debt due, within the due time frame. In the first case, there are usually no formal bankruptcy proceedings, but a renegotiation of the agreement is likely (Altman & Hotchkiss, 2006). While, in the second case, the insolvency scenario is more concrete but even not sure.

Finally, there is the concept of bankruptcy. Altman & Hotchkiss (2006) define two main types: the first is the one above described in the case of insolvency, a bankruptcy that concerns the fact that the company's equity is negative. The second refers to the declaration of bankruptcy by a court, which defines the arrangements for the liquidation of assets or, possibly, the restructuring of the debt. This thesis uses these terms without distinct differences. The terms bankruptcy, insolvency, failure, and default are all intended as the company ceases to exist due to its inability to satisfy its obligations. In this sense, these four terms are used as synonymous, without considering their technical differences. In particular, the database considered in the analysis developed in the following chapter contains the statutory financial statement of both insolvent companies and those companies that are in a process called "preventive agreement" from the Italian term "Concordato Preventivo." A procedure, deriving from the Italian Bankruptcy Law, which is aimed at protecting both the interests of the company in crises and the interests of the company's debtors.

1.2 Bankruptcy Prevention Models

This paragraph aims at describing the various models that have characterized the forecast or the prevention of a company bankruptcy situation over the years. The analysis of the models, in terms of technical characteristics and results, serves as a reflection and starting point for the choice of the characteristics of the empirical analysis of the next chapters.

1.2.1 Literature Review

Many economic and mathematical researchers tried to discuss and prove the existence of an effective method that demonstrates if it is possible to notice, in advance, the unfavorable situation of a company. These scholars are as numerous as their theories, factors considered, and models developed.

From the analysis of the bankruptcy prevention literature, it emerges that there are four main methodological approaches. As the next paragraph describes, these are discriminant analysis (the first analysis adopted), logit analysis, probit analysis, and neural network analysis. What comes up is that all of them share common points: the set of reference (i.e., the set of companies that are analyzed in order to test their forecasting model), the factors adopted (i.e., the indicators that are chosen to be observed), and the goal they try to reach. Besides, there are further common details that differentiate each from the other. Some of these are the period of the data collected, and the focus of the observations analyzed.

Although these analyses have a common final purpose (providing models for predicting bankruptcy), the way they try to achieve it differs considerably in various aspects. Indeed, some authors adopted "few" factors such as Altman (1968), who considers five ratios developing its Z-Score analysis, while others took into account a considerably higher number, such as Skogsvik, (1990), which considers seventeen ratios.

Models differ considerably not only in terms of the number of ratios used but also in terms of the reference target. Some models are more sector-specific than others. Altman (1968) looks at manufacturing companies while, for example, Tam (1991) looks at banks. Others consider only those companies coming from certain countries, such as Izan (1984), that considered a sample of all Australian companies

Bellovary, Giacomino, and Akers (2007) have tried to analyze the numerous models developed during the twentieth century, trying to understand their essential characteristics. According to these authors, the main works developed before the sixties were few and focused on the consideration of a single variable. This research highlights ratios such as Working Capital to Total Assets and Current Ratio as good reporting indicators for the company's decline. Among these studies, the first is the Bureau of Business Research analysis. This work is characterized

by comparing twenty-four different ratios of 29 companies with the average calculated among them. From this study, it emerged that eight ratios could be considered as good indicators. These include Working Capital to Total Assets, the Current Ratio, Cash to Total Assets, and Fixed Assets to Total Assets. These studies have been essential as they have laid the foundation for many studies that have developed in the second half of the century. Indeed, the number of studies relating to the second half of the century is very high.

One of the primary authors that follow this type of analysis was Beaver (1966). He applied the univariate analysis (analysis based on the evaluation of one factor per time), considering different financial ratios coming from the corporate finance area.

The first turning point is with Altman (1968), which introduces the multivariate discriminant analysis (also known with the acronyms MDA), a model that served as a starting point for subsequent studies until today.

Indeed, between 1960 and 1980, the analysis that found more interest among researchers is the discriminant analysis, while starting from 1980, other analyses started to develop. These analyses are logit analysis and neutral analysis. Although Probit analysis has also developed in recent years, it has found less interest among professionals. (Bellovary, Giacomino, and Akers, 2007).

1.2.2 The Main Models

As described in the previous paragraph, one of the first analyses that have developed over the years is the univariate analysis. In the theme of corporate bankruptcy prediction, this type of analysis examines "the predictive ability of ratios, once at a time" (Beaver, 1966, p. 100). Indeed, Beaver (one of the leading exponents of this type of analysis) tried to test a set of financial indices in a starting database made up of two types of companies: failed companies and non-failed companies. His analysis is characterized by calculating these indices for both categories and comparing their performance over time. In particular, in order to compare these ratios, Beaver will use the average of the values of the single companies (Beaver, 1966).

As will be pointed out later, this type of analysis is the main starting point on which the empirical analysis of this thesis is based. Nevertheless, it is necessary to introduce also those models that, later, have developed during the century. This introductive description underlines what could be the alternative models to the applied one.

The ratios taken from the company's financial statements can allow analysts to concretely understand whether a company is in a difficult situation or not. However, a ratio alone may not be enough to determine a company's situation, and multivariate discriminant analysis has been applied to solve this problem. This analysis consists of a statistical technique that allows

calculating, through the combination of several financial indices, the probability of failure of a company.

The study carried out by Altman describes it in a very detailed and precise way. In the paper "Predicting financial distress of companies: Revisiting the Z-Score and ZETA® models.", the author defines a solution based on the following model:

Z = V1X1 + V2X2 +...+ VnXn .

Where: V1, X2, ... Vn = discriminant coefficients (calculated through statistical techniques based on historical financial data of both failed and non-failed companies, which description goes beyond the scope of this thesis). While V1, X2, ... Xn = independent variables.

Z is defined as the Z score, i.e., the score calculated and attributed to the company that defines its possibility of failure. The independent variables are:

X1 = working capital / total assets,

X2 = retained earnings / total assets,

X3 = earnings before interest and taxes / total assets,

X4 = market value equity / book value of total liabilities,

X5 = sales / total assets

Finally, the value obtained Z is compared to a scale of values that varies according to the companies taken into account (Altman, 2000).

Logit Analysis can be defined as a model-based on "a cumulative probability function" that "provides the conditional probability of an observation belonging to a certain class without requires independent variables to be normal, and it considers all the perspective factors in a problem solved simultaneously" (Zhou, Elhag, 2007, p. 302). The non-adjustment of multivariate normality and equal covariance matrices are the biggest differences between this type of analysis and the previous one. Ohlson (1980) is one of the major exponents of the use of this method. This author, not agreeing with the peculiarities of the MDA, introduced the logistic regression. He, through the application of his model based on Logit Analysis, was able to identify 85% of the 105 failed companies examined in his paper. Atiya Aamir (2001, p. 930) defined this model as "essentially a linear model with a sigmoid function f(x) = 1/(1+e^-x) at the output".

Probit Analysis is an alternative to the above analyses. Although it is defined as one of the main methods used, it does not differ significantly from the Logit Analysis. The main difference between the two analyses is that Probit Analysis takes into consideration random variables normal distribution.

Neutral Network Analysis is a particular type of analysis that tries to recreate the way the human nervous system works. Furthermore, this architecture is structured in three types of layers: Input (where the data are inserted), Hidden (one or more hidden layers), and Output (where any results come out). These layers are characterized by "neurons," which are connected with all the neurons of the more advanced layer. The connections represent relationships between the neurons and have different weights (Ibm.com, 2019). A continuous evolution characterizes neutral Network Analysis: once the architecture has been built and all the inputs have been determined, the model repeats itself, adapting the different weights until specific criteria are reached. (ibm.com, 2019) . After that, it can be used in order to estimate the unknown future bankruptcy situation of a company. The following table ("Figure 1. Neutral Network Analysis Scheme"), represents the architecture of a simple neural networks model.

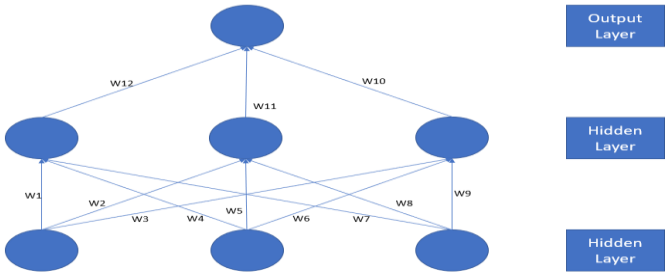

Figure 1. Neural Network Analysis Scheme

1.2.3 Kind of Sample Considered

What characterizes the researches previously mentioned in the literature review is undoubtedly the factors considered. Nevertheless, it has emerged the importance of considering the right variables to take into consideration. Indeed, the studies that have shown the highest accuracy[4] over the years are not only those with the highest number of factors taken into account. Considering the accuracy degree of the models, among the most accurate authors, there are both those with a "reduced" number of factors and those with a larger number of factors. For example, with ten factors analyzed, Daniel (1968), obtained an accuracy of 91.8% for failed companies and an accuracy of 100% for non-failed companies. Even Coats and Fant (1992), considering five factors, reached an accuracy of 91% for distressed companies and 96% for healthy companies. Furthermore, the research carried out by Altman (1968), which is one of the first work in this field of study, is based on "only" five financial ratios or factors. For these

[4] "Closeness of computations or estimates to the exact or true values that the statistics were intended to measure" (Stats.oecd.org., 2020).

reasons, the main question may regard which ratios to take into consideration rather than how many of them.

Many authors solved this problem, considering some of the factors that have found more interest in various studies. Taking up the analysis of Gissel, Giacomino and Akers (2007), that analyzed about one hundred and fifty studies concerning the prediction of bankruptcy, it emerges that the three most used factors are Net Income/Total Asset (used fifty-four times), Current ratio (fifty-one times) and Working Capital/Total Assets (forty-five times). However, forty-two different ratios are used at least five times in the studies analyzed.

The repetition of the "usual" ratios is mainly due to their accuracy, but it is also since many authors have solved the issue by choosing what seemed to be the most used factors, analyzing the studies before theirs.

For these reasons, in the analysis, explained in the following chapter, both the most used ratios that emerge from this literature and other ratios that emerge from other sources are applied. The reason for the choice of the ratio is explained in the second chapter.

Another relevant question concerns the number of observations. In this term, Altman (1968) considered an initial sample of sixty-six manufacturing companies, of which thirty-three failed and thirty-three not failed. While other authors, such as Beaver (1966), considered one hundred fifty-eight companies (seventy-nine failed and seventy-nine not failed) coming from thirty-eight different sectors. Therefore, the choice of the sample is more subjective and it is mainly linked to the author's focus.

Indeed, beyond the precise number of companies, the choice of whether or not focusing on a specific sector is also crucial. Some authors have focused on more targeted samples. Among them, Tam (1991) looks at banks. Other authors considered more general samples, as Izan (1984) considered in his research a sample made of all Australian companies in all sectors.

In this thesis' analysis, a wide range of companies is considered. Indeed starting from a sample of more than one thousand companies (including both failed and not failed companies), different ratios are tested. The database considered is characterized by many companies deriving from different sectors, and, in the beginning, the analysis is realized without considering the companies' sectors. Nevertheless, in the second part of the analysis, the sectors of the companies composing the database are taken into account, providing a more sector-specific analysis. Considering both the general and sector-specific point of view, the analysis has the purpose of being more comprehensive and in-depth.

1.2.4 Model Accuracy

What differentiates a model from another one is not just the nature of the model itself. Indeed, one of the most discussed points in the bankruptcy prediction literature is the accuracy of these models. Accuracy consists of the model's ability to predict the failure (or not) of the companies examined.

In particular, two types of errors are usually discussed, and they take the common names of "type 1 error" and "type 2 error" (Altman and Hotchkiss, 2006).

Type 1 error consists of identifying a company as not bankrupt while it is in bankruptcy, whereas type 2 error consists in identifying a company as in bankruptcy while it is not in bankruptcy.

A non-failing or Bankruptcy company is defined as a going concern company, "an entity is assumed to be a going concern when it is able and willing to continue operations in the foreseeable future" (Koh, 1987, p. 3). Both error types imply costs for the company and the person performing the analysis. According to Koh (1987, p. 50) "Type I errors may result in the auditor being sued for not providing early warning signals of distress to investors and creditors (as expected by the society in general and the proposed SAS in particular), and Type II errors may result in the auditor losing clients for unwarranted qualifications."

The need to prove the validity of the models used in the analyses has become increasingly evident over time. Several types of research have used a particular method: the Lachenbruch method. It consists in retaining and predicting the classification of each observation that constitutes the estimation sample. The procedure is particularly optimal in the case of a small sample. Jones (1987), suggests a further step beyond the Lachenbruch model. According to this author, greater validity can be achieved if it is also considered a "control sample," i.e., a sample of observations separated from the initial sample with which to further test the model used.

The following table ("Table 4. Model Accuracy Summary") summarizes the degree of accuracy of the models:

Table 4. Model Accuracy Summary[5]

Methods	Lowest Accuracy	Highest Accuracy	Highest Accuracy Authors
MDA	32%	100%	Izan (1984); Takahashi et al. (1984);
Logit analysis	20%	98%	Dambolena and Shulman (1988)
Probit analysis	20%	84%	Skogsvik (1990)
Neural networks	71%	100%	Messier and Hansen (1988); Guan (1993);

The table is based on the studies analyzed by the three authors, one hundred and sixty-five different papers. The methodologies that have shown the most considerable degree of accuracy are the Multivariate Discriminant Analysis and Neutral Networks. The latter seems to have the best range with a minimum degree of accuracy of 72%. Logit analysis also performed well with the study by Dambolena and Shulman (1988). While MDA performs better with Izan (1984) and Takahashi et al. (1984).

1.2.5 Prediction Timing

Another important topic of bankruptcy prediction models is the prediction timing of the analysis. This time is usually expressed in years. Higher is the number of prediction years, and higher is the reliability of the analysis. Indeed if we consider two analyses, the one that gives the prediction time with more forewarning is the one more considered, ceteris paribus. In the case of the thesis' analysis, a ratio that better define the difference between the bankruptcy company and the Non-Bankruptcy company with more time prior the bankruptcy is considered as more relevant. Most of the authors give their best accuracy rates one year before the company's failure, and most of the accuracy rates previously mentioned are related to one year. However, some authors were able to obtain a longer timing, such as Deakin (1972), he was able to get the timing of two years before failure with 97% accuracy. It is, therefore, necessary to consider the length of time that a proper analysis can provide. For these reasons, the analysis developed in the second chapter takes into consideration the financial statements from five years before the companies' bankruptcy. In this way, it is possible to see if the financial ratio in question can provide a red flag signal "many" years before the distress. The ratios that provide the red flag advice, with more time, are more in-depth discussed in chapter three.

[5] Source: Gissel, Giacomino, and Akers (2007)

1.3 Index Analysis

In the second chapter, the developed analysis is not a precise model described in paragraph one, but it is an analysis based on financial ratios. Indeed, indices from different models and evaluation techniques will be used in the following chapter. However, this analysis is based on the same basis as the analyses previously described, i.e., the Financial Statement.

The ratio analysis is a technique based on the elaboration of financial statement data.

In order to get the best results in terms of valuation and interpretation, it is necessary to analyze a series of financial statements by studying the significant ratios trends over time. In this way, it is possible to understand the trend and direction of the company. (Facchinetti, 2008).

As mentioned above, through the analysis of the ratios based on the company's financial statement, it is possible to identify the company's situation. Then, once this analysis has been applied to all the companies in the dataset, it is possible to compare the results obtained in order to identify similar ratios among the companies that then went bankrupt and similar indices among the companies that did not go bankrupt. In particular, this analysis is necessary in order to study when these two types have begun to divide and to determine whether, through these indices, it is possible to identify a problematic situation in advance.

Nevertheless, in order to realize this process, the right financial ratio has to be found.

Indeed, in the following chapter, a multitude of ratios have been taken into account in carrying out the analysis. Particular attention has been paid to the description of the reclassification, and the related indices, made by Penman (2013) in his book on equity valuation "Financial Statement Analysis and Security Valuation." This author described how, by the usage of the financial statement analysis, an analyst might be able to understand the real value of a company. Even if Penman’s analysis is more appropriately focused on the listed company and the understanding of their real stock price, his financial statement considerations can also be used for the dataset considered.

The company analysis, through financial statement indexes, consists of identifying those numerical ratios between values of the reclassified financial statements. This analysis allows a brighter, more synthetic and functional vision of the situation of a company.

It is characterized by the calculation of particular ratios that define different aspects of the company's activities: from the aspect of liquidity to that of indebtedness as well as from the aspect of profitability to the aspect of efficiency. As it is explained in the second chapter, in order to have a more comprehensive view of the company, it is necessary to take into consideration indices coming from different areas of the company (Liquidity, Leverage, Profitability, and Efficiency).

The financial ratios analysis is the primary analysis of the financial statement. The company's financial statement is considered as "the lens on the business" (Penman, 2013, p. 17). However, financial statements often provide an obscure image, and it is up to the analyst to apply the appropriate corrections in order to have a more defined image.

Furthermore, once the analyst has a clearer picture of the situation, he should then convert them into a company's value valuation, and this is the precise task of the technologies or techniques of corporate evaluation.

In the choice of the right technics, the analyst must consider the pros and cons, "weighting simplicity against the costs of ignoring complexities" (Penman, 2013, p. 18).

1.3.1 Financial Ratio from the Italian Accountant World

The Italian State has concretely intervened in terms of company bankruptcy detection and prediction, as well. Indeed, it assigned, through the article 13 co. 2 of "Codice della Crisi e dell'insolvenza d'Impresa" (the Italian code for the firms insolvency and distress), to the National Council of Accountants and Accounting Experts (in Italian "Il Consiglio Nazionale Dei Dottori Commercialisti e Eperti Contabili, also defined with the acronym CNDCEC) the task to define financial statement indices that signal the potential distress or bankruptcy situation of a company (Buongiorno, 2019). In order to find which are the best indices that may express that company situation, the Accountants and Accounting Experts Council cooperate with the most significant Italian information provider, CERVED. Indeed, this Italian provider supported the elaboration and the relative test of the analysis using an objective and scientific approach.

The Italian Code for the company insolvency provides that these indexes should be related to the Income, Equity, and Financial aspects of the company in addition to the specific characteristics of the businesses. Furthermore, it requires that, in case of the company's distress detection, the indices signal "the emergence of the so-called internal reporting obligations that the Code imposes on statutory auditors " (Cipolla, 2019, p.1).

