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"Financial ratios as an alert system to predict company's bankruptcy: insights from the Italian insolvency code"

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INTRODUCTION

The enterprise crisis is a well renowned phenomenon by the corporate and bankruptcy law spheres, especially after the 2008 crisis, due to the increase of companies that went to bankruptcy and the negative effects concatenated. The situation seemed to improve but, according to the research made by Cerved[1] (Cerved, 2015), between July and September of 2019 the number of liquidations reached 2291, with an annual growth of 4,2%, softening the positive trend that characterized the past five years.

The aim of the thesis is to provide an in-depth analysis about the efficacy and the efficiency of the bankruptcy predicting models, in order to be used as possible alert systems, introduced by the Art. 13 of the new Italian insolvency code. The prospect of using these kinds of tools, whether the analysis results favorable, it will be useful to improve the Italian industrial environment, identifying and assessing the probability of default before the crisis becomes irreversible. As a matter of fact, thanks to a forward-looking and preventive approach, it is possible to remove or, at least, weaken the negative effects correlated to the suspension of the firm's economic activity, since it does not concerned only the involved company, but it can indeed provoke a "domino effect", creating other entrepreneurial instabilities to other parties, unable to retrieve what they have lent[2] (Marco Cian et al, 2018).

In other words, the availability of tools disposable by internal and external agents, it can prevent the negative consequences of the bankruptcy, allowing a preventive intervention, able to balance the financial distress before it becomes irreconcilable and damages other parties.

One of the first economist that formulated models with the capability of predicting, or at least signaling, the risk of insolvency has been Edward Altman in the 1968, followed by others that modified its formula according to the subject of the analysis, such as SME or MNC.

The thesis is going to be divided into two macro-sections, the first one exposes the characteristics of the new Italian insolvency code, focusing on the, above-mentioned, "alert systems", the second one, analyzes the efficacy of the z score models, formulated by Altman, Taffler, Alberici, Bottani, Ohlson, Springate and Legault.

Due to the Italian industrial composition, the research takes into account only the manufacturing companies, excluding the third sector, due to the differences in the balance sheet item's composition, structure and organization.

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[1] CERVED, (2015), *"Fallimenti, procedure e chiusure di imprese",* December 2015, N°40

[2] Marco Cian et al, 2018, "Manuale di diritto commerciale", second edition, 7th section

CHAPTER I

1. THE SUBSTITUTION OF THE BANKRUPTCY LAW

Before starting with the analysis and discussion of the new insolvency code, it should be firstly discussed how the Italian law managed the economic issues of the firms before the legislative decree of the 12th January 2019. As it will be presented in this chapter, the old but still actual regulation, differently to the "Insolvency Code", is more directed and realized according to a punishment and creditor safeguard prospective, rather than a rescue dimension of the insolvent firm.

Before the insolvency code is entering into force on the 1st September 2021, data postponed due to the pandemic issue[3] (Lamanna F., 2020), the Italian industrial system, as regards the bankruptcy law, has been being regulated by the "Legge Fallimentare", emanated the 16th March 1942, that was born with the scope of managing the debt position of the entrepreneur, thought a coactive and simultaneous procedure[4] (Marco Cian et al, 2018).

This choice has been led by the intention of choosing a more efficient, economic and egalitarian tool compared to the individual and numerous actions taken directly by the creditors to tackle the assets of the insolvent entrepreneur. As a matter of fact, the idea was to avoid prearranged actions taken by individuals that could have impeded the respect of the interests of the smallest parts claiming the creditor right to the insolvent firm, actualizing procedures finalized to the observance of the proportionality principle whose guarantees the satisfaction of each creditors regardless the amount asked for.

In other words, in the old bankruptcy law, the benefits from the balance of a firm in a status of crisis were subdued by the intention of protecting creditors' losses and guaranteeing their satisfaction. On the other hand, the New Insolvency Code is directed to the premature diagnosis of the company's financial distress and the entrepreneurial safeguard, creating in this matter, the proper conditions for the firm balancing and reorganization before the situation turns into irreversible[5] (Mininno R., 2020).

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[3] Lamanna F., 2020, "*Fallimenti, il decreto liquidità fa slittare di un anno il debutto del nuovo Codice della crisi",* "La Repubblica"

[4] Marco Cian et al, 2018, *"Manuale di diritto commerciale"*, second edition, 7th section

[5] Mininno R., 2020, "*CODICE DELLA CRISI D'IMPRESA: approvato dal Consiglio dei Ministri il primo decreto integrativo e correttivo",* Il sole 24 Ore

The whole code develops under the principle of the going concerns, that is in this way reflected on every single procedure in order to guarantee its accomplishment.

2 THE ITALIAN INSOLVENCY CODE

2.1 INTRODUCTION TO THE ITALIAN INSOLVENCY CODE

The Italian Insolvency Code, replacement of the "Bankruptcy Law", is based on the work that comes from the "Rordorf commission", a ministerial commission established by the ministry of justice on 2015 with the participation of representative of the CNDCEC[6] ("National Council of Chartered Accountants and Accounting Experts"), with the purpose of rewriting the legislation about bankruptcy proceedings[7] (Il sole 24 ore, 2018) and takes inspiration, at least for what regards the alert procedures, from the French reform that came into force in the 80s. It is furthermore influenced by the European Union recommendation number 135 of the 2014 and by the European Union regulations number 848 of the 2015, both concerning the insolvency proceeding. Another important role has been played also by the international guidelines, concerning the insolvency, elaborated by the UNCITRAL, United Nations Commission on International Trade Law[8] (Bernardi D. & Talone M., n.d., p. 54).

It is focused on the firm's operating activity, making the going concern a pivotal principle of the Legislative Decree, it abandons the intent purely based on the punishment of the insolvent entrepreneur and the creditor's compensation and it implements processes more focused on the prevention[9] (Mastrangelo A., 2019). The purpose is to avoid the detection of the insolvency signals at irreversible stages of the crisis, in order words, it is finalized to a premature diagnosis of the enterprise's state of difficulty[10] (Assiteca, 2019). Lastly, as exposed in the first chapter of the legislative decree, the scope of prevention is reflected also on the duties of the debtor that, as a consequence, he is forced to adopt all the suitable measures useful to promptly notice the risk and the probability of the crisis and, whether it is the case, to take the initiatives that lead to the company rebalancing.

The insolvency code is divided into 10 sections, in which there are exposed the procedures that precede and succeed the arise of the crisis. Among the new implemented actions, such as the

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6 Consiglio Nazionale dei Dottori Commercialisti e degli Esperti Contabili
7 Il Sole 24 Ore, 2018, "Commissione Rondorf"
8 Bernardi D. & Talone M., "sistemi di allerta interna", book n. 71, ODCEC, p. 54
9 Mastrangelo A., 2019, "*La prevenzione in Italia alla luce del decreto legislativo 12 gennaio 2019 n.14"*
10 Assiteca, 2019, "*Codice della crisi d'impresa: tutte le modifiche alla legge fallimentare"*

previously mentioned alert systems, there are new regulations that must be taken and followed by the administrative body, such as the judicial liquidation ("liquidazione giudiziale"), in which the liquidation process is managed by an agent elected by the judge.

2.2 THE INTERNATIONAL SOURCES

2.2.1 EU REGULATIONS AND RECOMMENDATION[11]

The recommendation n. 185 by the European Commission is directed to "*ensure that viable enterprises in financial difficulties… have access to national insolvency frameworks which enable them to restructure at an early stage with a view to preventing their insolvency, and therefore maximize the total value to creditors, employees, owners and the economy as a whole*"[12] (European Commission, 2014) and it was established due to the lack of efficient procedures in some member states able to restructure businesses at earlier stage. Additionally, in the others the existing procedures concerning the insolvency proceeding can be actualized only at irreversible stage of the crisis. It is furthermore finalized to reduce the negative effects of the bankruptcy that damage the honest insolvent entrepreneur, giving him a second opportunity. As a matter of fact, as it is written in the section 11th of the recommendation, the European commission encourages the Member states to lower the cost of restructuring for debtors and to discharge the entrepreneurs from their debt no later than three years, allowing the subjects to come back to activity.

At the same time, the other Institution of the European union, so the European parliament, transmitted the regulation n. 848 in order to enhance the effective administration of the insolvency proceedings adopted with the Council Regulation No 1346/2000. It concerns the law related to the insolvency, including also the rescue of the enterprises, the restructuring of the debt and the liquidation. In the article 1 of the regulation it is shown the first similarity with the Italian insolvency code regarding the crisis composition procedure, indeed it provides the supervision of a court for the debtor's assets and affairs or, on the other hand, encourages the negotiation between the debtors and its creditors (composition with creditors), in both cases, the beginning of processes can start when there is only a likelihood of insolvency. It can be

[11] The subchapter follows the recommendation n. 135 of the European Commision
[12] 2014/135/EU: Commission Recommendation of 12 March 2014 on a new approach to business failure and insolvency

noticed how in both European "treaties" there is the willingness to preempt the appearance of the crisis, even if they do not refer to specific procedures such as the French or the Italian Alert Systems.

2.2.2 LEGISLATIVE GUIDE ON INSOLVENCY LAW[13]

Similar to the European decrees the "legislative guide on insolvency law" has been drafted by the "United Nations Commission on International Trade Law", in order to encourage and foster the adoption of efficient procedures on the subject of corporate insolvency law.

The Guide, written by the United Nations' Entity, provides a set of feasible solutions and suggestions to the insolvency issue, balancing the debtor's and the creditor's needs, supporting the negotiation between the two parts and the business reorganization rather than liquidation. This last meets the purpose defined by the Report of maximizing the value of assets since, as written on key objectives section, *"creditors would not involuntarily receive less than in liquidation and the value of the debtor to society and to creditors may be maximized by allowing it to continue. This is predicated on the basic economic theory that greater value may be obtained from keeping the essential components of a business together, rather than breaking them up and disposing of them in fragments*"[14] (UNCITRAL, 2004, p. 11) it can be notice how this concept coincides with the purpose of the Italian insolvency code related to the going concern.

The guide suggests also the provision of processes able to increase the efficiency of the insolvency procedures without damaging the parts involved and the reduction of their costs and time, in a matter to support the theory about the maximization of the asset value. Additionally, it recommends a selection between insolvent businesses, in order that it should be guaranteed the survival of the more efficient and potentially viable business while, regarding the inefficient ones, it should be prioritized the liquidation.

It should be highlighted how, even in this case, the guide does not mention any type of prevention, such as the French and the Italian code; the only paragraph that seems to share this information is on the fourth part of the guide, in which it is exposed how the insolvency proceedings should be commenced during the "twilight zone", in other words, when the

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[13] The subchapter follows "The legislative guide on insolvency law" parts one, two three and four

[14] UNCITRAL, 2004, "Legislative guide on insolvency law", parts one and two, p. 11

company faces the beginning of the deterioration of the financial stability, signaling the imminent or unavoidable insolvency[15] (UNCITRAL, 2004, p. 14).
The entirely guide, contrary to the Legislative Decree, is mainly focused on the maximization of the assets value, influencing the way of executing and choosing the insolvency procedures, making the "going concern" a consequence of the theory while, in the Italian and French countries it has been elected as the key principle of the reform.

Once it has been exposed the contexts that influenced the Italian code, it is clearer why, among the international laws and texts above mentioned, that one that shares more deeply similarities with the Italian Legislative Decree is the French one, by which have been exported concepts and procedures that were not present in the old "Bankruptcy Law".

Concerning these concepts and procedures shared with the French Insolvency Code, they are, as mentioned in the introduction, focused on the prevention of the insolvency, so characterized by the purpose of commencing processes before the arise of the crisis, in order to guarantee the interests of shareholders and stakeholders. The preventing principle is in this way reflected in the article 13 of the insolvency code, in which are reported as indicators of crisis, all the financial and income imbalances compared to the enterprise benchmark. These anomalies can be evaluated through the indexes elaborated by the C.N.D.C.E.C. (CNDCEC, 2019)[16], that furthermore assessed the values for which these unbalances can be considered as alarming.
These indexes are composed by:

- The ratio between the financial liabilities and sales;
- The ratio between shareholder's fund and total assets;
- Ratio between cash flow and total asset;
- Ratio between current assets and current liabilities;
- Ratio between "social security and tax related debt" and total assets

2.3 NOTION OF CRISIS: THE ARTICLE 2

The insolvency code makes several distinctions, exposed in the article 2, between crisis, insolvency and over-indebtment, even if they seem to be synonymous.

[15] UNCITRAL, 2004, *"Legislative guide on insolvency law"*, parts one and two, p. 14
[16] CNDCEC, 2019, *"Crisi dell'impresa: gli indici dell'allerta allerta"*

Regarding the first one, it is explained as the state of economic and financial complication that makes probable the insolvency, and it arises from the inability to repay the debt; as regards the second one, it is meant the state revealed by the non-fulfillment or other external facts indicating the impossibility of extinguishing the obligations; finally, regarding the last one, it is intended as the state of insolvency for all the parts and entities not subjected to all the liquidation procedures provided by the Civil Code. It should be highlighted that moments and periods of financial and economic difficulties are elements that a company will probably face during its activity but that, at the same time, they could not be related to the corporate structure, implying the possibility to solve them. In order words, the insolvency is always preceded by a crisis, but it can be just one of its possible consequences.

The ODCEC, in the book n.71, identified several phases that precede the arising of an irreparable crisis[17] (Bernardi D. & Talone M, n.d., p. 11):

- The incubation that is characterized by the first symptoms of inefficiency and detectable only internally through prognostic tools that evaluate the future trend of the company.
- The maturation, characterized by the beginning of the asset's deterioration and identifiable through a backward-looking approach, so through the analysis of the balance sheet.
- The reversable crisis, distinguishable by financial unbalances and loss of stakeholder's trust. In this phase the monitoring body should launch intervention plans.
- The reversable insolvency, in which there are external interventions
- Insolvency: the non-fulfillment of obligations is clear and identifiable also by external subjects.