The Italian code for the firms insolvency and distress detect the firm's distress when there is a significant delay of the payment terms, and there is the evidence of a negative equity or an equity value lower than that provided by the law and "through evidence of the non-sustainability of the debt in the following six months through the free financial flows servicing it" (Cipolla, 2019, p.1).

For this reason, the Italian CNDCEC (the National Council of Accountants and Accounting Experts) provides the usage of the financial ratios indexes just in case the Debt Service Coverage Ratio is not applicable.

The ratios found by this National Council are five, and they should be applied together in order to detect the distress situation of a company more appropriately. These ratios are:

- Index of Sustainability of Financial Charges (in Italian: indice di sostenibilità degli oneri finanziari) that equals to Financial Charges divided by Revenues;
- Capital Adequacy Ratio (in Italian: indice di adeguatezza patrimoniale) that equals to the ratio between Equity and Total Debt;
- Asset Cash Return Ratio (in Italian: indice di ritorno liquido dell'attivo) that equals to the ratio between cash flow and assets;
- Liquidity index (from the Italian term: Indice di Liquidità) that represent the short-term ratio assets to short-term liabilities;
- Pension and Tax Debt Ratio (in Italian: indice di indebitamento previdenziale e tributario), equals to the ratio of pension and tax debt to assets.

The indexes have also a particular threshold which overcoming indicates a company's approaching bankruptcy. Nevertheless, these indices should be interpreted together and not individually. (Buongiorno, 2019). Exceeding the threshold for an index does not indicate the failure of a company. However, exceeding several indexes at the same time could symbolize the negative trend in company health.

It comes necessary to see how these indexes will be applied and monitored by the auditors that the Italian Code provides as responsible for signaling the problem.

In order to provide a deep financial ratios consideration, these indexes are all considered in the analysis developed. As it is explained later in the second chapter, some of these indexes were already taken considering the literature or other information sources. Their interpretation is deeper analyzed in the following chapter.

1.4 Bankruptcy legislation

The analysis of this thesis is based on an Italian company dataset and, for this reason, an introduction to the Italian legislation system is necessary. Therefore, this paragraph describes the legislative background in which an Italian company is forced to operate in a difficult situation. This description has not the function of describing the procedures' details, but it aims at describing the legal environment that influences the company's considerations when dealing with the financial distress situation.

A non-uniform system over the years characterizes the Italian bankruptcy legislation. Indeed, the procedures followed by companies are different if compared among the decades.

At the beginning of the century, there were three leading alternatives for a company: composition with creditors, bankruptcy, and receivership (which was later repealed). These were procedures by which the company was wound up under the supervision of external bodies appointed by the court (Dorini, 2017). Only large companies had access to the extraordinary administration, which consisted of continuous activity of the company employing commissarial management supervised by the mystery of productive activities.

Since 2006, with the reform of the bankruptcy law, instruments have been introduced through which the company, in crisis, was able to agree with its creditors in order to facilitate and rebalance the situation in a cooperative manner (Dorini, 2017). These tools were the recovery plans (outside the judicial control) and the debt restructuring agreements (under the supervision of the competent court). They require the development of a plan and its approval.

Another critical reform was carried out in 2012, with the introduction of Article 161 of the Bankruptcy Law. This article provides for the so-called "in bianco" or "prenotativo" arrangement. This order consists of an application submitted to the court by the company. It requests a deadline to give its creditors a proposal for composition. In this case, the management is left to the company itself (for the ordinary administration).

Finally, from August 2020 will come into force the new Code of the Crisis of Enterprise and insolvency (or "Codice della Crisi d'Impresa e dell' Insolvenza") which confirms the continuous change and modeling of the legislation point of view regarding the theme of bankruptcy or corporate crisis (Dorini, 2017).

However, when it comes to the failure of a company, ideas are often not clear and precise.

Indeed, it is necessary to clarify the meaning, the procedures, and functions of that company's situation. To better understand the point of view of the Italian law on this issue, it is necessary to take into consideration the "Regio Decreto 267 of 1942", or the Bankruptcy Law. This law has undergone considerable reforms and changes over the years. However, it is the fundamental

point of bankruptcy law. It provides for a procedure that takes the name of failure procedure or "procedimento fallimentare," following the Italian name. This law is activated if and only if specific requirements are met and, especially if the amount of unpaid debt is substantial. For this reason, in case a small debt is not paid by its due date, it does not automatically activate the procedure.

To get a deep understanding of the topic, the thesis considers other sources besides the Bankruptcy Act. In particular, the interpretation described by the Italian site "avvocato360.it" is considered in order to give a more realistic view of the process.

Generally, this procedure begins in an already stressful situation for which the intervention of a court is required. These are situations in which the owner of the company and one or more creditors of the company see no alternatives other than to address a forum to safeguard their interests. Subsequently, the verification of the requisites takes place.

In case the requisites are met, the owner of the company is replaced by a person appointed by the court who has the task of repaying creditors. Usually, in this phase, the core business of the company is interrupted in order not to risk increasing the debt and its reparation.

As already mentioned, special requirements must be met for this law to take effect. In particular, there are two main types of requirements: subjective requirements and objective requirements. Subjective requirements require that "only" an individual enterprise or a partnership, simple or capital, may fail. Thus, those who fall into the categories of self-employed and so-called small entrepreneurs will not be covered by this law. In particular, the latter is defined by the online journal avvocato360.it as those who have the following simplified financial structure :

- Assets of less than EUR 300000 per year,
- Income below EUR 200000 per year,
- Total Debt of less than EUR 500000.

The company insolvency characterizes the objective requirement. Rules do not specify in a definite way the state of insolvency to leave a certain degree of freedom to the court based on the present case. Judges, over time, have identified some "symptoms" to identify this situation: inability to repay a debt (default) and lack of profit to give guarantees to creditors (weak assets). Moreover, after the 2007 reform, the unpaid debt must exceed EUR 30000 to be declared bankrupt (Redazione avvocato360, 2019).

Assuming that the two above requirements are met, the court responsible for initiating the procedure may apply. Such a request may be made (Redazione avvocato360, 2019):

- by the bankrupt company
- by the creditors of the company in question

- by a public prosecutor in other exceptional cases

Following the submission of the application, a collegiate tribunal shall declare whether the application is bankrupt. In this case, there are particular consequences for the entrepreneur that vary according to the type of company to which we refer.

Alternatively to the bankruptcy procedure, the company may opt for other solutions, including:

- Agreement with creditors. The company could agree with creditors who have applied to the court, proposing a plan to repay them.
- Agreed quote: the company may submit to the court itself, before failing, a plan to repay creditors, at least partially, in a time of crisis. This plan will have to be accepted by both creditors and the court.
- Debt restructuring: another type of agreement that must be approved by at least 60% of creditors.

1.4.1 An international point of view

The bankruptcy concept is not the same thing in all countries. While in some countries, bankruptcy may be similar, in others, both the concept and the process may be significantly different.

In a situation of bankruptcy, the well-being of society can be risky: unpaid creditors, the job at risk, administrators who follow personal interests instead of those of the company. Institutions are trying to solve this situation in such a way as to achieve an efficient allocation of resources and protect the interests of the actors involved. However, how these countries intervene is different.

Vaughn S. Armstrong and Leigh A. Riddick, in his paper "Bankruptcy Law Differences Across Countries, Managerial Incentives and Firm Value," consider the bankruptcy policies of the G7 countries in which the above-cited differences can be seen. All G7 countries have bankruptcy laws that provide for liquidation or reorganization. These laws are named in various ways, and when translated, they appear similar, but each one has its nuance. An example is France, where the court (in addition to having a protective role towards workers) decides whether it is appropriate to reorganize. Creditors and managers have no power over this. In order to grasp the more profound differences, it is necessary to analyze the procedures that are provided for by these codes (Armstrong and Riddick, 2003). An example of this is the causes of the proceedings.

CHAPTER 2. Empirical Analysis

This chapter describes the analysis that has been carried out in order to answer the research question anticipated in the introduction: Is it possible to understand through financial indicators whether a company will fail or is failing?

In order to achieve this objective, a vast database of companies from Veneto, coming from two of the most industrialized provinces of the region (the province of Padua and the province of Vicenza), has been used.

Considering the information described in the first chapter, this chapter describes the main characteristics of the empirical analysis realized: from the description of the database considered to the introduction of the financial ratios used and the analysis steps elaborated. Indeed, the chapter characterized by three paragraphs:

- Database: considering the bankruptcy concept, the observation numbers and the model's features described in the first chapter, in this paragraph it is described how the database was formed;
- Financial Ratios Applied: from the information described in the first chapter about the literature review (regarding the bankruptcy prevention topic), and the Financial Analysis, in this paragraph it describes the choices behind the decision on which ratio to take into account and their explanations;
- Analysis Description: finally, this paragraph describes the two principal analysis elaborated: a general analysis (considering all the database) and a sector analysis (focusing on some sectors of the companies considered).

2.1 Database

The purpose of this paragraph is to introduce the database from which the analysis, defined in the following paragraph, was carried out. This introduction is neither intended to go into the motivations, which led the database authors to use one technique rather than another, nor to go into the nature of the techniques applied. However, the purpose is to explain which set of data was the source of the analysis that is later explained.

In order to carry out the critical analysis of this thesis, a database of companies provided by the University of Padua has been taken into consideration.

The database is characterized in a set of statutory financial statements of a multitude of companies. In particular, it is characterized by the financial statement of 1101 Italian companies. These companies come from the provinces of Padua and Vicenza and are divided into failed companies, 189, and non-failed companies, 912.

The university elaborated this database before being passed on to thesis writers. It is necessary in order to give a complete introduction to the analysis made, specifying how this sample of companies' financial statements has been structured.

The elaboration process of the data-set was divided into two phases.

The first one, all those companies whose financial statement data were available in the “Aida Bureau Van Dijk” database were extracted, starting from a list provided by the Chamber of Commerce (from the Italian name “Camera di Commercio”), containing all the bankruptcies occurred in the provinces of Padua and Vicenza from 2014 (until 2018), all those companies whose financial statement data were available in the Aida Bureau Van Dijk database were extracted.

In the second phase, on the other hand, five non-failed companies, from the same sector as the failed company and based in the provinces of Padua or Vicenza, were combined with each failed company. This combination was made possible thanks to the use of the "Propensity Score Matching" econometric technique. This technique allows matching the observations of two different populations, minimizing the difference between some parameters set beforehand. The pre-set parameters, chosen by those who carried out this work in the database, were:

- Sales revenue,
- EBITDA/Total Assets,
- Net Assets/Total Assets.

The three parameters define respectively the Size, the Performance, and the Indebtedness of the companies. In this way, a set of undertakings defined as 'group of control' has been achieved, which is sufficiently linked to the set of failed undertakings:

Table 5. Database Summary

Bankruptcy Firms	189
No Bankruptcy Firms (Control group)	912
Total Firms	1101

Regarding the years taken into account, the years from the fifth year before bankruptcy have been taken. In this way, the two groups have a sufficient amount of time to have both shared and opposite signals.

Indeed if in the year of bankruptcy, completely different indices are expected, the two categories may show similar ratios five years before the bankruptcy.

Once in front of the database composed of about 1101 financial statements of Veneto's companies, a reclassification of them has been carried out in order to be able to apply the financial indices with greater flexibility.

Finally, further steps have been taken to make the results more reliable. These changes will be explained in section 2.3 as part of the analysis.

2.2 Financial Ratios Applied

In order to answer the research question, an analysis based on financial ratios has been developed. Once the database described in the previous paragraph was obtained, considerations were made about which indices to use. Indeed, before the analysis explained in the following paragraph, several sources were taken into consideration to choose the best indexes for that given database. The sources considered were four:

- The literature on bankruptcy prevention (analyzed in chapter 1);
- S.H. Penman, "Financial Statement Analysis and Security Valuation";
- The website corporate financial institute (corporatefinanceinstitute.com);
- Crisis Alert Indexes published by order of Accountants and Accounting Experts.

In the first case, the indices that have been repeatedly considered by the principal authors have been taken into consideration. In particular, in order to collect these indices, the work of Gissel, Giacomino, and Akers (2007) has been taken into consideration. These authors, as already described in chapter 1, collects and analyses about 150 works on bankruptcy prediction by different authors. Their work shows which indexes have been used most often in the various analyses. For this reason, starting from this list, it has been taken into consideration those indexes that proved to be among the most used in the various researches.

Then the work of Penman, "Financial Statement Analysis and Security Valuation," has been examined. This author is among the most famous researchers in the field of corporate finance, with particular reference to the analysis of company financial statements, in order to calculate most appropriately the real value of a company. As already mentioned in chapter 1, this author focuses on the study of listed companies in order to define from the financial statements, which are their actual fundamental value. Although this specialization differs from the database taken into consideration (non-listed companies), some of the indices studied by Penman were nevertheless taken into account.

Then an alternative source was sought, a leading website explaining corporate finance and its indices to assess the health of companies. This choice fell on the corporate financial institute website, which is one of the leading websites on corporate finance, offering adequate and extensive explanations as well as offering real courses.

In order to carry out this analysis, higher weight was given to the indices presented by the corporate finance site, rather than to the Penman financial ratios presented in his book. This decision was made for more than one reason. The indices presented by the site include both some indices emerging from the literature and some indices presented by Penman's book. So we focus on that source, also providing the indexes of the other sources. Besides, the website's

indices have proven to be easier to use for the characteristics of the database considered. Finally, an analysis using Penman's indexes has already been previously carried out by the university, so for the original reason, it was decided to try to use other (however valid) sources.

Finally, the document describing the business crisis alert indices developed by order of Accountants and Accounting Experts was taken into account. Five leading indicators emerge from this document. One of these has already been considered thanks to the sources described above (that is the Current Ratio that represents the relationship between assets and liabilities in the short term) while the others have been added to the list of final indices considered.

Through this series of considerations, a total of twenty-four indices were finally selected. This number was obtained by selecting five indices by macro-category (i.e., Liquidity, Indebtedness, Profitability, and Efficiency). Furthermore, it has been added to them those provided by the document of CNDCEC (the National Council of Accountants and Accounting Experts) from the Italian name "Ordine dei Dottori Commercialisti e degli Esperti Contabili."

These indices can then be divided and grouped into the following four categories: Liquidity Indices, Debt Indices, Profitability Indices, and Efficiency Indices.

Using ratios from all four categories, it has been given a broader and more complete view of the company's health. Moreover, having available indices coming from different economic areas of the company, it has been possible to obtain different points of view on the state of health of the companies.

The following ratios explanation has the function to clarify the interpretation given to the indexes considered. The motivation for choosing a particular ratio rather than the other is contained in the ratio definition and interpretation.

2.2.1 The Financial Ratios

The Financial Statement Ratios are a tool capable of reformulating the company's situation through statistical reports, reworking data from the statutory financial statement into more analyzable and comprehensible data. There are five main macro-areas of financial indices:

- Liquidity ratios
- Leverage ratios
- Efficiency ratios
- Profitability ratios
- Market value ratios

In this analysis, the last area will be omitted as it includes values deriving from the company's listing. As unlisted companies characterize the database, this category has been excluded. Concerning the liquidity area, it describes the ability of a company or group of companies (as in the analysis that will be described below) to repay both short and long term obligations. The liquidity ratios analyzed are the following:

Table 6. Liquidity Ratios

Liquidity Ratios
Current Ratio
Quick Ratio
Cash Ratio
Cash Flow Ratio
Cash Flow to CAPEX

- Current Ratio: This index measures a company's ability to meet its obligations within one year. Being characterized by the formula: Current Assets / Current Liabilities, it is an index of corporate liquidity. Generally, a Current Ratio of more than one is a positive indicator of the company's financial status. However, there are no reference values in terms of values that are too high as the relative sector should be analyzed. If the indicator is exceptionally high, it may indicate that the company is neglecting the expansion of its business, leaving excess liquidity (a. Corporatefinanceinstitute.com, 2020). This index is also considered by the CNDCEC (the Nation Council of Accountants and Accounting Experts) among those indicators that signal the potential company bankruptcy with the name “Liquidity Index” (from the Italian name “Indice di liquidità”).

- Quick Ratio: This is another liquidity index that is also called Acid-Test Ratio. Similar to the previous ratio, it measures the company's ability to meet current liabilities using assets. Nevertheless, this index considers that only some components of current assets will be transformed into Cash (usable to pay current liabilities) in the short term. In fact, the formula applied is: (Cash + Cash equivalent + Marketable Securities + Current Receivables) / Current Liabilities. (b. Corporatefinanceinstitute.com, 2020). The higher is the value of the ratio, and the greater is the financial state of health of the enterprise, but as for the previous indicator, an excessively high value can also suggest problems of conversion in cash of the more liquid components or further problems of inefficiency. (Accountingcoach.com, 2020)

- Cash Ratio (or also, Cash Asset Ratio): this index is a further narrowing of the calculation of the company's ability to repay short-term liabilities. If the current ratio considers all the current assets and the quick ratio considers some components of current assets, the cash ratio considers only the most liquid components of the current assets, i.e., cash and cash equivalents (c. Corporatefinanceinstitute.com, 2020). Indeed, It indicates the percentage of current liabilities that the company can cover through the use of the more liquid components. A value between 0.5 and 1 is generally considered to be useful, but this indicator should be compared to the sector indicator and, above all, consideration should be given to company policies as some companies prefer to keep little liquidity. For this reason, a low index is not always a negative symbol. These first three ratios resulted in the most used ratios in the studies about companies' bankruptcy prediction.

- Cash Flow Ratio: This index suggests a company's ability to repay short-term bonds through the use of cash generated by core business activities. It is characterized by the following formula: Operating cash flow / Current liabilities (Penman, 2013). The importance of this index is due to its numerator: Cash flow from Operations. This value indicates how much cash the company can generate from its core business activities. Generally, if the ratio is higher than one or it is constant or increasing, then the company is considered in good health because it means it has more (or increasing) Operating Cash Flow then its current debts. While, if it is less than one, it may indicate some short-term liquidity problems.

- Cash Flow to Capex ratio: This index is used to calculate a company's ability to acquire capital assets using the cash flow generated by the business core activities. This ratio is calculated using the formula: Cash Flow From Operations / Capital Expenditures (or CAPEX) (Penman, 2013). Where Capital Expenditures describes the expenses made by the company in order to realize and maintain investments. Capex is calculated by the formula: Current PPE - Prior PPE + Depreciation (d. Corporatefinanceinstitute.com, 2020). If a company can fully finance CAPEX through cash flow, then it will not have to rely on debt or equity. Usually, growing companies have a higher ratio, as they invest more aggressively in PPE (Purchase Plant and Equipment) than more mature companies.