2.4 ALLERT SYSTEMS[18]

In the previous paragraphs, the insolvency code has been presented as an innovation in the Italian business-related law and directed to contain the negative effects of the bankruptcy; in the subsequent sections it will be exposed and explained the new introduction of the "Alert Systems and crisis composition".

[17] Bernardi D. & Talone M., "sistemi di allerta interna", book n. 71, ODCEC, p. 11
[18] L.D. 12th january 2019 n. 14, article 12

In the article 12 are explained the tools able to facilitate in reaching the scope of the code that are designated not only as economic or analytical actions, such as the business analysis, but also as all the procedures intended and directed to the warning of the firm's anomalies and to commence the processes able to safeguard the business activity and operativity.
In order to do that, to the corporate monitoring bodies, in other words the internal and external auditors, it has been assigned the responsibility of signaling in time the discovery of crisis symptoms and verifying the constantly evaluation, by the administrative body, of the financial and economic equilibrium; this evaluation has to take into account also the future firm's economic prospectus.
The final purpose of these subjects is to express a professional judgment on the balance sheet, making sure of the correct application of the accounting principles, and, according to the principle ISA 570, this judgment should take into consideration also aspects referring to the going concern.
The final opinion is influenced by information about the company's organization, structure and activity and by the analysis of the balance sheet items.

The use of "financial and managerial indicators", especially in a multi-year approach and prospective, is useful to spot anomalies able to deteriorate the business activity.
a) As financial indicators are considered:

- Negative shareholders' funds and deficit of the current assets (current assets – current liabilities)
- Operating losses
- Difficulties on repaying dividends
- Incapability of repaying debt, whether long or short term.

b) The managerial indicators are:

- Intention of liquidating the company.
- Loss of members of executives without substitution.
- Loss of market position, primary clients and suppliers.
- Issues with employees.
- Decrease of supply.
- Legal procedures.

Whether the principles ISA can be applicated to the external auditors, the article 1 of the International Accounting Standards[19] requires the administrative body to continuously assess the company's ability to continue to operate. This assessment, in order to be more accurate, should be based on the evaluation of the future firm's economic performance, and should take into account fundamental aspects which are able to affect the analysis, such as the company's dimension and dependence on external factors.

In any case, the authority of reporting the firm that shows a probability of bankruptcy has been assigned also to public institutions, such as the Income Revenue Authority[20] and the National Institution for the Social Welfare[21].
It has to be highlighted that are excluded from the alert systems banks, funds and asset management societies, insurance societies and the all the big enterprises[22] that correspond to the criteria established by the "CONSOB".

The commitment of internal and external reporting of a firm showing signs of insolvency, has been amplified by the same code thanks to the enlargement of the group of limited companies obligated to the designation of a control body or an external auditor.
As a matter of fact, the criteria indispensable in order to be included in these "audience" is the passing for two subsequent periods of at least two of these elements[23] (Il Sole 24 Ore, n.d.):

- Total assets: 4 million
- Sales: €4 millions
- Employees: 20

While previously this duty included only companies that crossed for two subsequent periods the limit of:

- 4.4 million for total assets
- 8.8 million for sales
- 50 employees

[19] IAS, article 1
[20] The income revenue authority is obligated to warn the public authorities when the expired and unpaid debt from the value added tax is at least 30% of the firm's income.
[21] When the debtor is 6 months late in paying the social security tax for a value that is over €50.000 and over the half of the previous year debt.
[22] According to the art. 3, par. 4, of the European legislation 2013/34, are considered as big enterprises, the societies that present a financial statement that crosses the values of at least two of these criteria: 1) total assets over €20 millions 2) net income over €40 millions 3) number of employees over 250
[23] Il Sole 24 Ore, n.d., *"Article 2477"*, Guida al diritto

In order to make the objects of the article 12 effective, the Code provides the establishment of an organism finalized to the assisted composition of the firm's crisis. This entity, whose composition is activated by the subjects mentioned in the previous paragraphs, has the authority of creating a board composed by three experts, with the purpose of assisting the company on the subject of insolvency procedures and of crisis management and crisis controlling. This system is finalized to move the proceedings from the judicial sphere, in order to encourage its use by the enterprises.

The whole chapter II of the Italian code is inspired by the section regarding the "procedure d'alerte" of the French Bankruptcy Law, in which, the alert procedures, originates from a judicial body called "tribunale de commerce" (commercial court), regulated by strong and well-defined legislative regulations. In this difference, Federico Pernazza, in the text "The legal transplant into Italian law of the "procedure d'alerte", exposes his uncertainty about the efficacy of the Italian body, due to the differences in legislation between the two countries and the lack of experience in this field[24] (Pernazza F., 2017)
Other doubts come from the exclusion from the alert procedures of a consistent group of companies[25], which are fundamentals for the country's economy. Pernazza's opinion about this exclusion is related to the presence of alternative procedures, such as the extraordinary administration, upon which these enterprises can rely on.

Differently from the previous article the art. 13 exposes the indicators of crisis, that, as written before, are constituted by financial and economic unbalances, taking into account to the characteristics and the date of establishment of the enterprise and the business in which the company operates.
They are considered as relevant indexes that one able to evaluate the sustainability of the indebtedness through the generation of future financial flows. In addition, according to the article 24, they are considered as indicators of crisis also the delay on payments and the existence of expired debt concerning salaries and suppliers.

[24] Pernazza F., 2017, *"The Legal Transplant into Italian Law of the Procédure d'Alerte. Duties and Responsibilities of the Companies' Bodies.",* The Italian Law Journal, Vol. 03-N. 02;
[25] Such as big enterprises, asset management companies and insurance companies

The changes introduced by the insolvency code do not concern only the previously mentioned chapter II, so the article 12th and 13th, but also modification about procedures introduced by the old bankruptcy law such as the liquidation, the debt restructuring and the composition with creditors, changes finalized to enhance and increase the efficacy of the processes linked to the enterprise's crisis, so the going concern.