Regarding the indebtedness ratios, they are those indices that try to define the degree of indebtedness of the company. The ratios used for the analysis of this area are as follows:

Table 7. Leverage Ratios

Leverage Ratios
Debt Ratio
Debt to Equity ratio
LT Debt to Asset ratio
Interest Coverage ratio
Cash Flow to Debt

- Debt to Equity Ratio: This index is given by the formula Total Debt /Total Equity (Penman, 2013). Its function is to define the number of loans that have been brought by creditors rather than shareholders. Indeed, this indicator indicates how assets are finances. If the value of the index is high, it means that a large part of the financing to the company comes from debt, while if the index is low, it indicates that the company is mainly financed by equity. This index is particularly used to estimate the amount of risk of a loan; indeed, it is more used by lenders. (e. Corporatefinanceinstitute.com, 2020).

  Furthermore, these ratios are very similar to the index indicated by the CNDCEC (the Nation Council of Accountants and Accounting Experts). This board suggested as one of the five best indices to indicate the bankruptcy situation of a company, the ratio between Equity and Shareholders' Equity. This index takes the name of Capital Adequacy ratio (from the Italian name "Adeguatezza Patrimoniale"). Since the components of the index are the same concerning the Debt to Equity Ratio, and since

the objectives of the two indices are the same, it was decided to consider only the Debt to Equity Ratio.

- Debt Ratio: Unlike the previous index, this ratio considers Assets as the denominator instead of Equity. It is calculated using the formula Total Debt / Total Assets (Penman, 2013). This ratio indicates the portion of the Asset that is financed through debt. Also, it is used by creditors to assess the overall risk and to verify whether a company is capable of repaying its debts. In particular, the higher the value of the index, the greater the company's debt (especially for values higher than one), while if the value is low (towards zero), it means that the company has more assets than liabilities and therefore has to be considered as less risky. (f. Corporatefinanceinstitute.com, 2020).

- Long Term Debt to Asset Ratio. Like previous indices, this index tries to identify corporate indebtedness. The formula applied is: Long Term Debt / Total Assets. In fact, unlike the previous index that takes into account all liabilities, it represents only that portion regarding the long-term debt (debt with more than one year of maturity). If the index has a low value, it suggests a good financial position, while if the index is high or rising, it can represent a potentially dangerous financial position, because it indicates that debt is the primary source for the company in order to finance its activities. Indeed, the higher the financing with debt, the higher the insolvency risk. (Penman, 2013)

- Interest Coverage Ratio: The following formula was used to calculate this index: Ebit / Interest Expenses. Where Ebit stands for Earnings Before Interest and Taxes, while Interest Expenses regards the interest payable on borrowings. This index describes how a company can repay interest on debt using its operating income. From this point of view, the lower the value of the index, the higher the possibility of the company going bankrupt, due to the lower ability to meet its payments. Indeed the Interest Coverage Ratio expresses the number of time Operating Income can repay the interests. (Penman, 2013)

- Cash Flow to Debt: This index represents the fifth indicator considered to analyze the indebtedness company’s point of view. The formula used to calculate this value is Cash Flow from Operations / Total Debt. This ratio describes the company's ability to repay its debts using the cash generated by its core business activities. In case the index has a

high value, the company can be defined in a good financial situation as the cash generated in the period from the core business can cover a significant part of the company's total debt. Considering that in Total Debt is included both current and long term liabilities. (g. Corporatefinanceinstitute.com, 2020).

As far as the area of profitability is concerned, it describes the company's ability to generate different types of revenue. The indices chosen in this case are the following:

Table 8. Profitability Ratios

Profitability Ratios
Gross Margin Ratio
Ebitda Margin
Operating Margin
RNOA (=Return on Net Operating Assets)
Cash flow margin

- Gross Margin Ratio: This ratio represents the company's ability to generate profit after payment of the cost of goods sold. It is calculated using the formula: (Net Sales - Cost of Goods Sold) / Net Sales. Generally, a higher ratio indicates higher profitability of the company, (even if this should be compared to the values of the sector to which the company belongs). In case the index has a low value (compared to the reference group), it indicates lower and or even negative profitability. Moreover, through the use of this indicator, an idea of the cost-efficiency of the company's products may be obtained. (h. Corporatefinanceinstitute.com, 2020).

- Ebitda Margin: This index is based on the ratio: EBITDA / Net Sales. Where, EBITDA defines the earnings that a company can generate before deducting interest, tax, depreciation and amortization expenses. A company with a positive EBITDA does not always mean that it is generating cash. "This is because EBITDA ignores changes in working capital, which is usually needed in growing a business. Additionally, it does not take into account capital expenditures which are needed to replace assets on the balance sheet". (i. Corporatefinanceinstitute.com, 2020). A high value of this index indicates a good ability of the company to derive revenues (excluding interest, tax, depreciation, and amortization expenses) from its sales.

- Operating Margin: Like the two previous indices, the Operating Margin (or EBIT margin) is characterized by calculating the company's profitability and performance based on a portion of revenues. Unlike the two previous indices, which consider respectively (Net Sales - Cost of Good Sold) and EBITDA as numerators, this index considers EBIT (or operating profit). EBIT (Earnings Before Interest and Taxes) indicates the company's earnings after deducting, from net sales revenues, the costs of production, personnel costs, depreciation, and amortization expenses. This acronym indicates the revenue deriving only from the typical management of the company. By dividing EBIT with Net Sales, an index that indicates the company's ability to generate income through its core business is obtained. In particular, if the value of this index is low or even negative, it indicates a substantial inefficiency in the nuclear business activities. (j. Corporatefinanceinstitute.com, 2020)

- RNOA: The formula that gives this index is Operating Income (or EBIT) / Average net Operating Asset. This financial ratio is characterized by considering both the numerator and the denominator values coming from the company's core business. Indeed, it measures how much operating profit a company can generate through the Average Net Operating Assets (i.e., Net Operating Assets of the previous period + Net Operating Assets of the period divided by two). The higher is this value, and the higher is the income that a company can generate through Net Operating Assets. (Penman, 2013)

- Cash Flow Margin: This is the last index taken into account for the company profitability area. It indicates the company's ability to convert sales into cash. Indeed, this index compares Cash Flow from Operations and Net Sales. Cash Flow from Operations describes the cash flow generated by the company through its core business. Therefore, if a company can generate positive or increasing Cash Flow from Operations, it will be evaluated positively, and the index will be higher. While if the company generates a negative Cash Flow from Operations, the value of the index will be harmful and this indicates a reduced ability of the company to generate cash from its core business. It should be noted that a negative Cash Flow from Operations is not always a negative index. Indeed, if the company is making long-term investments, it may have a low or negative index value but it does not mean that the company is in the wrong financial position. (Investopedia.com, 2019)

Finally, the last company's area taken into consideration is that of efficiency. It defines how efficiently a company is using its resources and assets. The ratios used in this field are as follows:

Table 9. Efficiency Ratios

Efficiency Ratios
Net Working Capital Ratio
Turnover Payables Tot Debt
Turnover Receivables
Turnover Inventory
Asset Turnover Ratio

- Net Working Capital Ratio: The formula used to determine this index is: (Current Asset - Current Liabilities) / Total Assets. This value "tell if a business is gradually shifting more of its assets into or out of long-term assets, such as fixed assets" (Bragg, 2019). The difference between Current Assets and Current Liabilities represent the company's Working Capital, which is the current asset portion after the "payment" of the short term liabilities. A high or increasing value is considered good because it means that the company tends to minimize investments in long-term assets and prefers to keep its assets as liquid as possible.

- Turnover Payables Ratio: This ratio was calculated using the formula: Cost of Goods Sold / Average Account Payables. Cost of Goods Sold was used instead of the Net Credit Purchases since the second component was not determinable using the database described in paragraph 2.1 of this chapter. If the value of this index is high, it indicates that payments made to suppliers have been made on time. However, it may also indicate that the payments to be made by the company have a short deadline, or the company may want to achieve a particular discount with shorter payments. On the other hand, a low value may suggest a slower payment to suppliers, which may have multiple reasons. These include advantageous arrangements where the maturities are long-term or a lack of liquidity that prevents the payment from being executed. (k. Corporatefinanceinstitute.com, 2020).

- Turnover Receivables Ratio: This ratio was calculated using the formula: Net Sales / Average Account Receivables (l. Corporatefinanceinstitute.com, 2020). Where Net Sales were used instead of Net Credit Sales because this second component was not determinable from the information in the database. While the Average Account

Payables represents the average between the payables accounts and the beginning and end of the year. This index indicates the ability and efficiency through which the company issues credits to its customers and collects funds from them. Indeed, a high value of the index indicates a conservative lending policy and an efficient credit collection department.

- Turnover Inventory Ratio: This index defines how many times a company can sell and replace its inventory in a year. It is calculated using the formula: Cost of Goods Sold / Average Inventory (m. Corporatefinanceinstitute.com, 2020). Where Average Inventory represents the average between the beginning and the end of the year inventory (or the period taken into account). Generally, a high rate indicates greater efficiency than a lower rate. "This is because a high turn shows that you're not overspending by buying too much and wasting resources on storage costs." (Tradegecko.com, 2020, p. 1).

- Asset Turnover Ratio: This is the last efficiency indicator considered. It was calculated using the formula: Net Sales / Average Total Assets (n. Corporatefinanceinstitute.com, 2020). Where the denominator indicates the average between the assets at the beginning and end of the year, this indicator, like the predecessors, helps describe the efficiency with which the company carries out its business. In particular, this index measures the efficiency in the use of assets to generate revenue. If this index has a high or increasing value, it means that the company or group of companies in question is/are efficient (or are increasing their efficiency) in this type of use, while if the value of the index is low or decreasing it indicates inefficiency in the use of assets.

After this series of indices, it has also been considered a series of indices defined by CNDCEC (the Nation Council of Accountants and Accounting Experts) to recognize the state of the company's crisis. Excluding the "Liquidity Index" and "Capital Adequacy" indices, which correspond respectively to the above-mentioned Current ratio (Current Asset - Current Liabilities) and "partially" to the Debt to Equity Ratio, the three remaining indices are:

Table 10. CNDCEC Financial Ratios

CNDCEC Financial Ratios
Financial Charges Sustainability
Tax and Social Security Indebtedness
Active Liquid Return

- Financial Charges Sustainability (from the Italian name "Sostenibilità Oneri Finanziari"): This index is calculated using the formula: Financial Charges /Net Sales. It expresses the ratio between a company's turnover and expenses for its financing. If the company has a turnover that increases less than the increase in its financial charges, then the goodness of that turnover is questioned. Therefore, the lower the index, the higher the sustainability of the financial charges, because either the turnover is high or the charges are low. (Fissoetasse.com, 2019)

- Tax and Social Security Indebtedness (from the Italian name "Indebitamento Tributario e Previdenziale"): It has been used applying the following formula: (Taxes + Payables to Social Security Institutions) / Total Assets. The high value of this index indicates an unfavorable position of the company, as the high ratio indicates the higher inability of the company to meet the two expenses quoted to the numerator using its assets. (Fiscomania.com, 2020)

- Active Liquid Return (from the Italian name "Ritorno Liquido Attivo"): This index is characterized by the formula: Cash Flow from Operations / Total Assets. Similar to some of the indexes mentioned above, it tries to identify the relationship between cash flow and another component in order to determine how the company's main assets have generated liquidity. This index indicates the ratio between the liquidity generated by the core business and the total assets of the company. In other words, it defines how many investments were required to generate operating cash flow. If the index has a high value, it means that the company can generate operating cash not using excessive amounts of assets. (Commercialisti.it, 2019)

The financial indices suggested by CNDCEC (the Nation Council of Accountants and Accounting Experts) should be used together and, above all, should relate to the specific sector

of the company in question. Indeed, this council has pre-established threshold levels that, if they are exceeded, the ratios indicate the adverse health of the company.

Analyzing the mentioned ratios, when it comes to low/lower or high/more significant value, it is referred to as the value of the other category (no bankruptcy firms) taken into analysis. Indeed, in order to obtain an optimal consideration on the value of the index, it would be necessary to compare the value of the index with the past of the company (therefore consider the performance of the index over time), the average value of the sector (comparing the index of the company with that of other companies in the sector and with the average value of the sector) and the forecast of the index itself (comparing the index of the company with the index planned for the future). In the analysis explained in the next paragraph, a different approach has been chosen.

Having a database made up of more than a thousand companies, with the related statutory financial statements, the comparison of each of these compared to the three paraments described above was dispersive, although more precise. For this reason, it was decided to focus on the comparison of the two categories: Bankruptcy vs No Bankruptcy companies, rather than in the comparison of each company. In this way, we tried to have an indication on which indices may or may not suggest a potential bankruptcy during the five years preceding the bankruptcy.

2.3 Analysis Description

The purpose of the analysis is precisely to understand which financial indicators can be considered as red flags warning the future crisis of the company. In order to determine these indicators, it is necessary to evaluate their functioning in a large number of cases. Indeed, after having obtained and processed the database (in order to have the data available and understandable), containing the statutory financial statements of a large number of failed and no-failed companies (as described in the first paragraph of this chapter), financial statement ratios, described in the second paragraph of this chapter, were calculated and analyzed.

After this first analysis, in order to verify whether indices different from Altman's were similar to red flags, two analyses were carried out: The financial ratios analysis, where the results of the indices between failed and non-failed companies are compared, and the financial ratios analysis by sector, where the sectors with the highest number of observations are identified and comparisons between failed and non-failed companies of these sectors are made.

Before the description of the steps taken in carrying out the two analyses mentioned above, it is necessary to mention an important step carried out before everything else: the reclassification of the financial statements. Indeed, to make the data analyzable and flexible according to the various phases of the analysis, a reclassification of the statutory financial statements was necessary. This operation allowed a more straightforward application of the indices and greater flexibility in carrying out the two analyses.

After this first, but relevant, step, numerous steps have been elaborated. These can be summarized in the following two steps:

Database Financial Ratios Analysis:

- Calculation of indices illustrated in the second paragraph;
- Indices result cleaning;
- Separation of results into two categories (Bankruptcy and No Bankruptcy);
- Calculation of the index median;
- Comparison between the medians of the two categories;
- Graph processing;
- Individualization of the best indices.

Financial Ratio Analysis by Sector:

- The individualization of companies reference sectors
- Reduction to significant observations (in quantitative terms)
- Identification of the four sectors with more observations
- Calculation of indices illustrated in the second paragraph;

- Indices result cleaning;
- Separation of results into categories (Bankruptcy and No Bankruptcy) and sectors;
- Calculation of the index median;
- Comparison between the medians of the two categories and the sectors found;
- Graph processing;
- The individualization of the best indices.

2.3.1 Database Financial Ratios Analysis

Once the statutory financial statements have been reclassified, the financial ratios, explained in the previous chapter, have been calculated using the formulas previously described.

As the database in question had some missing data, some indexes (for some companies) were not calculable.

Moreover, after the calculation of the indexes, some of them have presented partially wrong values: the application of the formula did not allow to determine an actual value but a value far from reality. This problem is mainly due to the application of the formula and not to incorrect financial statement values. For these reasons, some corrections were made in order to exclude these outliers from the next steps of the analysis.

Therefore, the excluded values do not include those that are far from the expected value but include those that, through the application of the formula, were wrong. Besides, companies whose equity plus liabilities were equal to the assets in the fifth year before bankruptcy were taken into account. These small precautions were necessary in order to exclude those values that, within the analysis, would have vitiated the results obtained.

After making these changes, the two main categories of data (Bankruptcy firms and No Bankruptcy firms) were divided in order to distinguish the values better.

At this point, the median was calculated for each index and concerning each year, in order to obtain five total values for each index. In addition to the median, the average was also taken into account. Since there were values far from many others (defined as Outliers), there was the probability of obtaining a value that did not adequately describe the index for the reference category. For this reason, the choice fell to focus on the median.

The median, considering the value that occupies the central position of the data series, allows limiting the influence from those particular indexes.

Once the medians of the two categories (Bankruptcy firms and No Bankruptcy firms) had been obtained for each index, and for each year considered, all the results were grouped in tables summarising the results. An example is the following table:

Table 11. Turnover Inventory Ratio Table - Example

Turnover Inventory		
	Bankruptcy	No Bankruptcy
Year 1	4.894	4.880
Year 2	3.295	5.023
Year 3	2.981	5.020
Year 4	2.795	5.113
Year 5	3.148	4.861

As can be seen from the table above, "Year 1" corresponds to the fifth year before the bankruptcy (so the first year that is taken into consideration), while "Year 5" corresponds to the Bankruptcy year. Furthermore, the name "Bankruptcy" was given to that group of companies considered as failed, while the name "No Bankruptcy" was given to that group of companies considered as being solvent. In this way, it was possible to compare the medians of the indices between the two categories, and above all, to identify the trend of each index over the five years under consideration.

For this reason, graphs have been elaborated to describe in the same Cartesian plan the trend of an index for the two different categories. The type of graphs taken into consideration was that of the line graph, which presented on the plane of the abscissae the reference years and the plane of the ordinates the medians of the indexes for each year.

Once this point was reached, the comparison between the two categories began in order to understand what the indexes described. Finally, an attempt was made to identify which indexes indicated red flags. These last ratios were considered significant, and they are reported and discussed in the next chapter.

2.3.2 Financial Ratio Analysis by Sector

This analysis is remarkably similar to the previous one in terms of the procedure followed. What differentiates this more specific part of the analysis from the previous one are the steps carried out before the calculation of the median. Once the indices had been calculated as in the previous paragraph, starting from each company and its ATECO code, the macro sectors to which each activity referred were identified.

The ATECO code is an alphanumeric identification code provided by the Chamber of Commerce when opening a new business; it identifies the reference sector of the company.