2.5 JUDICIAL LIQUIDATION[26]

The new decree provides the substitution of the "Bankruptcy" with a new procedure called judicial liquidation, finalized to the liquidation of the assets of the insolvent entrepreneur and it is applicated to the entrepreneurs whose are in state of insolvency and do not satisfy the criteria of the "minor enterprise"[27] (L.D. 12th january 2019 n. 14).
In order to be classified as "minor enterprise", the firm has to jointly satisfy these criteria:

a) Value of total assets lower or equal to three hundred thousand euro on past three years before the application for the judicial liquidation
b) Value of sales lower or equal to two hundred thousand on the past three years before the application for the judicial liquidation
c) Value of non-expired debt lower or equal to five hundred thousand

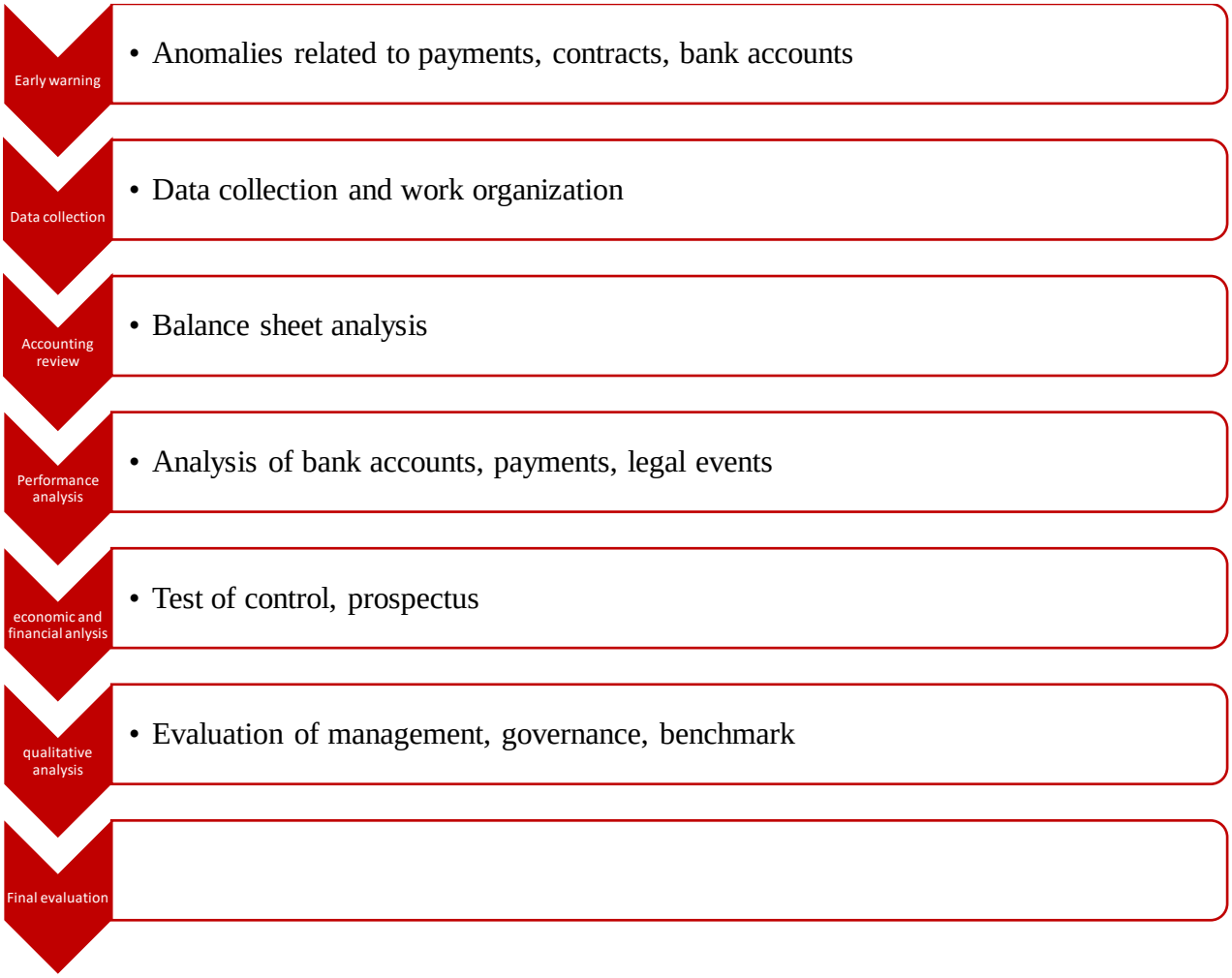
The figure of the insolvency administrator ("curatore"), who is elected by the judge appointed to the control of the correct execution of the procedure, plays an essential role in achieving the process' purpose of liquidation.
This subject, according to the article 128, obtains the administration of the debtor's assets and executes all operation of the procedure under the surveillance by the judge and the creditor's committee. In order to be elected, the insolvency administrator has to be registered on the register of the lawyers, accountants or labor consultants.
As regard the creditor's committee, it consists of a group of three to five members chosen among the creditors, in order to satisfy the volume and the quality of the credits and it is authorized to monitor the insolvency administrator and approve his acts.

[26] Cipolla L., 2019, *"La liquidazione giudiziale: gli organi della procedura",* Il sole 24 Ore
[27] L.D. 12th january 2019 n. 14, article 2

2.6 ALERT SYSTEM: ACTION PLAN[28]

The "Order of Chartered Accountants and Auditors of Milan" (Ordine dei Dottori Commercialisti ed Esperti Contabili) in the Book n. 71, describes the alert systems as procedures that can be implemented above all inside the company by the control body, especially through monitoring procedures and activities in support of the monitoring process and the risk assessment.

The efficacy of these tasks is related to the execution of approaches not anymore back-ward looking but, above all, forward-looking, therefore orientated to a well-planned and organized "planification and control phase" and to the analysis of the ability of generating sufficient financial flows to cover liabilities.



Source: Book n.71, the alert system action plan

[28] Bernardi D. & Talone M., *"sistemi di allerta interna",* book n. 71, ODCEC, p. 67

On the book n.71 are presented two suggested action plans developed for middle and big enterprises and for that one with smaller dimension, that should be followed by the control body, for internal audit tasks, and by external auditors. Each plan has been created in order to maximize the efficacy of the alert system for both types of companies, creating a simplified one for firms representing a less complex administration system.

Concerning the first one, related to bigger companies, the ODCEC provides a scheme composed by 7 consequently phases based on the collection, analysis and evaluation of the external, such as suppliers and creditors, and internal, such as balance sheet, information about the enterprise.

Concerning the first phase, it consists in the analysis and monitoring of the preliminary insolvency indicators, so called early warning, whose consistency and concurrence over time shows high probability of crisis, due to their ability of corroding the business activity and operations.
In order to efficiently monitor the insolvency risk, during this process, they should be taken into account several anomalies related to:

- Payments to commercial subjects;
- Relationship with the funding body and banks;
- Commercial contracts
- Balance sheet accounts
- Management policy
- Tax payments
- Legal events

Consequently, to the first step, the monitoring subjects (controlling body and auditors) should ask for a list of data[29] useful to the analysis of the probability of default. The check list will refer to documents concerning the organization, structure, financial and economic situation of the enterprise.

[29] Appendix B of the book n.71, p. 108 from *"sistemi di allerta interna"*, book n. 71, ODCEC

It comes in succession the accounting review, composed by the typical procedures of auditing and finalized to the evaluation of the rating of the firm. The purpose of this step is analyzing all the elements of the financial and income statements according to the principles ISA, in order to assess the accuracy of the balance sheet and the real risk of insolvency.

The subsequently step regards the activity of *"due diligence"* and performance analysis, in order to report anomalies related to the management system of the financial flows. In order to correctly complete this process, they should be analyzed the relationships with:

- banks and other funding societies involved in short and long-term contracts;
- with leasing and factoring societies;
- with other entities whose influence the financial position and the cash conversion cycle.

Evaluating these last two elements, whose cover funding and commercial aspects, it is fundamental in order to understand the company's ability of generating financial flows, whose directly impact the capability of paying debt and other long and short-term liabilities, so directly correlated to the probability of default.

One of the last phases comprehends the economic and financial analysis, based on the study of the recent balance sheets of the company and on the evaluation of the prospectus, so the theoretic future performances and trend of the firm.
Similar to the previous step, this phase is finalized to the assessment of the enterprise's rating (probability of insolvency), through the examination of the corporate documents (financial statement, income statement and cash flow statement), in order to understand the company's ability of generating a sustainable and adequate flow of liquidity, capable of guaranteeing an economic growth and a safe position in the market.
This step involves the monitoring of the financial indicators that make up the *"early warning tools"* and their comparison with the past values at the same period of the analysis. This last procedure is useful to understand the deterioration of the corporate economic and financial equilibrium.
The overall analysis should take into account seven areas related to the management system:

- Economic growth with a focus on the assessment of the future enterprise's trend;
- Financial and economic flows volatility, in order to understand the ability of covering unexpected losses;

- Operating structure and management efficiency, analysis the costs and the incomes structure and composition;
- Self-financing, in order to understand whether the incomes are able to guarantee and sustain the future economic growth;
- Debt sustainability, based on the calculation of the Debt Service Coverage Ratio[30];
- Financial structure;
- Financial and liquidity equilibrium, based on the analysis of the Cash Conversion Cycle;

The ultimate phase of the plan is constituted by the qualitative analysis, whose consists in the assessment of the efficiency of the managerial, operating and strategic areas and it can be considered as an integration and an in-depth analysis of the previous phases. During this step, they should be taken into consideration the firm's market position, the characteristics of the market in which the enterprise operates and the firm's organization concerning the operations, the management and the information flow.

Lastly, the final evaluation phase concludes the early warning action plan and it involves the editing of a report containing the causes of the crisis, the anomalies founded out during the analysis and a reiterative judgement about risk of insolvency. This step is directed to the managerial board of the company in order to encourage them to formulate and employ correcting action plans.

As previously mentioned, there are two different operating plans about the alert system on a basis of the dimension of the enterprise, so the different type of organization, management system and accounting methods.
It has been exposed that the advisory of the insolvency from "outside", it is easily discoverable due to the non-fulfillment of the obligations, on the contrary, the warning of the crisis appearance from external parties and entities can be verified only through the analysis and the assessment of the future performance of the firm, making complementary and, sometimes superficial whether it is used alone, the study of the past trend[31] (Bernardi D. & Talone M., n.d., p. 89). Indeed, the analysis of tools, such as accounting data and financial and economic

[30] (operating cash flow-tax) / (interests + principal)
[31] Bernardi D. & Talone M., *"sistemi di allerta interna",* book n. 71, ODCEC, p. 89

indicators/indexes, provides information that has been already occurred and that can be influenced by the insufficient knowledge about the enterprise. As a matter of fact, in order to give a realistic judgement about the probability of insolvency, it is necessary identifying the incapacity of fulfilling the past and the predictable obligations, whose it is an assessment that comes from information well known from an inside prospective but not from an external one. As a consequence, especially for the smaller firms, it is fundamental the role of the governance in the assessment of the probability of insolvency, since it can put together quantitative and qualitative information with the analysis of the past performances and future trend. In order words, in other to develop an accurate assessment of the real risk of default it should be involved a forward-looking analysis that enables the development of prompt correcting action plan or, at least, accelerates the procedures related to the insolvency. This is the reason why, especially for the small enterprise that are not used to do it, it is fundamental the development of budgets and multi-year plans, characterized by several possible and concrete scenarios, taking into account the external factors related to the market and the country's economy. With this future prospective, it should not be forbidden the creation of provisional cash flows statements, able to give an idea about the ability and capacity of covering future obligations and cash out, whether foreseen or unexpected. Through this systems and procedures, the financial and economic position that characterized and surrounded the company becomes clearer.

The subsequent phases should be the same of the alert systems action plan for the bigger firms, in other words the accounting review, the performance analysis and the financial and economic analysis. Equally to the big enterprise's phases, these steps are directed to find out the possible anomalies present in the balance sheets and to analyze the anomalies related to the management system of financial flows, through a due diligence activity. In the end there should be taken into consideration and analyzed, the economic and financial indicators, through a year to year assessment, in order to study the past and future trend of the firm, making clearer the company's situation.

In conclusion, the final purpose of the operating plan for small firms is not to give a judgement about the rating, so the company's probability of default, on the contrary to the bigger enterprises, but to constitute an efficient internal alert system, in order to intercept the first

threat signals and, as a consequence, to activate the necessary correcting action plans directed to oppose the risk of insolvency[32] (Bernardi D. & Talone M., n.d., p. 95).

CHAPTER II

3 BANKRUPTCY PREDICTING MODELS

As briefly outlined in the introduction the purpose of the thesis is to provide an adequate and real analysis of possible bankruptcy predicting models in order to amplify the category of the financial indicators and tools, able to give a concrete and realistic judgement about the company's financial position, in order to be used as possible alert systems in the art. 13 of the Italian Insolvency Code.

As exposed in the previous chapter, in order to assess the risk of insolvency it is fundamental using a prospective view of the firm, taking into account future possible scenarios of the firm's economic and financial position. Naturally, all of the following models take into consideration only the items from the financial and income statements, but nothing prohibits to take them from multi-year budgets, on the basis of the forward looking prospective.

3.1 ALTMAN'S Z SCORE MODEL

Among the bankruptcy predicting models, one of the most appreciated and utilized is surely the Altman's Z score. Edward Altman published his research on the 1968 on "The Journal of Finance" under the title "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy" with the scope of finding an analytical model able to predict bankruptcy. In order to reach his purpose, he took into consideration sixty-six companies dividing them into two groups with same number, thirty-three in the first one and thirty-three in the second one. The first group was made up of manufacturing firms under a bankruptcy petition during the period between 1945 and 1965. Altman considered this range too wide to give accurate results, but he was forced to using it in the analysis due the lack of available data. The first group sample was composed by companies with total asset between a range of $0.7 million to $25.9 million.

[32] Bernardi D. & Talone M., *"sistemi di allerta interna",* book n. 71, ODCEC, p. 95

On the other hand, the second group consisted of companies, even in this case in the manufacturing sector, with an asset size between $1 million and $25 millions and still in existence during the research period.
The economist decided to exclude from the analysis larger asset-size companies because of their lower bankruptcy probability and the characteristics of their financial ratios, that could have deflated the statistics. Additionally, he could have not considered firms with an asset-size lower than one million dues to the lack of comprehensive data[33] (Altman E., 1968).