Once all the macro-sectors of the companies in the database were identified, it has been detected how many cases each sector presents. In other words, how many companies in the data-set belonged to each sector. This analysis identified a total of thirty-nine sectors. These are described by the ISTAT (the National Institute of Statistics, the Italian public research institute that deals with social and economic surveys) description in "Table 14. Annexes - Companies Sector" in the annexes. At this point, it was decided to restrict the analysis to those sectors with the highest number of companies, in order to get a better understanding of the company's trend. First of all, those sectors that have a minimum number of thirty companies were determined (see "Table 14. Annexes - Sectors with at least thirty firms"). Then it was decided to consider those sectors among those previously found, that have at least ten cases of Bankruptcy companies. The following table represents the result:

Table 12. Sectors with a minimum of ten bankruptcy firms

Sector (from "second analysis"[6]) with at least ten bankruptcy firms			
ATECO CODE	*N. FIRMS*	*ISTAT SECTOR DEFINITION*	*N. Bankruptcy firms*
28	60	FABBRICAZIONE DI MACCHINARI ED APPARECCHIATURE NCA	10
41	157	COSTRUZIONE DI EDIFICI	29
46	132	COMMERCIO ALL'INGROSSO (ESCLUSO QUELLO DI AUTOVEICOLI E DI MOTOCICLI)	22
68	184	ATTIVITA' IMMOBILIARI	32
		Total Bankruptcy Firms	93
		No Bankruptcy Firms Related	439
		Total Firms	532

In this way, the following four sectors were found:

- Manufacture of machinery and equipment, with ten bankruptcy companies;
- Construction of buildings, with twenty-nine bankruptcy companies;
- Wholesale trade (excluding motor vehicles and motorcycles), with twenty-two Bankruptcy companies;
- Real estate activities, with thirty-two Bankruptcy companies.

In addition to these, the related No Bankruptcy companies have logically been taken into account (which total in 439 companies).

6 See "Table 15. Annexes - Sectors with at least thirty firms"

Once the sectors were identified, the companies were separated between Bankruptcy and No Bankruptcy and about the four sectors previously mentioned.

After that, the division had been carried out, which identified a total of eight groups of companies (four Bankruptcy and four No Bankruptcy groups), the respective medians were calculated. This calculation was carried out in the same way as the previous analysis, i.e., by calculating the median for each index and each year. Unlike the previous analysis, in this case, the medians were related not only to the two categories Bankruptcy and No Bankruptcy but also to the four sectors listed above.

In order to identify those indices that better identified the red flags, according to the sector analyzed, line charts have been elaborated, as in the previous analysis.

An example of a line chart elaborated during the two main analysis can be seen in the following image:

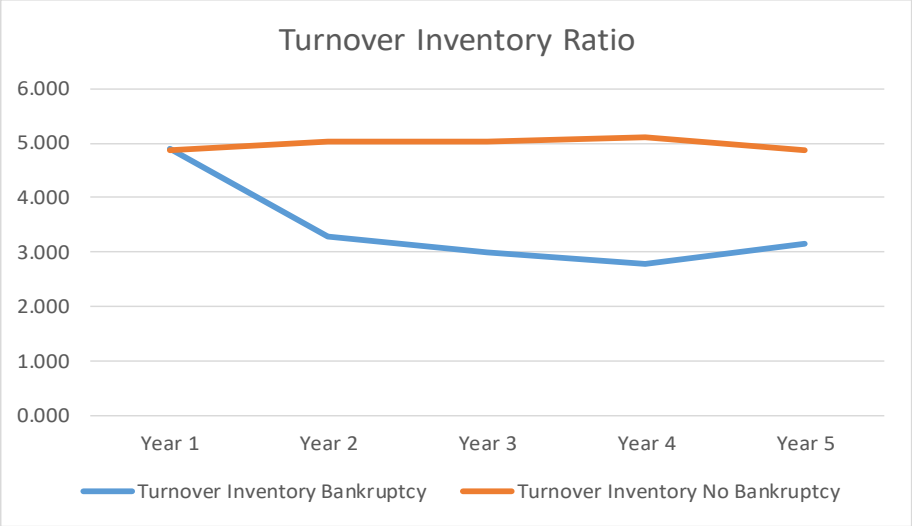

Figure 2. Turnover Inventory Ratio Graph - Example

Through the use of this type of chart, it has been possible to compare in the same cartesian plan the trend (related to a particular index) of the two analyzed companies groups (Bankruptcy and No Bankruptcy Firms).

CHAPTER 3. Discussion

This chapter has the function of describing the results obtained through the considerations and analyses and carried out in the two previous chapters.

In particular, the objective of this chapter is the identification of financial ratios that serve as red flags in reporting the potential failure of a company, the central thesis goal.

The ratios introduced and calculated in the previous chapter are interpreted and compared between Bankruptcy and No Bankruptcy firms, considering as a period of observation the five years preceding the bankruptcy.

In this way, it is easier to understand if some of these indices describe a significantly different behavior between the two categories and, therefore, if it is possible to indicate, in advance, a behavior that indicates a potential failure.

Starting from the assumption that different patterns are expected in the performance (from income, liquidity, efficiency, and debt point of view) between the two categories, the identification of which ratios (and their timing) better illustrate this different situation is required.

For analysis and interpretation purposes, line graphs containing both the function of the median of the "Bankruptcy" companies group and the median of the "No Bankruptcy" firms group are used. In this way, it was possible to analyze, in the same plane, both trends and behaviors (for the same index) of both categories.

Three parts characterize the chapter:

- the discussion of the significant financial ratios from the paragraph 2.3.1 analysis, carried out by considering and comparing the all companies contained in the database;
- the discussion of the significant financial ratio related to paragraph 2.3.2 analysis, the analysis that considers the sectors to which the most significant number of observations belong;
- the further consideration paragraph, where deeper considerations related to the developed analysis are discussed.

Furthermore, this chapter is not intended to analyze all the twenty-three indexes taken into consideration, but it aims at focusing on those that seemed to be more closed to the concept of a “Red Flag.”

3.1 Significant Financial Ratios Discussion

The discussion of significant financial ratios analyzes those indices, in the five years examined, that showed a different trend, or different values, between the bankruptcy and non-bankruptcy firms. In particular, it aims at describing the results obtained by the database financial ratios analysis described in paragraph 2.3. Furthermore, this analysis is considered more general because, differently from the one explained in the next paragraph, it does not consider the sector to which these companies belong.

In order to describe the main potential red flags, this discussion takes into account graphically and descriptively, those indices that have shown, in the period analyzed, different values and trends in the Bankruptcy and No Bankruptcy firms' groups (considering the interpretation of the index anticipated in chapter two and the rations' filed mentioned).

Among these leading indices, there are liquidity ratios. Those that showed the most difference between failed and not-failed companies are: Quick Ratio, Cash Ratio, and Cash Flow Ratio.

As can be seen from the figure below (" Figure 3. Quick Ratio"), the medians calculated for the Quick Ratio index (also known as "Acid Ratio") underline different values for the two categories of enterprises. The curves representing these values follow quite similar trends but with clearly different values. Indeed, if the Quick Ratio for the No-Bankruptcy category seems constant over the five years, the ratio calculated for the Bankruptcy category shows a similar trend even if, in the two years, further away from bankruptcy, it has an increasing value. This increase can be related to the decreasing of the current liabilities (probable thanks to their payments) or the increase in the company's current assets. However, the No Bankruptcy category shows higher values. The reasons for this difference can be mainly twofold: higher (or lower) liquidity for non-failed (or failed) companies, or lower (or higher) short-term debt for non-failed (or failed) companies. Considering the formula applied to calculate this index, i.e. (Cash + Cash equivalent + Marketable Securities + Current Receivables) / Current Liabilities, it can be noted that as the numerator (the component representing liquidity) increases or the denominator decreases (the component representing the short-term debt), the value of the index increases. This graph underlines that the not failed companies group seems to have a better capacity to have high and constant current assets (those assets that are expected to be converted into liquidity in one year) and lower current liabilities (the amount of money the company has to pay to its creditors in one year). For this reason, Bankruptcy firms show a lower capacity to cover their current liabilities using their current asset even five years before the Bankruptcy.

Furthermore, the fact that from "Year 3" failed companies show this financial ratio equals more than one indicates that by the usage of all these components, it can pay its current liabilities.

The problem arises when the company is not able to covert its current assets that were supposed to be convertible in the short term (one year). Indeed it may be the case that accounts receivables are not paid in the year expected (for example, due to the debtors' liquidity problem). In this situation, the company owning the credit is not able to convert it into cash, and if not able to pay its current liabilities with its other current assets, it will be in trouble.

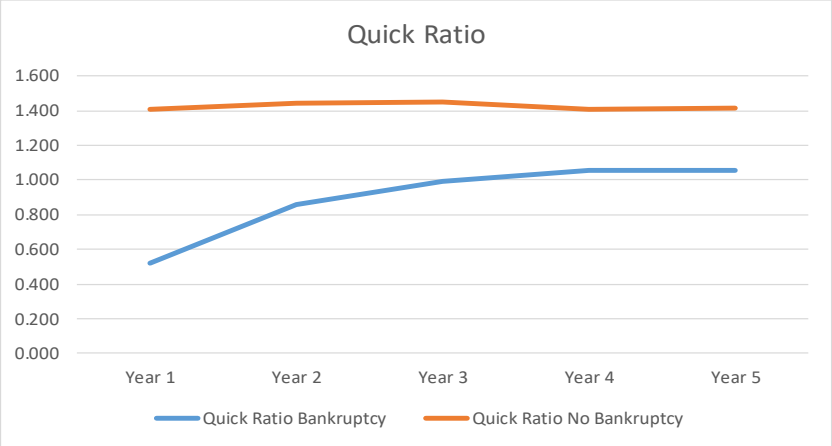

Figure 3. Quick Ratio

Regarding the Cash Ratio, it was calculated using the formula: (cash and cash equivalents) / Current Liabilities. It, as the index explained above, shows how the most liquid components in the company's balance sheet (in this case, the only cash and cash equivalents) can offset short-term liabilities. As can be seen from the following image ("Figure 4. Cash Ratio"), the trends are once again similar between the two categories, but the calculated values show a clear difference (more significant than in the previous index). It is probably due to the components that differentiate the two indices, Marketable Securities and Current Receivables. Indeed, their absence seems to underline the inability of the remaining factors to cover the short-term liabilities. For this reason, the Bankruptcy category appears to have a lesser ability to repay debts through more liquid components. Therefore, it seems that the No Bankruptcy category has more liquidity than failed companies even five years before the bankruptcy. If the Current Ratio (Current Assets / Current Liabilities, see " Figure 32. Annexes - Current Ratio") is taken into account, it presents a trend similar to the two indices previously described, but at the same time, it presents values between the two categories that are different in a lesser way. These ratios underline how some components of the Current Assets (i.e., those that differentiate the three indices Current Asset, Quick Ratio, and Cash Ratio) influence the values of the two categories examined.

The lack of liquid assets phenomenon, in failed companies, may be explained by the fact that these companies, over time, had faced moments when it was necessary to use their liquid assets

in order to repay some debts or to finance some investments. As a result, these companies were no longer able to recover these resources to sufficient levels. This mechanism probably triggered a vicious circle until the companies had to resort to debt.

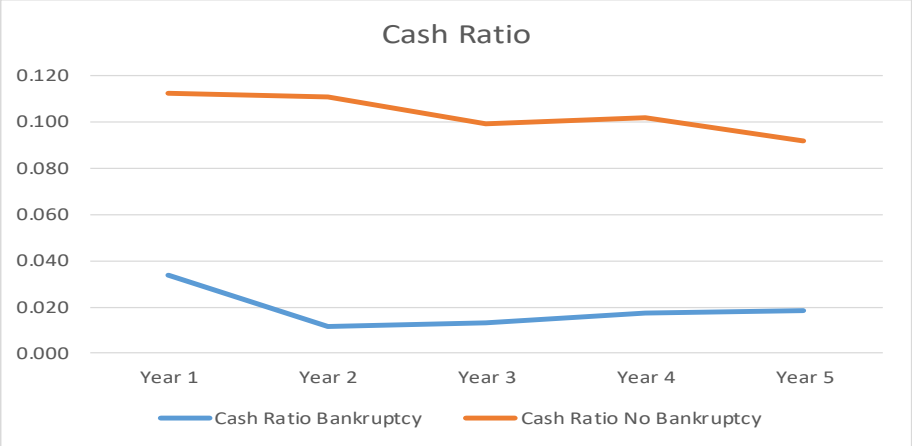

Figure 4. Cash Ratio

The last index (regarding the liquidity area), showing an exceptional ability to highlight the differences between the two types of companies, is the Cash Flow Ratio. Unlike the indices described so far, it does not take into account Current Assets or a part of them, but it considers the company's Cash Flow from Operations. In particular, Cash Flow from Operations has been calculated as Net Income + Depreciation –/+ Increasing/Decreasing of Account Receivables –/+ Decreasing/Increasing in Account Payables. In this way, it can describe how a group of companies can meet its short-term liabilities using the Cash generated by the core business. The chart below ("Figure 5. Cash Flow Ratio") describes how failed companies show a lower cash flow ratio than companies that have not gone bankrupt. This low value indicates that the bankruptcy group is characterized by a much lower ability to pay liabilities by the cash generated in the period than the no bankruptcy group. Indeed, the graphic underlines that non-failed companies appear to have a more exceptional ability to meet their current liabilities using cash from their core business.

Furthermore, the figure shows how failed companies are "burning" money during the last three years. Indeed the trend shows a decreasing value until the Bankruptcy year. The fact that the cash flow from operations is negative is mainly due to the inability of the company to generate cash from its core business. Another explanation for the trend of this index lies in consideration of short-term liabilities. Assuming that Cash Flow from Operations remains constant over time, the following chart can show that failed companies have significantly higher short-term liabilities than non-failed companies.

This index, like those described above, describes differences between the two companies as early as five years before the Bankruptcy category of companies went bankrupt.

The inability to generate the right level of liquidity from the core business should be one of the first signs of the company's unfavorable situation. Indeed, assuming the company is not financing projects or investments, a low value (or even negative) of Cash Flow from Operations indicates a substantial inability of the company.

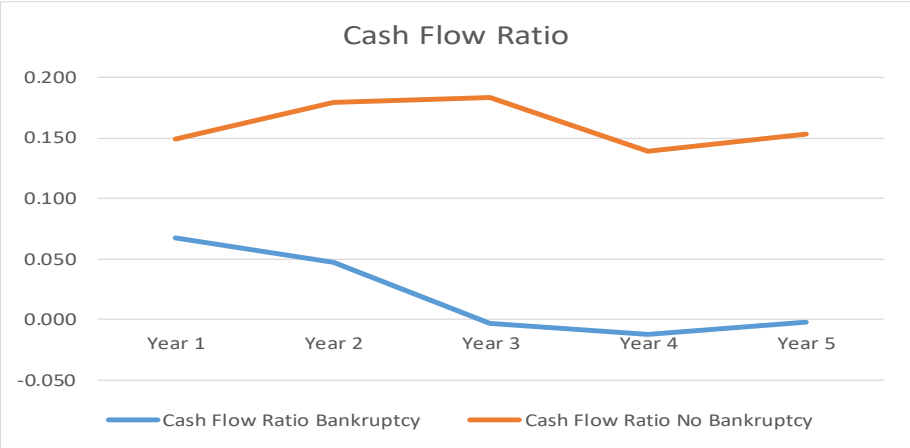

Figure 5. Cash Flow Ratio

As far as the financial indices belonging to the debt area are concerned, the ones that have shown greater precision in highlighting the differences between the two examined categories are Debt to Equity Ratio, Long Term to Asset Ratio and Cash Flow to Debt Ratio.

The Debt to Equity Ratio describes the relationship that the two groups of companies have between their total debt and equity. In particular, this ratio identifies with how much debt or equity companies finance their assets. The higher the value of the index, the greater the use of debt to finance the company's assets. As can be seen in "Figure 6. Debt to Equity Ratio", failed companies have a much higher debt than non-failed companies. In particular, while non-failed companies have a lower and constant value over time, failed companies have a higher and increasing value over the five years considered. Only in the last year (the bankruptcy year) the value is decreasing. This movement is probably due to the debts' partial payment. These index values indicate that bankrupt companies make greater use of both short and long term debt, to finance their activities. It should be noted that the higher the use of debt, the greater the risk of the company. Indeed, in the case analyzed, the companies with the most debt turned out to be those that went bankrupt. Moreover, especially in the years before the bankruptcy, the debt ratio

is more than four times the equity value of companies. This value confirms the high riskiness of this category.

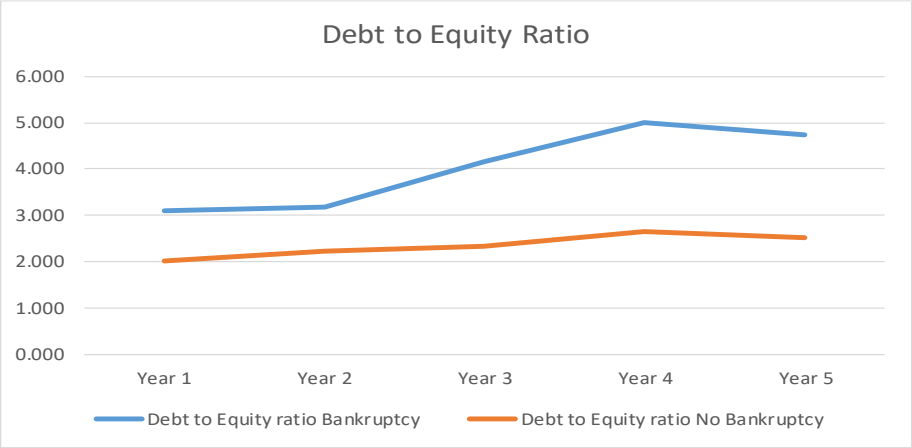

Figure 6. Debt to Equity Ratio

Regarding the Long Term Debt to Asset Ratio, this index describes how the group of companies in question finances its assets using long-term debt (i.e., debt with a maturity of more than one year). Indeed, it is calculated by the formula Long Term Debt / Total Assets. From "Figure 7. Long Term Debt to Asset Ratio" it can be noted that failed companies resort much more than non-failed companies to this type of debt. Indeed, while non-failed companies show a relatively low and constant index, using long term debt to finance about 10-20% of their assets, failed companies seem to use this type of debt as their primary financing (80-90% of their assets one year before bankruptcy). Furthermore, it seems that failed companies are characterized by a high and increasing Long-Term Debt to Asset Ratio, with an increasing trend from four years before the bankruptcy. This trend is a signal that underlines how high indebted firms that decide to increase the long-term debt further have a high possibility of going bankrupt. The increasing value of long term debt can be explained by the fact that the company is not able to pay its current liabilities using its cash and the cash generated by the core business in the period considered, for this reason, it tries to cover this payment getting money from new long term

debts. Collecting all these debts pushes the company into financial problems if it is not able to change the negative direction, starting to generate cash.

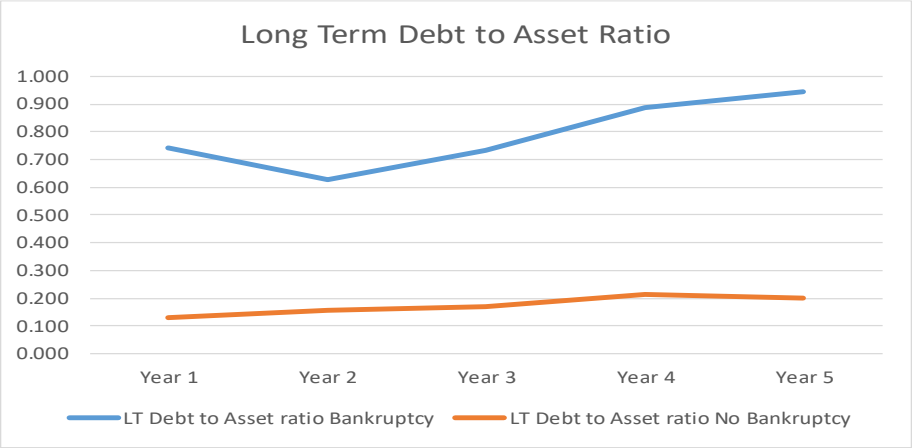

Figure 7. Long Term Debt to Asset Ratio

The Cash Flow to Debt Ratio seems to confirm what has been written so far. An inability to generate cash from the core business and a high level of debt seem to characterize companies belonging to the Bankruptcy category. Indeed, as can be seen from " Figure 8. Cash Flow to Debt Ratio", while non-failed companies can have a Cash Flow that is about 7-9% of their total debts, failed companies show a Cash Flow of about 2-3,5% in the first two years considered, after that, it shows a negative value (due to the negative value of Cash Flow from Operations). These values show a clear inferiority of failed companies to repay debts through the use of cash generated by the core business. Indeed, this index shows how much debt the company can repay if it uses all the cash flow generated by its core business in the year.

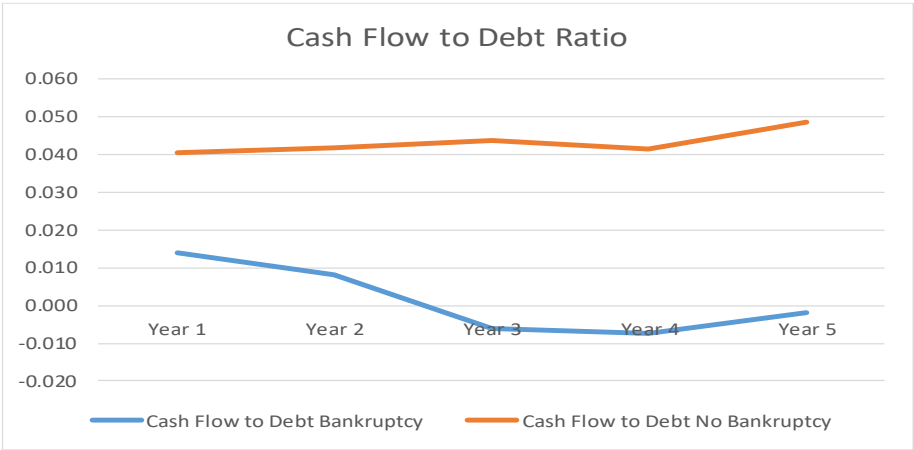

Figure 8. Cash Flow to Debt Ratio

Regarding those Financial Ratios that describe the profitability of the company, among them emerge the Gross Margin Ratio.

The Gross Margin Ratio is the first profitability index as it indicates how much revenue the group of companies can realize once paid the costs incurred for the products sold (or Cost of Goods Sold). Looking at the graph, " Figure 9. Gross Margin Ratio", it can be seen that the two types of companies have similar trends but different values. The graph shows that the companies that will go bankrupt have lower profitability than the group of companies that will not go bankrupt. In particular, Bankruptcy firms have an index that varies between 15-20%, while No Bankruptcy firms have an index of about 25%. These values underline how bankruptcy firms spend more money on producing their sold goods than non-failed firms, or, more precisely (in the case of Bankruptcy Firms), 80-85% of their revenue goes to pay the expenses incurred to produce the goods sold. There can be more than one justifications for the values described in the following graph. These include the fact that bankrupt companies probably cannot afford a high mark-up on the price of the product sold, or the fact that bankrupt companies have too expensive suppliers or even production problems (that causes a higher consumption of resources). These problems are consequences of business inefficiencies, including inadequate marketing policies or inefficiencies in the assembly line (or generally in the production field).

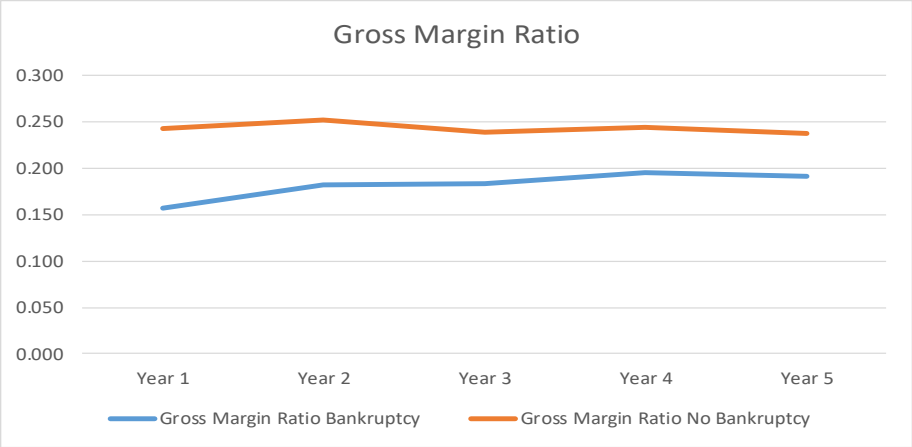

Figure 9. Gross Margin Ratio

As regards the area of business efficiency, the financial ratios that emerge are mainly two: Turnover Payables Ratio and Turnover Inventory Ratio. These two ratios have been calculated using the following two formulas, respectively: (Cost of Goods Sold / Average Account Payables) and (Cost of Goods Sold / Average Inventory).

The resulting graph from the Turnover Payables Ratio for the two categories Bankruptcy and No Bankruptcy Firms is shown in the following chart ("Figure 10. Turnover Payables Ratio"). As can be seen, the functions represented have a similar trend, except for the slight increase in value for Bankruptcy Firms in recent years before the bankruptcy (probably due to the payment

of some account payables). This index shows how many times the company can repay its debts from purchases. Indeed, non-failed companies can repay their Account Payables on average 1.4 times in the year under consideration, while for failed companies, these debts have never been fully repaid in a single year. Failed companies repay about 0.6-0.8 times the Account Payable. This ratio is remarkably low for the bankruptcy firms, maybe because of advantageous agreements with suppliers (which give companies more time to make payments). However, it may also indicate a lack of liquidity needed to make payments. This last cause leads companies to do not meet the payment deadlines. Considering the other indices highlighted in this chapter, with particular reference to the indices that consider cash flow, it can be noted that failed companies seem to have a lack of liquidity such that the cause that this index presents a low value does not seem to be related to the advantageous payment terms.

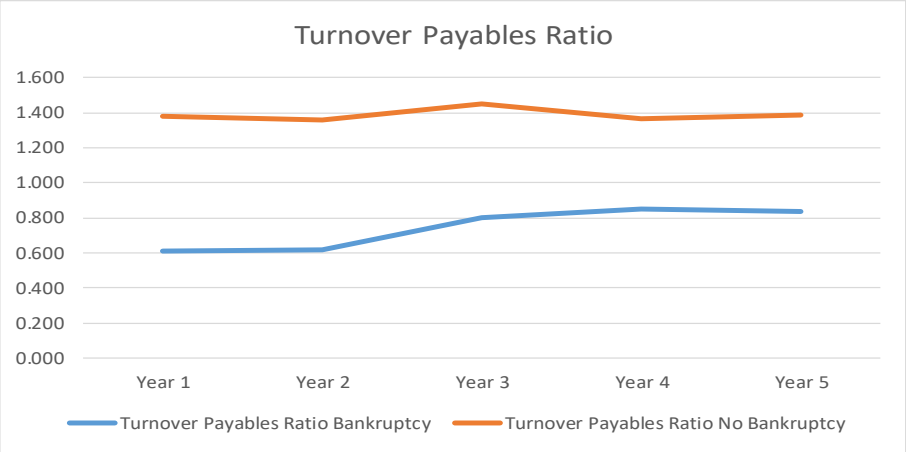

Figure 10. Turnover Payables Ratio

Regarding the Turnover Inventory Ratio, it seems to be the index that best describes the performance of the two categories of companies over the five years considered. Indeed, taking into consideration the graph in the figure " Figure 11. Turnover Inventory Ratio", it can be noted that the two companies start from a similar situation, five years before the bankruptcy, after that they arrive at entirely different situations in the year of bankruptcy. This index identifies the number of times the company can sell its inventory during the year. Looking at the chart below, it can be noted that non-failed companies seem to be more efficient in selling their inventory. Indeed, this category of companies seems to be able to maintain a constant value over time, while the opposite category has a decreasing index. If in "Year 1" both categories sell inventory five times in a year, in "Year 5", failed companies reduce the index to about three. These values describe how efficiently a company can manage its inventory and for this reason, the lower the value of the index, the higher the costs associated with maintaining the warehouse itself (including the possibility of product obsolescence). For this reason, the trend described in the

following figure means that failed companies are spending money (because of their inefficient inventory management) in an increasing way in the five years preceding their bankruptcy.

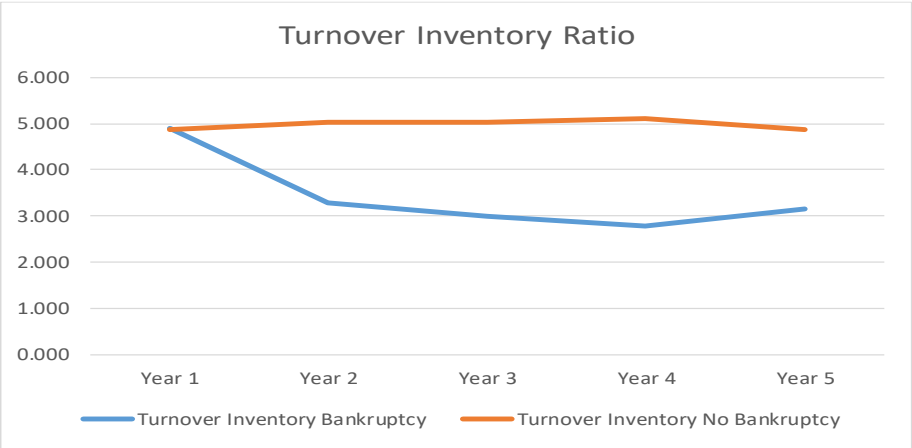

Figure 11. Turnover Inventory Ratio

Finally, as regards the indices proposed by CNDCEC (the Nation Council of Accountants and Accounting Experts), in addition to the already mentioned Debt to Equity Ratio, the Financial Charges Sustainability emerges. As can be seen from the following chart (Figure 12. Financial Charges Sustainability) Bankruptcy companies seem to have a significantly higher index than No Bankruptcy companies. In particular, Bankruptcy firms show a decreasing index until "Year 3" and then constant until "Year 5", while No Bankruptcy shows a much lower and constant value throughout the five years under review. This index describes the ratio of financial expenses to net sales. Therefore, the high value that characterizes failed companies is a negative sign because it represents a ratio between financial expenses and sales that is too high compared to the opposite category.

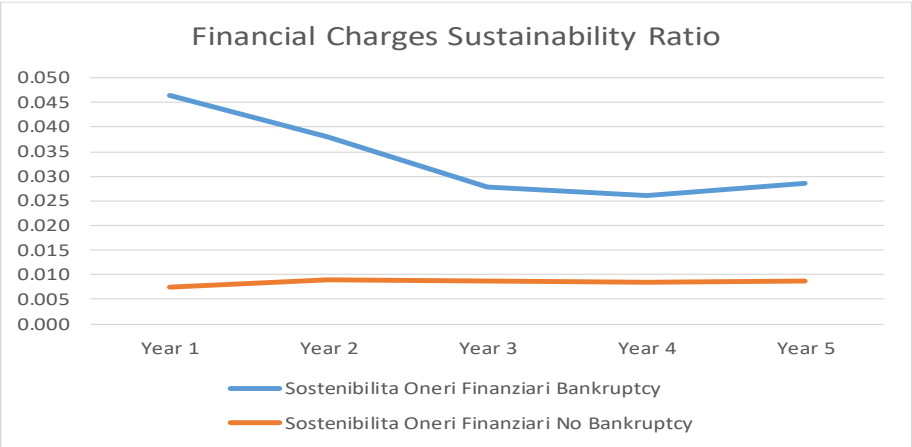

Figure 12. Financial Charges Sustainability

3.1.1 Further Significant Financial Ratios Considerations

What emerges mainly from this analysis is that several indices are describing the differences between these two categories, even before the bankruptcy year. Indeed, even if these results are based on a general analysis that considers many different types of companies, the results obtained and the relative discussion can show how some ratios may be helpful in the evaluation of a company's potential future failure. Furthermore, the fact that Bankrupt companies appear to have significantly lower liquidity and much higher debt than non-failed companies confirms the goodness of this analysis, as these components are the main characteristics expected of distress, or going bankrupt, company.

At the same time, it presents some characteristics that may seem misleading if not interpreted in the right way. In the case of financial ratios that take into account the cash flow generated by the core business, they do not show that there are also companies presenting a positive value for the cash flow from operations for the bankruptcy group. Indeed, it may be the case that a company, even if it can generate cash from its main activities, it is going to be bankrupt. This phenomenon is explained by the companies' extremely high indebtedness level. If a company has high debts that must be paid but its liquid assets (in particular cash and cash equivalents) are not enough, it cannot fulfill them. From the graph ("Figure 9. Cash Flow to Debt Ratio") that describes the companies' cash flow values and the debts values, it has emerged that there are companies that are both "burning" and generating cash from their core business, but this is not enough. Indeed their high level of debt does not allow them to survive after the "Year 1" (the bankruptcy year). For these reasons, it has to be considered that a company may also fail even if it is generating positive (but not enough) Cash Flow from Operations.

The increase of long term debt ratio expressed in "Figure 7. Long Term Debt to Asset Ratio" may be misleading, as well. Indeed, while it seems to signalize the inability of the bankruptcy companies to pay their long term debt and their continuous recourse to this type of financing, it may also be interpreted from the assets point of view. Indeed, the ratio increase may be due to the decrease in the value of the assets over time. If the company is repaying some short or long term debt, it has to use the cash available (so cash and cash equivalents that are part of its assets). This first aspect has the consequence to decrease the current assets. If these two components are not enough, the company may choose to convert its current assets (those not already liquid) or even part of its fixed assets to get cash in order to pay the long term debt.

This company's choice generates a further decreasing value of the total assets value and, consequently an increasing value of the financial ratio Long Term Debt to Asset Ratio.

Since the sample considered contains a large number of companies, and the values (on which the graphs are based) are the medians for companies (divided by Bankruptcy and No Bankruptcy) that are coming from different sector and with distinct differences, there may be different causes that push them into bankruptcy.

Moreover, this first and general analysis highlights that failed companies show to have: an inability to repay short-term debt through the most liquid assets; debts, which in addition to being higher than the other category, are significantly increasing in the years before the bankruptcy (with particular reference to long-term debts); expenses for the production and sale of their products which are too high if compared to those companies that do not go bankrupt (this underlines further management inefficiencies); high inefficient warehouse management which increases significantly as the year of bankruptcy approaches; finally, inability to generate sufficient cash flow from the core business in order to maintain their activities.

The following table summarizes, which are the significant financial ratios previously described:

Table 13. Significant Financial Ratios

Financial Ratios	***Formula Applied***
Quick Ratio	(Cash + Cash Equivalent + Marketable Securities + Current Receivables) / Current Liabilities
Cash Ratio	Cash and Cash Equivalents / Current Liabilities
Cash Flow Ratio	Operating Cash Flow / Current Liabilities
Debt to Equity Ratio	Total Debt / Total Equity
Long Term Debt to Asset Ratio	Long Term Debt / Total Assets
Cash Flow to Debt Ratio	Cash Flow from Operations / Total Debt
Gross Margin Ratio	(Net Sales - Cost of Goods Sold) / Net Sales
Turnover Payables Ratio	Cost of Goods Sold / Average Account Payables
Turnover Inventory Ratio	Cost of Goods Sold / Average Inventory

3.2 Discussion of Significant Financial Ratios Analysis by Sector

The discussion of the significant financial ratios analysis, coming from the "Financial Ratio Analysis by Sector" (paragraph 2.3.2), aims to deepen the analysis described in the previous paragraph, considering those sectors with the most significant number of observations and the relative financial ratios that proved to be more significant.

If in the previous analysis the medians relative to the indices (described in paragraph 2.2.1) were calculated and compared (over the five years of reference and between the Bankruptcy and No Bankruptcy categories) in this analysis the same method of comparison has been applied but with the focusing on specific sectors.

In this way, it was possible to identify which indices proved to be the most significant for the sectors considered. As already described in paragraph 2.3, once the sectors to which each company referred were identified, those sectors with at least thirty total observations and at least ten observations relating to failed companies were identified. These numbers seemed appropriate in order to obtain a meaningful set to analyze. By making this selection, four main sectors were obtained. These sectors are manufacture of machinery and equipment, construction of buildings, wholesale trade (excluding motor vehicles and motorcycles), and real estate activities.

3.2.1 Manufacture of Machinery and Equipment

Considering the Manufacture of Machinery and Equipment sector, the ratios that seem to be the most significant red flags are Current Ratio, Cash Flow Ratio, Long Term Debt to Asset Ratio, and Asset Turnover Ratio. Indeed, these Financial Ratios show essential differences between Bankruptcy and No Bankruptcy firms.

The current ratio (showed in "Figure 13. Sector Analysis - 28. Current Ratio") that compares current assets and current liabilities highlights the opposite trend between the two categories of companies. Indeed, while for No Bankruptcy firms, it assumes a constant trend with high values, for Bankruptcy firms it has a trend that swings from increasing to decreasing moments while maintaining values significantly lower than those of the other category. This trend highlights the lack of short-term assets (compared to short-term liabilities) of failed companies, which is more significant for this sector than the gap seen in the more general analysis.