Altman initially considered twenty-two possible indicators of company's problems, progressively reducing them to five according to the efficacy in predicting bankruptcy. The final variables were part of five categories: profitability, leverage, liquidity, activity ratios and solvency.
The final discriminant function was the following:

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

Where:

- X_1 = Working Capital / Total Assets
- X_2 = Retained Earnings / Total Assets
- X_3 = Earnings Before Interests and Taxes / Total Assets
- X_4 = Market Value of Equity / Book Value of Total Debt
- X_5 = Sales / Total Assets

Concerning the first variable X1, it consists in a measure of net liquidity in relation to the total company's assets. The dividend is given by the difference between current assets, composed by resources convertible into cash within a year, and current liabilities, made up of elements that has to be paid by the year. More specifically they are respectively taken into account inventories, cash and accounts receivables and accounts payables, short-term debt and other current liabilities.
The working capital shows whether the company is able to pay liabilities within a year. A positive difference reveals a volume of liquidity adequate to cover the short-term liabilities, on

[33] Altman E., 1968, "Financial Ratios, Discriminant Analysis And The Prediction Of Corporate Bankruptcy", The Journal of Finance, Vol. 23, No. 4, pp. 589-609

the contrary it may show the necessity of borrowing other funds from external parties[34] (CFI, n.d.)

Regarding the second variable X2, it concerns the profitability of a firm. As explained by Altman on his publication, it is proportionally correlated with the age of firm, since the ratio of a young company should show a low value due to the difficulties in accumulating profits, so higher probability of default, and the opposite for an older firm.
The retain earnings are made up of earnings not distributed to shareholders, so that they can be reinvested for the business activity and assets. In this way a company with high values of retain earnings may have less difficulties in covering liabilities and it can employ the accumulated earnings in capital expenditures and in the repayment of debt, guarantying and increasing the probability of going concern.

The X3 variable consist in a profitability, or, as mentioned by Altman, in a productivity ratio since it shows the ability of a firm to generate earnings in relation to its assets. The economist chose this index since, as he explained on the Journal of Finance, the existence of a firm is strictly correlated to the earnings power of its assets, so that low values of the ratio reveal high probability of bankruptcy and the opposite. Moreover, the ratio is also useful to evaluate the management efficiency in generating revenues from its resources.

The fourth index *"shows how much the firm's assets can decline in value before the liabilities exceed the assets and the firm becomes insolvent"*[35] (Altman, E, 1968). Differently from the previous failure studies the ratio adds a market value aspect to the equation.

The last variable, also named as capital turnover, is a financial ratio that shows the capability of the assets of producing revenues and it measures the ability of a firm in dealing with competitive external factors. It is the other index that evaluates the management efficiency.
In my opinion Altman could have avoided this choice since, during the analysis, the amount of sales was not related to the risk of bankruptcy. As a matter of fact, a firm can be able to generate high volume of revenues but whether it has high operating costs, this value becomes superficial, especially for manufacturing companies. To conclude the X3 represent in a better and more

[34] CFI, n.d, *"What is the working capital formula?"*
[35] Altman E., 1968, "Financial Ratios, Discriminant Analysis And The Prediction Of Corporate Bankruptcy", The Journal of Finance, Vol. 23, No. 4, p. 595

realistic way the management efficiency and the economic condition of a firm, since the expenditures have already been calculated in the ratio.

In 1993 Altman adjusted the equation for non-listed companies obtaining:

$$Z=0.717X1+0.847X2+3,107X3+0.42X4+0.998X5$$

Where:

- X_1 = Working Capital / Total Assets
- X_2 = Net Income / Total Assets
- X_3 = Earnings Before Interests and Taxes / Total Assets
- X_4 = Shareholders funds / Total Debt
- X_5 = Sales / Total Assets

In other words, he modified the coefficients and the second and fourth variable due to the differences on the balance sheets items. Regarding the former, it is commonly known as return on assets and, even in this case, it measures the profitability in relation to the firm's assets, so the efficiency in production and management[36]. Naturally, in the calculation of the ratio are considered all the expenditures, taxes and, whether they are existent, losses and incomes generated by interests. This variable is useful to compare companies' performances in the same industry since it shows different levels of efficiency in relation to similar operating expenditures, at the same time it is worthless between companies operating in different markets.

Regarding the latter, it concerns the relationships between short- and long-term debt and the funds owned by the owners of the company. Regarding this last one it has to be said that is directly influenced by the net income and other funds[37].

[36] CFI, n.d., *"ROA Formula"*

[37] According to the National Accounting standards the shareholders' funds are regulated by the OIC 28.

3.1.1 EMPIRICAL RESULTS OF ALTMAN'RESOURCES

	Predicted group membership	
Actual group membership	Bankrupt	Non-bankrupt
Bankrupt	H	M1
Non-bankrupt	M2	H

Altman classified the two companies' group on the basis of the model's prediction, identifying H as correct classification and M as miss classification, where M1 stands for type I error and M2 stands for type II error.

The economist analyzed the firms' financial statement data one year and two years prior the bankruptcy in order to assess the efficacy of the efficacy of the equation in different life period. The results revealed that in the first case the accuracy of the correct classification of the group one and two was respectively 94 and 97 percent while, in the second case, 72 and 94 percent.

It has to be highlighted that the model, according to the Altman's results, was efficient only up to two year before the bankruptcy, since further tests showed a correct classification percentage of 48 for three years, 29 for four years and 36 for five years prior the failure.

To conclude the analysis, Altman identified three sectors essential for the interpretation of the Z scores, in other words the "non-bankruptcy zone", the "gray zone" or "zone of ignorance" and finally the "bankruptcy zone". Concerning the first one, all the firms that show a value above 2,99 will not fall into bankruptcy, regarding the second one, the companies with values between 1,81 and 2,99 are characterized by an uncertain probability of bankruptcy, so in this section there can be errors of misclassification and finally all the values below 1,81 reveal a certain failure within one year.

It has to be highlighted that, regarding the gray zone, Altman fixed 2,675 as cut off point, in order to better classify the firms inside the section. This limit reveals that companies with values of the Z scores above the threshold are characterized by low probability of bankruptcy up to the value of 2,99, starting point of the non-"bankruptcy zone", while scores with a value below 2,675 are part of the insolvency zone; to be remembered, below 1,81 the insolvency is certain.

3.2 ALBERICI'S Z SCORE[38]

Another important contribution to the literature concerning the bankruptcy predicting models, was given by Adalberto Alberici in the 1975 with his publication "Balance sheet analysis and prediction of insolvency".

The Italian economist, differently from Altman, utilized five different equations taking into consideration the five years prior the bankruptcy[39] (Madonna S. et Poddighe F., 2006).