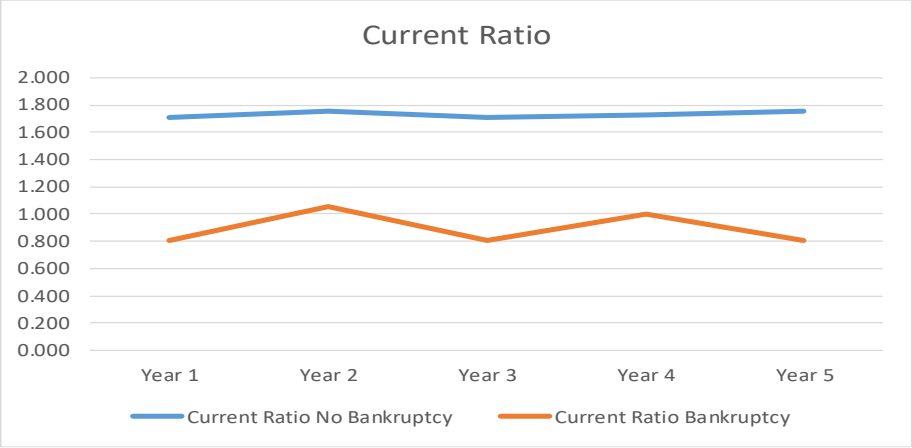

Figure 13. Sector Analysis - 28. Current Ratio

The Cash Flow Ratio (shown in "Figure 14. Sector Analysis - 28. Cash Flow Ratio"): this index highlights the contrast between Bankruptcy and No Bankruptcy companies showing completely different trends for the two types of companies. Indeed, while failed companies show a sharply decreasing Cash from Operation to Current Liabilities ratio from "Year 1" to "Year 3" and a lightly increasing but still low trend in the following two years, non-failed companies show a more regular trend that remains above the values of bankruptcy firms. This phenomenon seems to underline how the inability to generate cash from the core business, combined with recourse to short-term debt, affects failed companies. This index can be misleading five years before the bankruptcy, but it may start to be considered as a red flag already three years before the bankruptcy. The significant drop described in the following graph seems to be a clear sign of the beginning of the company's crisis period.

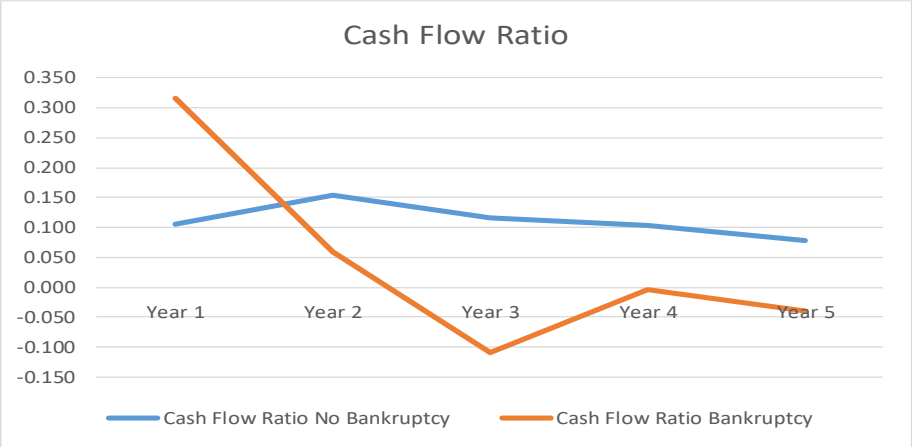

Figure 14. Sector Analysis - 28. Cash Flow Ratio

Long Term Debt to Asset Ratio (shown in "Figure 15. Sector Analysis - 28. Long Term Debt to Asset Ratio"): this index confirms what is described in the more general analysis discussion. In other words, there is a significant difference in the use of long-term debt between the two categories of companies. Indeed, even for this sector, bankrupt companies seem to make

considerable recourse to long-term debt, with a fluctuating trend compared to all five years considered. While the No Bankruptcy group of the same sector presents low value for this index, underlining the problems to have a high degree of indebtedness.

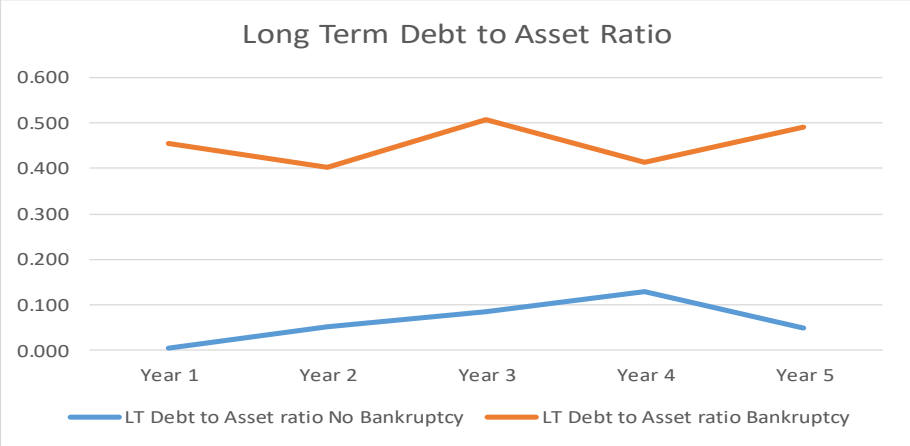

Figure 15. Sector Analysis - 28. Long Term Debt to Asset Ratio

Cash Flow to Debt Ratio (shown in "Figure 16. Sector Analysis - 28. Cash Flow to Debt Ratio"): this index seems to confirm what has been described by the previous ratios that have been highlighted for this sector. It shows how for failed companies, the ratio between cash flow from operation and total debt of the company decreases significantly after the year "Year 1" and then stops at a level significantly lower than the other category until the year of bankruptcy.

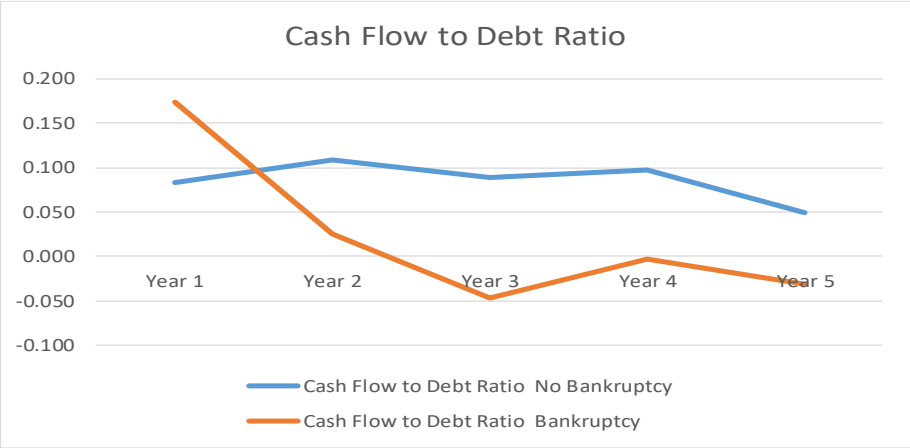

Figure 16. Sector Analysis - 28. Cash Flow to Debt Ratio

Unlike the more general analysis, the analysis of this sector also shows the Asset Turnover Ratio as a red flag ("Figure 17. Sector Analysis - 28. Asset Turnover Ratio"). Indeed, as can be seen from the following chart, there is a sharp contrast in the ratio's values for the two categories: failed companies have a significantly lower value. This financial ratio's value indicates a considerable inefficiency, by the failed companies, in using their assets to generate

revenue. Indeed, this index has been calculated using the Net Sales / Average Total Assets formula.

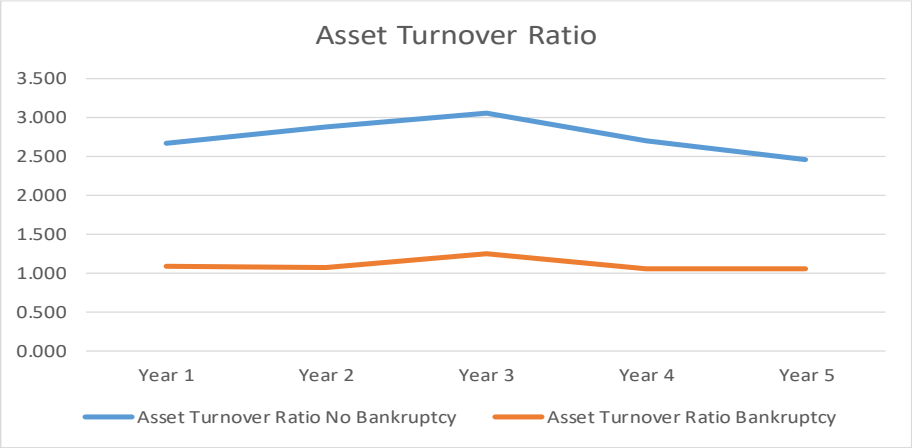

Figure 17. Sector Analysis - 28. Asset Turnover Ratio

In addition to the strong recourse to debt (with particular reference to long-term debt), and the lack of liquidity, which confirms what has already been described in the discussion of the previous paragraph, this sector presents some peculiarities. Indeed, the trend and values of the financial ratios described seem to indicate that the failed companies in this sector were characterized by a substantial decrease in Cash Flow from Operations. This ratio's value seemed even higher at first compared to non-failed companies, but then it decreased vertiginously. This trend is confirmed by all financial ratios considered that contain the cash flow from operations among their factors. This phenomenon seems to be due to the loss of a significant customer or the non-payment of a large order. It probably did not allow the company to generate cash from core business activities and pushed them into debt to continue their activities. Furthermore, the high level of debts and the payments of the short term liabilities pushed the company to "destroy" cash rather than create it. Moreover, failed companies in this sector seem to be characterized by a substantial inefficiency. Indeed the Asset Turnover Ratio shows values that indicate a further inefficiency: the inefficient use of assets to generate revenue.

3.2.2 Building Construction

Regarding those financial ratios that proved to be the most significant red flags, underling some differences between the two categories analyzed, the following ratios emerged: Cash Flow Ratio, Long Term Debt to Asset Ratio, Gross Margin Ratio and Cash Flow to Debt Ratio.

Regarding the Cash Flow Ratio ("Figure 18. Sector Analysis – 41. Cash Flow Ratio"), it proves, also in this sector, to be an indicator of the difference between the two types of companies. It shows opposing trends characterized by clearly different values. Both companies and

enterprises, over the five years considered, show not constant trends. Indeed they show trends that vary over the five years bring the ratio's value (in "Year 1") back to the initial value (the value in "Year 5"). This financial ratio's value is just below zero for failed companies, showing that this group of companies, in this sector, is not able to generate liquidity from its core business. This value suggests that they are not generating cash at all, but they are "burning it up."

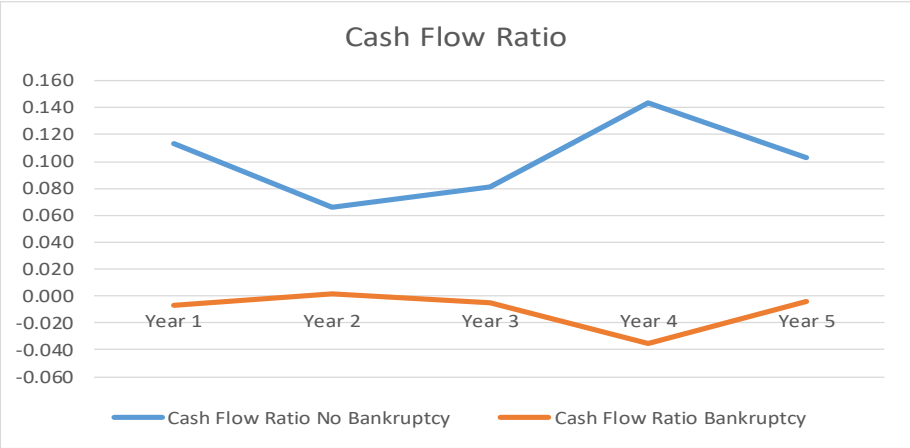

Figure 18. Sector Analysis – 41. Cash Flow Ratio

Another index that seems a red flag in this sector is the Long Term Debt to Asset Ratio ("Figure 19. Sector Analysis – 41. Long Term Debt to Asset Ratio"). Unlike the previous index, which shows differences between the two categories in all years under consideration, it shows similar trends up to "Year 3" (i.e., up to three years before bankruptcy). Indeed, after the "Year 3", while Bankruptcy firms significantly increase their long-term debt to total assets ratio (only in the fourth year, they can decrease the ratio, keeping it at high levels), No Bankruptcy firms show a generally steady trend with slight growth. These trends describe how Bankruptcy firms show considerable recourse to long-term debt, particularly in the years closest to bankruptcy. Besides, a decrease in assets can also explain the rise in this index (if LoNng Term Debts s assumed to remain constant). Indeed, there may be a case where companies under challenging situations see no other solution than to sell their assets to pay off some debts. This operation generates a decrease in the company's assets, which, if unweighted and healed in subsequent years, may lead the company to bankruptcy.

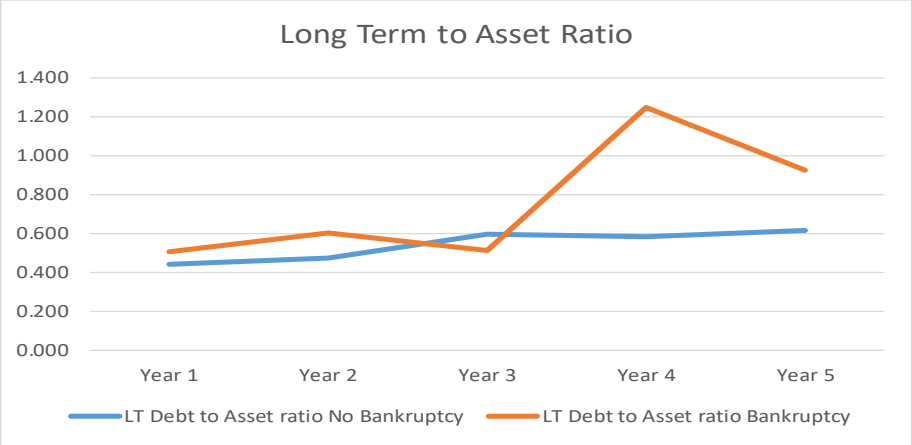

Figure 19. Sector Analysis – 41. Long Term Debt to Asset Ratio

The Gross Margin Ratio ("Figure 20. Sector Analysis – 41. Gross Margin Ratio") is a further index in the building construction sector, which indicates the different trends between Bankruptcy and No Bankruptcy companies. In particular, it describes values close to five years after the bankruptcy that begin to separate significantly from the fourth year before bankruptcy and then remain distinctly different. Indeed, while non-failed companies show a ratio that varies between 15 and 20%, failed companies show an index close to zero as early as four years before bankruptcy and even negative in the year of bankruptcy. This trend and value indicate that failed companies show a decreasing ability to cover the costs of the goods sold through their sales. For this reason, these companies are not able to pay their suppliers who have provided the materials and services needed to realize the goods sold.

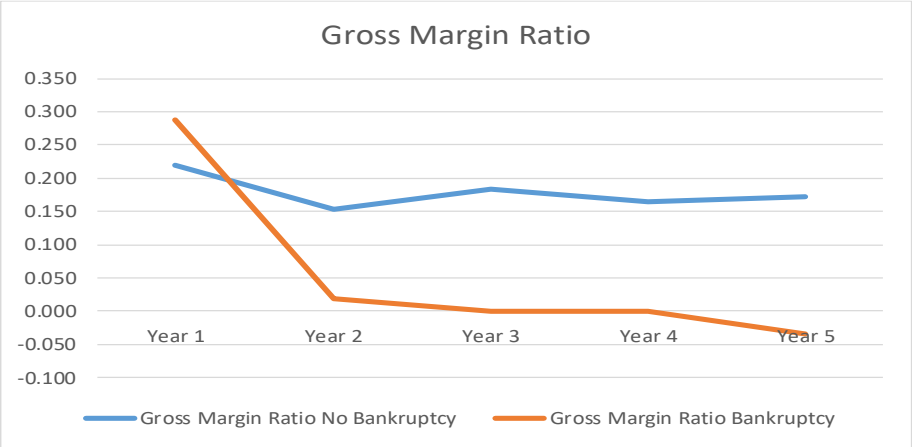

Figure 20. Sector Analysis – 41. Gross Margin Ratio

The Cash Flow to Debt Ratio ("Figure 21. Sector Analysis – 41. Cash Flow to Debt Ratio") is another indicator useful to describe how companies in this sector are not able to generate adequate cash flows from the core business (compared to non-failed companies in the sector), but they generate negative flows. Furthermore, the low value of this ratio underlines the high level of indebtedness that characterizes failed companies. Indeed, companies in this sector seem

to be characterized not only by an inability to generate adequate cash flows but also by a high level of debt when compared to non-failed companies in the same sector.

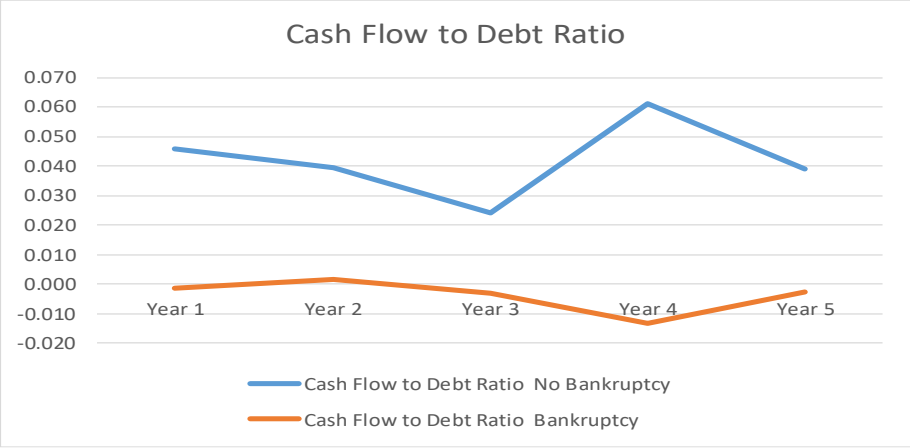

Figure 21. Sector Analysis – 41. Cash Flow to Debt Ratio

3.2.3 Wholesale Trade (except for motor vehicles and motorcycles)

As far as the Wholesale Trade (excluding motor vehicles and motorcycles) sector is concerned, the main financial ratios that emerge are the following: Cash Ratio, Long Term Debt to Asset Ratio, Turnover Inventory Ratio and Turnover Receivables Ratio.