Year $_{t-5}$

$$Z_{t-5} = -0{,}00401\ X_1 + 0{,}00203\ X_2 + 0{,}00346\ X_3 - 0{,}02201\ X_4 + 0{,}01374\ X_5 + 0{,}00108\ X_6 - 0{,}00417\ X_7$$

Year $_{t-4}$

$$Z_{t-4} = 0{,}00164\ X_1 + 0{,}00350\ X_2 - 0{,}01659\ X_3 - 0{,}04353\ X_4 + 0{,}04026\ X_5 + 0{,}00013\ X_6 + 0{,}00105\ X_7$$

Year $_{t-3}$

$$Z_{t-3} = -0{,}00213\ X_1 + 0{,}00319\ X_2 + 0{,}00421\ X_3 - 0{,}02482\ X_4 + 0{,}011613 X_5 + 0{,}00055 X_6 - 0{,}00319 X_7$$

Year $_{t-2}$

$$Z_{t-2} = 0{,}00004\ X_1 - 0{,}01528\ X_2 + 0{,}03013 X_3 - 0{,}07389\ X_4 + 0{,}07658\ X_5 - 0{,}000446 X_6 + 0{,}004828\ X_7$$

Year $_{t-1}$

$$Z_{t-1} = 0{,}00182\ X_1 - 0{,}02579\ X_2 + 0{,}00489\ X_3 - 0{,}05185\ X_4 + 0{,}00295\ X_5 - 0{,}03831\ X_6 - 0{,}01538\ X_7$$

The other difference with Altman is evident just observing at the equations, since the variables utilized are seven and not five.

Where:

- X_1 = Net income / total assets
- X_2 = Total debt / total assets
- X_3 = Shareholders funds / PPE
- X_4 = Shareholders funds + long term debt / PPE
- X_5 = Current assets / current liabilities
- X_6 = Quick assets / Current liabilities
- X_7 = Current liabilities / Total assets

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[38] Alberici A., 1975, "Analisi dei bilanci e previsione delle insolvenze", ISEDI

[39] Madonna S. et Poddighe F., 2006, *"I modelli di previsione delle crisi aziendali: possibilità e limiti",* Giuffrè Editore

As it can be noticed all the variables except for X_1 are different from the Altman's equation. Starting from the second variable, it is also named as debt ratio and classified as one of the leverage indexes, indicating the amount of assets financed through debt. The risk of default is directly proportional to higher value of the ratio, since it can reveal the future inabilities of debt repayment. Even in this case, such as of other ratios, the index has to be interpreted on the basis of the type and nature of the industry, since some of them require more funds than others.

The third and the fourth variables describe the ability of covering the expenditures in property, plants and equipment through permanent sources and, in the second case, also through debt[40] (Madonna S. et Poddighe F., 2006, p. 319).
The X_5 variable indicates the repayment capacity of obligations that are due to one year through current assets, such as cash and cash equivalents, inventories and accounts receivables. Differently from the previous ratios in this case high values of the fraction result increase the risk related to the firm, since it can easily cover the obligations through assets that can be converted into liquidity within one year. In case of values below one, the company should ask for external funds to finance the liabilities. The X_6 variable is similar to the last one but, in this case, it indicates the possibility to repay short term obligations only through liquid assets.
To conclude the last variable recalls the debt ratio but adding also other current liabilities.

3.2.1 ALBERICI RESULTS

Alberici took into account two groups composed each one of 21 companies that, for the first one, they were still active while, in the second one, they went to bankruptcy. In order to classify the insolvency risk, he fixed different cut off points for each year due to the different equations. It has to be highlighted that Alberici's "cut off" values work in a different way, since, differently from Altman, the firms that cross the threshold are classified as insolvent while that ones that show a measure below, are classified as safe. According to Alberici, this limit is 5,494 for the fifth year, 34,229 for the fourth year, 120,221 for the third, 7.192,602 for the second and finally 92,708 for the first year prior the bankruptcy.
The equations were tested to both companies' groups for each year giving the probability of correct classification for the first group[41] equal to 76,2% for the year t-5, 66,7% for the year t-4, 85,7% for the year t-3, 81% for the year t-2 and 85,7% for the year t-1; instead, the results

[40] Madonna S. et Poddighe F., 2006, *"I modelli di previsione delle crisi aziendali: possibilità e limiti",* Giuffrè Editore, p. 319
[41] Group made up of still existing companies at the period of the analysis

of the second group were 81% for the year t-5, 71,4% for the year t-4, 81% for the year t-3, 90,5% for the year t-2 and 85,7% for the year t-5. It has to be highlighted that the average of the correct classification for the first three years prior the bankruptcy was around 85%[42], while the average of the overall period was 80,49%.

It can be noticed that in some cases the misclassification probability is lower for the year that precedes the year prior the default, Alberici explained that the volatility is given by the lack of a wide sample that misalign the volatility.

If the Z scores of the two economists were compared, the result would award the Alberici' Z score as more efficient and accurate since the misclassification error by Altman's equation significantly increases when the period taken for the analysis gets more distant from the failure.

Year prior insolvency	Altman's accuracy percentage
5	36%
4	29%
3	48%
2	72%
1	95%
Average	56%

ALBERICI Z SCORE ACCURACY ANALYSIS			
Year prior insolvency	Group 1	Group 2	Average
5	81%	76,2%	78,6%
4	71,4%	66,7%	69,05%
3	81%	85,7%	83,35%
2	90,5%	81%	85,75%
1	85,7%	85,7%	85,7%
Overall average	81,92%	79,06%	80,49%

[42] Average of correct classification probability:

- Y_{t-3} = 83,35%
- Y_{t-2} = 85,75%
- Y_{t-3} = 85,7%

3.3 BOTTANI, CIPRIANI AND SERAO MODEL

The other analysis taken into consideration for the research was ideated by Pietro Bottani, Letizia Cipriani and Francescomaria Serao in 2004 and published under the title "The Z score analysis model applied to SME"[43] (Bottani, Cipriani et Serao, 2004) on the periodical "Administration and finance".

Differently from the other Z score models, this last has been developed specifically for the Italian context and Italian small and medium enterprises. Equally to the previous cases, the model uses the discriminant analysis and two groups of firms, the former in bankruptcy and the latter still existent.

The sample has made up of 66 manufacturing companies equally divided into the two groups, that are composed in one hand by firms declared in bankruptcy in 2002, on the other hand by firms still existent at period of the analysis. The balance sheets utilized for the research goes from the 1999 to 2000.

Concerning the discriminant function, it has been developed on the basis of the statistical contribution of each variable to the equation, the correlation between each ratio and evaluation of the results obtained. The final function was the subsequent:

$$Z = 1{,}981\ X_1 + 9{,}841\ X_2 + 1{,}951\ X_3 + 3{,}206\ X_4 + 4{,}037\ X_5$$

Where:

- X_1 = Working capital / total assets
- X_2 = Other shareholders' funds[44] / total assets
- X_3 = EBIT / (total assets – cash and cash equivalents)
- X_4 = shareholders' funds / (Shareholders funds + total liabilities)
- X_5 = sales / total assets

It can be noticed that, except for X_1 and X_5, the other ratios are slightly different from the others previously discussed for the Altman's and Alberici's Z scores. Regarding the second variable, it concerns the ability to reinvest the incomes generated by the operating activity. This ratio is inversely proportional to the risk of default and to the age of the firm, since in both cases, the value obtained will be lower than a safe company and closer to zero. The X_3 variable is a modification of the return on total assets, since they are excluded the liquid assets from the divisor. It expresses the productivity capacity, in terms of incomes, without considering taxes

[43] Bottani, Cipriani and Serao, 2004, *"il modello di analisi Z-score applicato alle PMI"*, 2004, Amministrazione e finanza n. 1/2004

[44] Other shareholder funds = *"Riserva legale"* + *"Riserva straordinaria"*

and financial losses and incomes. The last ratio that is going to be discussed is the X_4 variable whose reveals the threshold after that the circumstances of the insolvency disclose, so when the liabilities exceed the assets. Further tests on the variables, reveal that the most vivid ratios to the discriminant function are X_1, X_4 and X_5.