Cash Ratio ("Figure 22. Sector Analysis - 46. Cash Ratio"). Unlike the sectors highlighted above, this sector seems to present a liquidity indicator that shows the differences markedly, (over the period considered) for the companies surveyed. Indeed, while the two categories of companies show a similar index five years before bankruptcy (about 8% for non-failed companies and about 6% for non-failed companies respectively), then they show an opposite trend that indicates a stable index for non-failed companies and an index that decreases to almost zero for non-failed companies. This financial ratio confirms how non-failed companies, in the years before the bankruptcy, seem to consume all the most liquid assets (cash and cash equivalents) and increase their short-term liabilities.

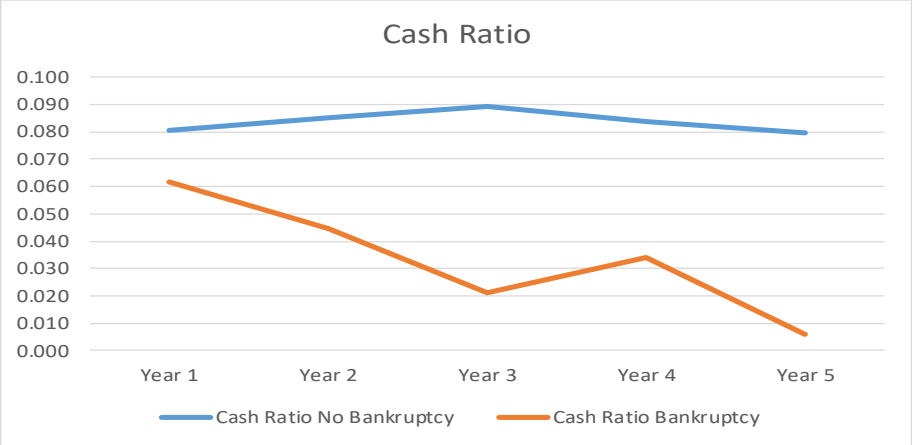

Figure 22. Sector Analysis - 46. Cash Ratio

The Long Term Debt to Asset Ratio ("Figure 23. Sector Analysis - 46. Long Term Debt to Asset Ratio") is also confirmed, in this sector, as an indicator of the differences between companies going bankrupt and companies not going bankrupt. Starting five years before the bankruptcy, it already shows differences in ratio's values between the two categories. While for failed companies, the financial ratio corresponds to about 20% (which indicates that the long-term debts of the company are equivalent to 20% of the value of total assets), for non-failed companies, it corresponds to about 10%. Moreover, in the following years, companies show different trends: bankrupt companies show an increasing trend up to about 50%, while non-failed companies show a constant trend over time. This trend underscores that also in this sector there is a propensity to resort heavily to debt from the bankrupt companies

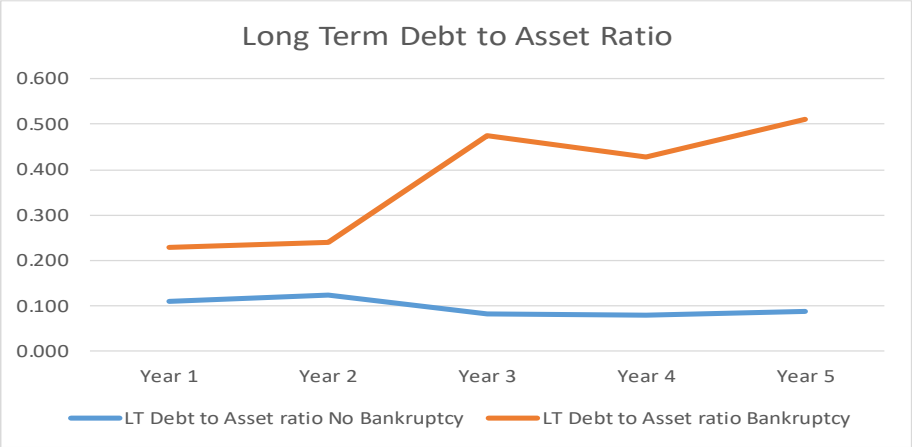

Figure 23. Sector Analysis - 46. Long Term Debt to Asset Ratio

Differently from the sector previously analyzed, in this sector, the Turnover Inventory Ratio ("Figure 24. Sector Analysis - 46. Turnover Inventory Ratio") proves to be an indicator that highlights, in the years preceding bankruptcy, the differences between Bankruptcy and No Bankruptcy companies. As described in the first analysis, this index proves to be similar for the

two categories in "Year 1" and especially in “Year 2”, but it follows opposite trends in the following years. These trends underline the two groups of companies’ efficiency in warehouse maintenance and management. Indeed, while non-failed companies show good and consistent warehouse management, failed companies show increasing inefficiency until the year of bankruptcy.

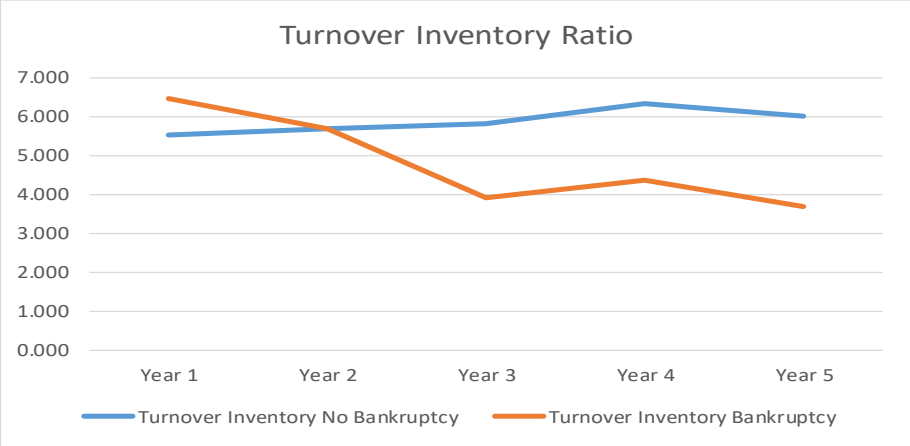

Figure 24. Sector Analysis - 46. Turnover Inventory Ratio

Finally, another noteworthy Financial Ratio for the building construction sector is the Turnover Receivables Ratio (“Figure 25. Sector Analysis - 46. Turnover Receivables Ratio”). It describes how companies follow opposite trends, although five years before the bankruptcy, they had similar values. This index underlines the efficiency that the group of companies in question has in collecting their receivables from customers. For this reason, this Financial ratio identifies both the deferment of payments that the company grants (the higher the deferment and the lower the value of the index) to its customers but also the quality of the customers themselves in repaying their debts to the company (the more customers meet the agreed terms the higher the value of the index). The following graph shows how the bankrupt companies in the sector of building construction appear to be decreasing their efficiency in the terms previously described. This decrease may be linked to the non-payment by a large customer (or several non-payment by small customers) and therefore, inefficiency on the part of the company's debt collection department. While No Bankruptcy firms seem to have a constant efficiency in their receivables from customers.

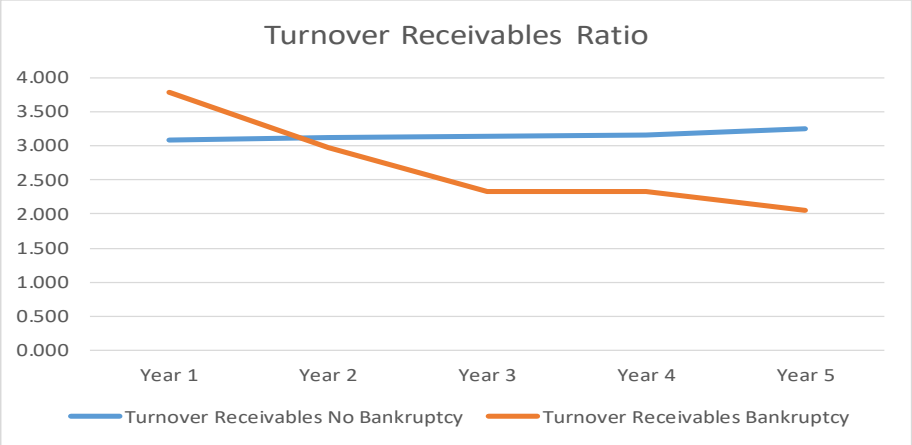

Figure 25. Sector Analysis - 46. Turnover Receivables Ratio

3.2.4 Real Estate Activities

Taking into account the Real Estate Activities sector, the Financial Ratios that proved to be the best red flags are Quick Ratio, Cash Ratio, Debt to Equity Ratio, Turnover Inventory Ratio and Cash Flow to Debt Ratio.

The Quick Ratio (calculated using the formula: (Cash + Cash Equivalent + Marketable Securities + Current Receivables) / Current Liabilities), underlines the inability to cover the current liabilities using the current assets mentioned in the formula for the bankruptcy companies. As can be seen from the graph below ("Figure 26. Sector Analysis - 68. Quick Ratio"), the quick ratio describes an increasing trend for bankruptcy companies. This direction means that these companies are increasing their ability to cover current liabilities. However, this direction can be misleading. Indeed, taking into consideration the graph in the next explanation (the Cash Ratio figure), it seems that the most liquid components of current assets (cash and cash equivalents) are increasing only in the last year. For this reason, the increasing value seems to be due to the Current Receivable (marketable securities are just a little amount in the current assets' value) increasing. This increase underlines that the company may be unable to get cash from its clients, accumulating account receivables from the previous years. In this case, even if the ratio's value increases, it is not sure the company will be able to pay its debts.

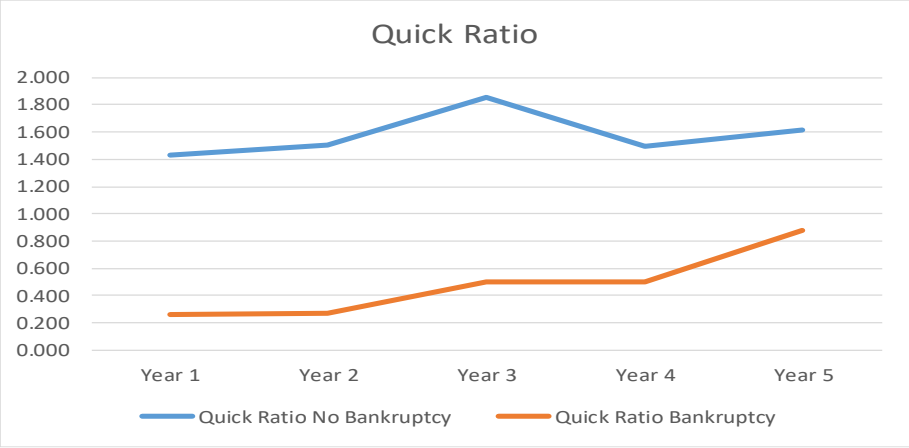

Figure 26. Sector Analysis - 68. Quick Ratio

Regarding the Cash Ratio, it, once again, shows clearly the differences (in the liquidity area) between the Bankruptcy and No Bankruptcy firms. Considering the graph below ("Figure 28. Figure 27. Sector Analysis - 68. Cash Ratio"), Bankrupted companies have shown a significantly lower Cash Flow Ratio level since "year 5" than non-failed companies in the same sector. This low value does not seem to grow over time. On the contrary, it decreases between the years "Year 4" and "Year 2" and then grows only slightly in the year of bankruptcy. On the other side, non-failed companies have not only a much higher ratio but also an increasing ratio over time. These different trends underline once again how bankrupt companies seem to be characterized by low availability of the most liquid assets and a high level of short-term liabilities.

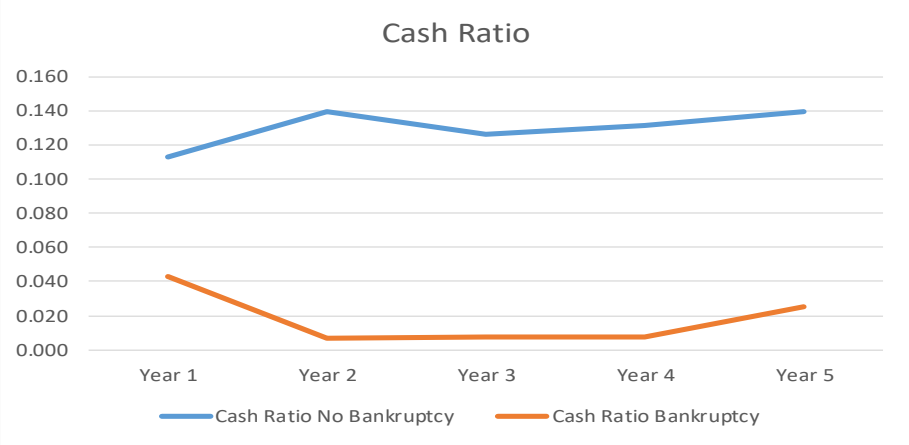

Figure 27. Sector Analysis - 68. Cash Ratio

The Debt to Equity Ratio is one of the indices that proves to be a red flag in this area. As described in section 2.2.1, it shows the debt to equity ratio with which the companies considered finance their activities. As can be seen from the graph below ("Figure 28. Sector Analysis - 68. Debt to Equity Ratio"), bankrupt companies have a debt ratio that has been growing dramatically since the third year before bankruptcy. Indeed, the two trends described in the

graph show different directions. While for failed companies, as mentioned, the trend is growing and showing exclusive use of debt, non-failed companies show a constant ratio over time that is slightly increasing in the years before the bankruptcy. This phenomenon can be described by the lack of willingness on the part of shareholders to increase capital (in order to cope with the lack of liquidity already highlighted by the previous ratio). Indeed, shareholders may be aware of the company's crisis, and not they do not want to risk further money. The remaining solution for companies with this characteristic is the resort to debt. Another explanation for such different trends may be linked to the fact that in this sector, in particular, the need for significant capital is more recurrent. For this reason, if a company needs liquidity and asks for a long-term loan, a significant increase in debt is expected. This increase leads to a significant increase in the index if the company obtains further debts without being able to repay them.

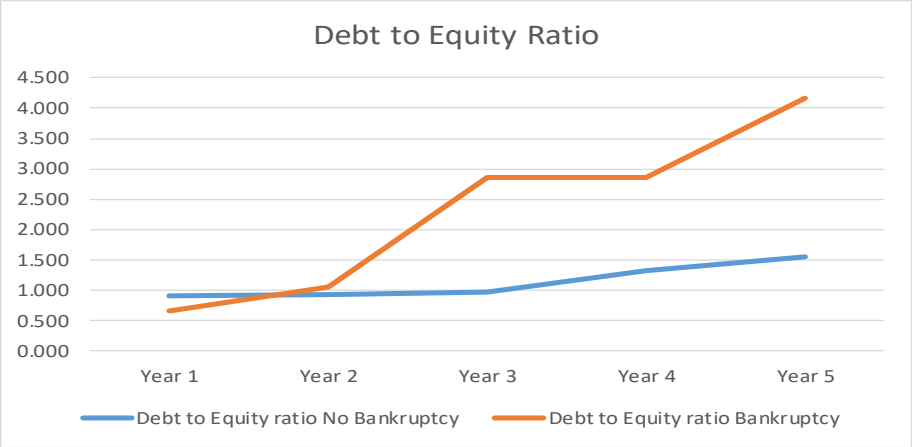

Figure 28. Sector Analysis - 68. Debt to Equity Ratio

Another interesting and significant ratio for the Real Estate sector is the cash flow to debt ratio. As can be seen by the following graph ("Figure 29. Sector Analysis - 68. Cash Flow to Debt Ratio"), Bankruptcy companies present a lower but positive (only in the "Year 2" it is slightly negative) cash flow generated by their core business. This value underlines what is been explained in the previous analysis discussion. In the database considered, some companies have a very low but positive value of cash flow from operations even if they are going to be bankrupt. Their failure is mainly due to the increase of the debts they must pay (that can be seen from the figure explained above), and to the fact that they do not have enough cash to pay their liabilities (that can be seen from "Figure 28. Figure 27. Sector Analysis - 68. Cash Ratio"). Furthermore, if they are not able to convert their current assets (those convertible into cash in the period) in time, they are going to be insolvent. The conversion problem of the current assets may also be due to the counterparty's problems rather than an inability to collect cash from the company department.

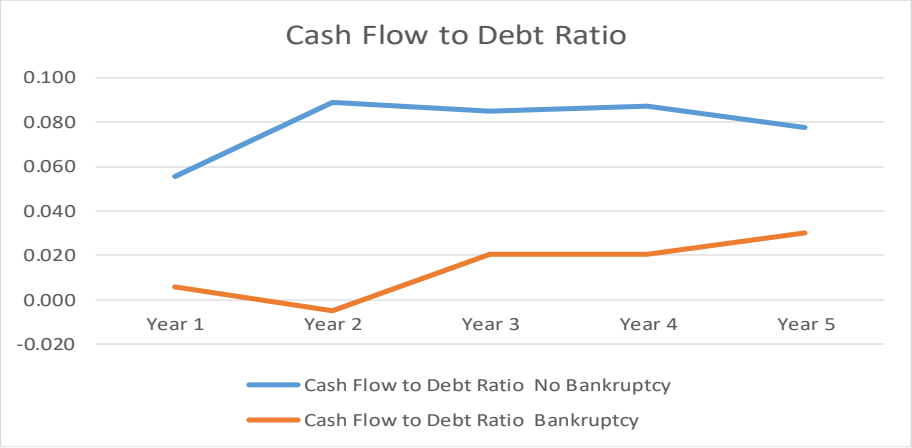

Figure 29. Sector Analysis - 68. Cash Flow to Debt Ratio

The last financial ratio that emerges from the analysis of this sector is the Turnover Inventory Ratio ("Figure 30. Sector Analysis - 68. Turnover Inventory Ratio"). Differently, for the more general analysis and the other sectors explained above, it explains differently the two company categories differences. Indeed, while in previous case (with the Wholesale Trade sector) it shows a gradual change in the companies' trend (until the bankruptcy year where the ratio value is completely different among the two categories), in this case, it shows a similar trend until "Year 4" (the year before the bankruptcy year). For this reason, the Turnover Inventory Ratio for this sector can be considered as a late red flag. Indeed, it shows significant differences "only" the year before the bankruptcy, when it may be too late for the company to take action in order to change the negative situation.

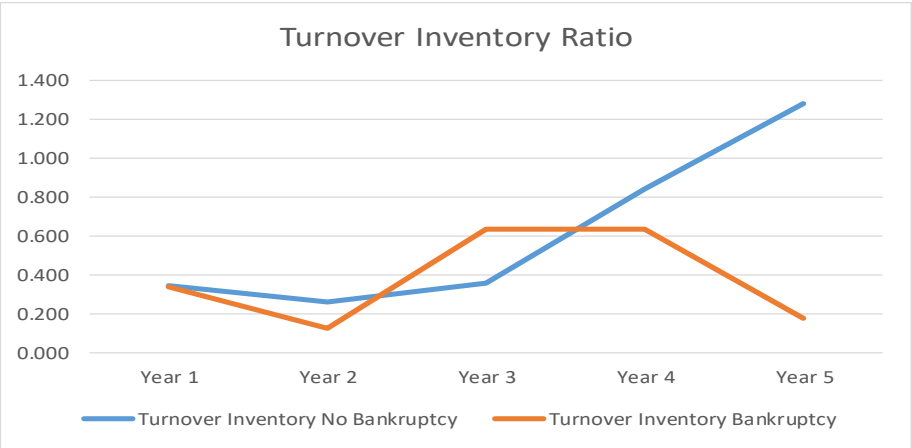

Figure 30. Sector Analysis - 68. Turnover Inventory Ratio

3.2.5 Other Considerations on Significant Financial Ratios from the sector analysis

The financial ratios analysis, for the sectors with the highest number of observations in the database, describes, in addition to the most significant indices mentioned in the previous paragraph, three main aspects:

- Some ratios are confirmed, concerning the analysis in paragraph 3.1, as red flags;
- Some ratios are not as significant as in the previous analysis (therefore they are not described in this paragraph);
- New ratios emerged, although, in the more general analysis, they have not proved to be significant.

Beyond these three more general aspects, one of the most interesting emerged things is to see how different ratios can describe some different sectors, and how some sectors present the same ratios as significant but with different trends. These differences underline the importance of weighing the results obtained according to the analyzed sector.

For example, while a ratio may report significant differences four years before bankruptcy in one sector (as the Turnover Inventory Ratio for the Wholesale Trade sector), the same ratio highlights these differences with much less notice when it is considered for another sector (the Turnover Inventory Ratio for the Real Estate sector). In the Turnover Inventory Ratio's case, this may be due to the different inventory management in the two sectors mentioned. While in the Wholesale Trade sector, failed companies seem to report an inventory inefficiency already four years before the bankruptcy, companies in the Real Estate sector, show this trend later.

Indeed, taking into account the most significant financial ratios that emerge from each sector, it can be noted that some characteristics distinguish the sectors among themselves. Some sectors show low liquidity trends in the case of asset and liability relationships.

In particular, from the Wholesale Trade and Real Estate Activities sectors, it appears that failed companies are unable to meet their short-term liabilities requirements using their cash and cash equivalents (see "Figure 23. Sector Analysis - 46. Cash Ratio" and "Figure 28. Figure 27. Sector Analysis - 68. Cash Ratio"). Indeed, while failed companies in the Wholesale Trade sector have a markedly decreasing value, failed companies in the Real Estate Activities have a low and quite stable value since the fifth year. This different trend, in both cases negative, shows that companies belonging to the Real Estate sector have a more constant level of liquidity and liabilities and present negative characteristics already five years before bankruptcy, while companies in the Wholesale Tarde sector tend to decrease their liquidity in a shorter time, showing initially (five years before bankruptcy) a value that, if compared to the group of non-failed companies, does not seem so different.

Another noteworthy difference that identifies different trend behaviors among the different sectors concerns those ratios that consider the Cash Flow from Operations. In particular, taking into account the Cash flow ratio (calculated by dividing the cash flow from operations with current liabilities), it shows that for the Manufacture of Machinery and Equipment's sector, there is a significant decrease over time (starting from a high value five years before bankruptcy), while in the Construction of Building sector there is a low value already five years before bankruptcy. Furthermore, this financial ratio has a negative (although fluctuating) value already five years before the bankruptcy in the case of the Building Construction sector.

This negative value points out that in this sector, failed companies already start "burning" money several years before the bankruptcy, while for companies in the Manufacture of Machinery and Equipment sector, this phenomenon occurs later.

If, on one side, the company is unable to cover its short-term liabilities through its core business and covert its current assets into cash, on the other side it will be forced to seek other sources to finance itself (such as debts from external lenders or equity from its shareholders). This phenomenon is underlined by those ratios that consider the indebtedness of companies. In particular, it seemed that failed companies finance their activities with debt rather than increasing their equity. If the Long Term Debt to Asset Ratio is taken into account, it can be seen that companies that go bankrupt use debt in different ways depending on the sector they belong to.

The Construction of Buildings sector describes how failed companies increase this index only in "Year 3" (the year in which a negative cash flow value occurs), while failed companies belonging to the Manufacture of Machinery and Equipment sector show a significant debt ratio a few years earlier. It should be emphasized that this ratio depends not only on long-term debt but also on the value of the assets. Indeed, as their value decreases, the ratio's value increases. As previously described, the company can try to sell off its assets in order to repay its debts. This difference between sectors, in the recourse to debts or in decreasing the value of their assets (more than the decline in the long term debts), can be explained by the characteristics of each sector, but also by events outside the company such as lower economic performance of client companies (which impede payments on time).

Finally, it should be pointed out that these sectors are nothing more than the aggregate of more specific sectors to which the companies in the database belong. The sector subdivision can be seen from the tables in the Annexes (see "Table 16. Annexes - MANUFACTURE OF MACHINERY AND EQUIPMENT", "Table 17. Annexes - BUILDINGS CONSTRUCTION", "Table 18. Annexes - WHOLESALE TRADE (EXCEPT FOR MOTOR

VEHICLES AND MOTORCYCLES" and "Table 19. Annexes - REAL ESTATE ACTIVITIES") which describe the more specific sectors that characterize each of the four sectors considered. The fact that more specific sub-sectors characterize each sector underlines that firms with slightly different characteristics are part of the same analyzed set of observations. Although this discrepancy, which may slightly alter the ratios' value, the analysis leads to the identification of financial ratios which, within the same sector, more or less clearly describe the differences between failed and not failed companies.

3.3 Further Considerations

The analyses described in the preceding paragraphs underline that even financial ratios different from those of Altman may show differences between failed and non-failed companies. In specific, as it emerges from the previous discussions, the analyses identify ratios that can express these differences not only in the last year under consideration (the year of bankruptcy) but even in the entire period considered (five years before the bankruptcy).

Even if in paragraphs 3.1.1 and 3.2.5, the thesis tried to go deeper considering the interpretation of more financial ratios, its analyses are based on univariate analysis of the two groups of Bankruptcy and No Bankruptcy companies. Indeed, through the use of different financial indices, the thesis describes the differences between failed and non-failed companies over an interval of time. Nevertheless, just as Bevaer (1966) did, the analysis is characterized by using mainly one factor (or financial ratio) at a time.

According to Altman (2000, p. 4), "Although these works established certain important generalizations regarding the performance and trends of particular measurements, the adaptation of the results for assessing bankruptcy potential of firms, both theoretically and practically, is questionable." Following this author, univariate analysis is, in this perspective, limited to interpretation errors.

If a company shows poor performance in the field of profitability, it could be interpreted as a failing company if other variables are not taken into account. However, a company that does not generate high profits but still has high liquidity is not to be considered in severe danger. In this sense, the univariate analysis could generate ambiguity in judging the performance of various companies

For these reasons, it should be underlined that the two developed analyses can serve as the starting point for more in-depth analysis. As described in the literature review in chapter one, the financial ratios calculated for a reference set, such as failed and not failed companies, can be further tested in order to have a deep understanding of their dynamics.

In particular, through econometric models (such as multivariate discriminant analysis, logit analysis, probit analysis, and neural network analysis), the characteristics of failed companies could be further investigated. These models allow not only to test the performance of financial indices individually but also the performance of several ratios combined.

CONCLUSION

The analyses carried out during the thesis respond to the research question mentioned in chapter one by describing some indices that allow identifying differences between failed and not failed enterprises in the five years before the bankruptcy. In particular, both the analyses carried out identify financial ratios as useful indicators that, if interpreted both individually and jointly, can describe the behavior of a group of companies destined for bankruptcy.

The thesis tried to answer the research question "Is it possible to understand through financial indicators whether a company will fail or is failing?" using financial ratios, collected from several sources (as described in section 2.2) and testing them in a wide range of companies.

By calculating these financial indices and comparing them for failed and not failed companies, it has been possible to identify particular ratios that come close to the concept of a red flag: a useful signal for companies to identify their potential financial distress.

Moreover, if, in the more general analysis, the emerging financial ratios describe values and trends influenced by the vastness of the companies that make up the database, the analysis that focuses on the four significant sectors tries to identify more precise behaviors among more similar companies.

It emerges how specific financial ratios can be defined as red flags both in more general analysis and in a more in-depth analysis of specific company sectors. This aspect underlines the fact that there are financial ratios, in addition to Altman's, which are able to warn those inside or outside the company who are intent on verifying its performance.

These ratios not only make it possible to monitor the condition of the company in particular business areas, but they have proved to be useful indicators in describing how a group of companies can find themselves in a difficult position, which can turn into a failure.

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ANNEXES

Table 14. Annexes - Companies Sector

First Analysis - Sector identification and N. of firms for each sector individualization		
ATECO CODE	N. FIRMS	ISTAT SECTOR DEFINITION
10	12	INDUSTRIE ALIMENTARI
11	6	INDUSTRIA DELLE BEVANDE
13	6	INDUSTRIE TESSILI
14	36	14CONFEZIONE DI ARTICOLI DI ABBIGLIAMENTO; CONFEZIONE DI ARTICOLI IN PELLE E PELLICCIA
15	36	FABBRICAZIONE DI ARTICOLI IN PELLE E SIMILI
16	30	INDUSTRIA DEL LEGNO E DEI PRODOTTI IN LEGNO E SUGHERO (ESCLUSI I MOBILI); FABBRICAZIONE DI ARTICOLI IN PAGLIA E MATERIALI DA INTRECCIO
17	5	FABBRICAZIONE DI CARTA E DI PRODOTTI DI CARTA
18	6	18STAMPA E RIPRODUZIONE DI SUPPORTI REGISTRATI
20	6	0FABBRICAZIONE DI PRODOTTI CHIMICI
22	22	FABBRICAZIONE DI ARTICOLI IN GOMMA E MATERIE PLASTICHE
23	24	FABBRICAZIONE DI ALTRI PRODOTTI DELLA LAVORAZIONE DI MINERALI NON METALLIFERI
24	17	METALLURGIA
25	42	FABBRICAZIONE DI PRODOTTI IN METALLO (ESCLUSI MACCHINARI E ATTREZZATURE)
27	54	FABBRICAZIONE DI APPARECCHIATURE ELETTRICHE ED APPARECCHIATURE PER USO DOMESTICO NON ELETTRICHE
28	60	FABBRICAZIONE DI MACCHINARI ED APPARECCHIATURE NCA
29	6	FABBRICAZIONE DI AUTOVEICOLI, RIMORCHI E SEMIRIMORCHI
30	6	FABBRICAZIONE DI ALTRI MEZZI DI TRASPORTO
31	6	FABBRICAZIONE DI MOBILI
32	30	ALTRE INDUSTRIE MANIFATTURIERE
38	12	ATTIVITÀ DI RACCOLTA, TRATTAMENTO E SMALTIMENTO DEI RIFIUTI; RECUPERO DEI MATERIALI
41	157	COSTRUZIONE DI EDIFICI
42	27	INGEGNERIA CIVILE
43	36	LAVORI DI COSTRUZIONE SPECIALIZZATI
45	23	COMMERCIO ALL'INGROSSO E AL DETTAGLIO E RIPARAZIONE DI AUTOVEICOLI E MOTOCICLI
46	132	COMMERCIO ALL'INGROSSO (ESCLUSO QUELLO DI AUTOVEICOLI E DI MOTOCICLI)
47	36	COMMERCIO AL DETTAGLIO (ESCLUSO QUELLO DI AUTOVEICOLI E DI MOTOCICLI)
49	12	TRASPORTO TERRESTRE E TRASPORTO MEDIANTE CONDOTTE
55	6	ALLOGGIO
56	6	ATTIVITÀ DEI SERVIZI DI RISTORAZIONE
59	6	ATTIVITÀ DI PRODUZIONE CINEMATOGRAFICA, DI VIDEO E DI PROGRAMMI TELEVISIVI, DI REGISTRAZIONI MUSICALI E SONORE
62	12	PRODUZIONE DI SOFTWARE, CONSULENZA INFORMATICA E ATTIVITÀ CONNESSE
63	6	ATTIVITÀ DEI SERVIZI D'INFORMAZIONE E ALTRI SERVIZI INFORMATICI
64	6	ATTIVITÀ DI SERVIZI FINANZIARI (ESCLUSE LE ASSICURAZIONI E I FONDI PENSIONE)
68	184	LATTIVITA' IMMOBILIARI
70	6	ATTIVITÀ DI DIREZIONE AZIENDALE E DI CONSULENZA GESTIONALE
71	6	ATTIVITÀ DEGLI STUDI DI ARCHITETTURA E D'INGEGNERIA; COLLAUDI ED ANALISI TECNICHE
72	6	RICERCA SCIENTIFICA E SVILUPPO
77	6	ATTIVITÀ DI NOLEGGIO E LEASING OPERATIVO
82	6	ATTIVITÀ DI SUPPORTO PER LE FUNZIONI D'UFFICIO E ALTRI SERVIZI DI SUPPORTO ALLE IMPRESE
Total	1101	

Table 15. Annexes - Sectors with at least thirty firms

Second Analysis - Sector with at least thirty firms in total		
ATECO CODE	N. FIRMS	ISTAT SECTOR DEFINITION
14	36	CONFEZIONE DI ARTICOLI DI ABBIGLIAMENTO; CONFEZIONE DI ARTICOLI IN PELLE E PELLICCIA
15	36	FABBRICAZIONE DI ARTICOLI IN PELLE E SIMILI
25	42	FABBRICAZIONE DI PRODOTTI IN METALLO (ESCLUSI MACCHINARI E ATTREZZATURE)
27	54	FABBRICAZIONE DI APPARECCHIATURE ELETTRICHE ED APPARECCHIATURE PER USO DOMESTICO NON ELETTRICHE
28	60	FABBRICAZIONE DI MACCHINARI ED APPARECCHIATURE NCA
41	157	COSTRUZIONE DI EDIFICI
43	36	LAVORI DI COSTRUZIONE SPECIALIZZATI
46	132	COMMERCIO ALL'INGROSSO (ESCLUSO QUELLO DI AUTOVEICOLI E DI MOTOCICLI)
47	36	COMMERCIO AL DETTAGLIO (ESCLUSO QUELLO DI AUTOVEICOLI E DI MOTOCICLI)
68	184	ATTIVITA' IMMOBILIARI
Total	773	

Table 16. Annexes - MANUFACTURE OF MACHINERY AND EQUIPMENT

28. MANUFACTURE OF MACHINERY AND EQUIPMENT
28.1 MANUFACTURE OF GENERAL PURPOSE MACHINERY
28.2 MANUFACTURE OF OTHER GENERAL PURPOSE MACHINERY
28.3 MANUFACTURE OF AGRICULTURAL AND FORESTRY MACHINERY
28.4 MANUFACTURE OF METAL FORMING MACHINES AND OTHER MACHINE TOOLS
28.9 MANUFACTURE OF OTHER SPECIAL PURPOSE MACHINERY

Table 17. Annexes - BUILDINGS CONSTRUCTION

41. BUILDINGS CONSTRUCTION
41.1 DEVELOPMENT OF REAL ESTATE PROJECTS
41.2 CONSTRUCTION OF RESIDENTIAL AND NON-RESIDENTIAL BUILDINGS

Table 18. Annexes - WHOLESALE TRADE (EXCEPT FOR MOTOR VEHICLES AND MOTORCYCLES)

46. WHOLESALE TRADE (EXCEPT FOR MOTOR VEHICLES AND MOTORCYCLES)
46.1 TRADE INTERMEDIARIES
46.2 WHOLESALE OF AGRICULTURAL RAW MATERIALS AND LIVE ANIMALS
46.3 WHOLESALE TRADE IN FOOD, BEVERAGES AND TOBACCO PRODUCTS
46.4 WHOLESALE OF FINAL CONSUMER GOODS
46.5 WHOLESALE OF ICT EQUIPMENT
46.6 WHOLESALE OF OTHER MACHINERY, EQUIPMENT AND SUPPLIES
46.7 SPECIALISED WHOLESALE TRADE IN OTHER PRODUCTS
46.9 NON-SPECIALISED WHOLESALE TRADE

Table 19. Annexes - REAL ESTATE ACTIVITIES

68. REAL ESTATE ACTIVITIES
68.1 PURCHASE AND SALE OF REAL ESTATE CARRIED OUT ON OWN ASSETS
68.2 RENTAL AND MANAGEMENT OF OWNED OR LEASED PROPERTY
68.3 REAL ESTATE ACTIVITIES ON BEHALF OF THIRD PARTIES

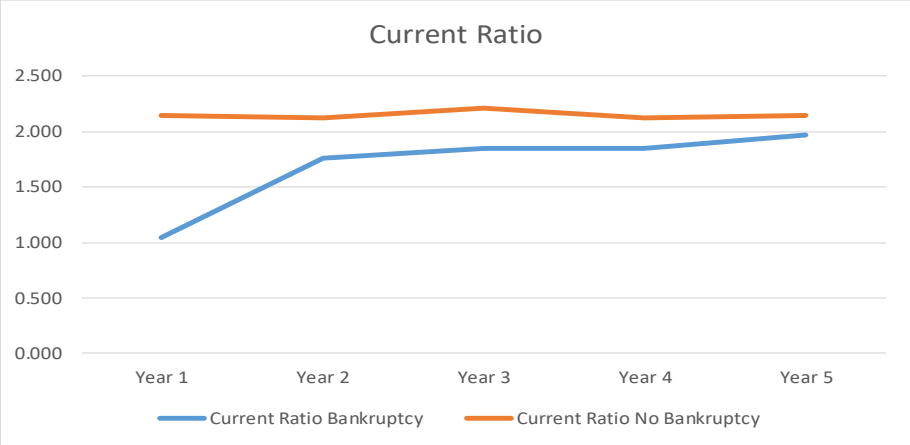

Figure 31. Annexes - Current Ratio