Regarding classification of the firms, the three authors identified, similarly to the Altman's analysis, three sections delimited by the respective values obtained from the Z score equation:

- The insolvency zone, represented by values of the Z score lower than 4,846;
- The precautionary zone, define by values between 4,846 and 8,105;
- The safe zone that is composed by firms that obtained a value above 8,105;
- Finally, the "cut-off" point has been fixed by the value of 7,14;

Concerning the efficacy of the Z score, according to the authors, their evaluation shows a correct classification percentage equal to 94% for the balance sheets of the year 2000 and even above[45] this value for the year 2001, probably due to the proximity with the declaration of bankruptcy (2002).

3.4 OHLSON P SCORE

Another score that is going to be taken into account for the thesis research, it is the outcome of James A. Ohlson's research in the field of bankruptcy predicting models specific for corporates and published on the "Journal of accounting research" on the 1980[46] (Ohlson J. A., 1980). Even if the object of the sample is different from the thesis one, it has been chosen to use it since the discriminant function is the most complex among all models analyzed and it includes external factors that are not taken into consideration in the other scores. Even in this case, the companies analyzed are divided into two groups, the former composed by 105 failed firms and the latter by 2058 still existent firms.

The population considered by Ohlson is made up of industrial firms characterized by the date of the failure situated between 1970 and 1976, only for what regards the first group, and the presence on stock exchange or over the counter market. They are excluded from the research companies that are part of the service industry, due to the structural differences, and they are considered only the balance sheets from period one to period three prior the failure.

The discriminant function developed by Ohlson is the subsequent:

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[45] The percentage in this case is not given by Bottani.

[46] Ohlson J. A., 1980, *"Financial ratios and the probabilistic prediction of bankruptcy"*, Vol. 18, No. 1, pp 109-131

$$P = -1{,}32 - 0{,}407\ X_1 + 6{,}03\ X_2 - 1{,}43\ X_3 + 0{,}076\ X_4 - 2{,}37\ X_5 - 1{,}83\ X_6 + 0{,}285\ X_7 - 1{,}72\ X_8 - 0{,}521\ X_9$$

Where:

- X_1 = log (total assets / GNP price-level index)
- X_2 = Total liabilities / Total assets
- X_3 = Working capital / Total assets
- X_4 = Current liabilities / Current assets
- X_5 = One if total liabilities exceed total assets, zero otherwise
- X_6 = Net income / Total assets
- X_7 = Cash flow from operations / Total assets
- X_8 = One if net income is negative for the last two years, zero otherwise
- $X_9 = (NI_t - NI_{t-1}) / (|NI_t| + |NI_{t-1}|)$
- The "cut off" point is set to the value of 0,038; for values greater than this the firm is classified as insolvent, safe otherwise.

Among the variables, comments should be made concerning the first, the fifth, the seventh and the last two variables, since they have not previously been analyzed and they are exclusive ratios of this function. Concerning X1, it puts into relationship the firm's structure with the economic conditions of the home country, in order to adapt the real "wealth" of the company to the market.

The fifth variable, that can be seen as a direct consequence of the fourth one, shows the company's ability to cover the obligations and it discriminates firms with a positive result[47], that are in this way penalized and signaled as risky firms. The seventh variable reveals the capability of the company in generating cash in relation to its assets, so how efficiently it manages its resources.

Finally, the last two variables are related to the firm's trend and it allows the partition between entities still able to generate positive and growing incomes and others that reveal a deterioration of their performances.

According to Ohlson's analysis, the model correctly classified 96,30% of the companies analyzed.

[47] For positive, it is meant a value equal to one, so the case of total libilities higher than total assets.

3.5 SPRINGATE Z SCORE AND LEGAULT CA- SCORES

The last two scores taken into consideration for the research, are the models developed by Gordon Springate in 1978 and Jean Legault in 1987. In both cases, the sample is made up of small manufacturing Canadians firms.

The Springate's discriminant function is a simplified version of the Altman's Z score[48] (Lubawa, Louangrath, 2016):

$$Z = 1{,}03\ X_1 + 3{,}037\ X_2 + 0{,}66\ X_3 + 0{,}40\ X_4$$

Where:

- X_1 = Working capital / Total assets
- X_2 = EBIT / Total assets
- X_3 = EBT / Current liabilities
- X_4 = Sales / Total assets
- 0,862 represents the cut off points so that for values below the threshold the firm is classified as in bankruptcy risk;
- According to the research the model has an accuracy equal to 83%;

Instead, the Legault's function is represented by[49] (Lubawa, Louangrath, 2016):

$$CA = 4{,}5913\ X_1 + 4{,}5080\ X_2 + 0.3936\ X_3 - 2{,}7616$$

Where:

- X_1 = capital / Total assets
- X_2 = EBIT + financial expenses / Total assets
- X_3 = Sales / Total assets
- The "cut off" point is determined by -0,03;
- The model shows the same accuracy of the Springate Z score, in other words 83%;

[48] Lubawa, Louangrath, 2016, *"Using Altman Z score to assessthe financial effects of multiple Loans on SMEs"*; *International journal of research & methodology in Social Science;* Vol. 2, No. 1, p.63;

[49] Lubawa, Louangrath, 2016, *"Using Altman Z score to assessthe financial effects of multiple Loans on SMEs"*; *International journal of research & methodology in Social Science;* Vol. 2, No. 1, p.63

4. BANKRUPTCY PREDICTING MODELS ANALYSIS

4.1 SAMPLE AND DATA SELECTION

As briefly introduced on the introduction, the thesis is finalized to the evaluation of the predicting ability of the Z scores models previously exposed, for the purpose of being used as alert systems. In order to reach this purpose, they have been taken into account 513 Italian firms operating in the manufacturing industry with an insolvency proceeding. The data has been taken from the *Orbis* platform since it provides the financial statement, the income statement and the cash flow statement and, finally, the status of the company, in other words whether it went in bankruptcy or it is still existent. The platform, thanks to the several possible usable filters, allows to create a specific population of firms that better meet the necessary requirements. Through this system, it has been possible to select every company on insolvency proceeding with sales higher than € 1 millions and operating in the manufacturing sector. The available balance sheet data goes takes into account the period that goes from 1991 to 2018 and from the first year to the fifth year prior the bankruptcy. Sometimes the information available did not cover the whole quinquennial period, so that it has been possible to analyze the accuracy of the models only for the years provided. This last, it is a superficial issue since, as exposed in the previous paragraphs, the efficacy of the discriminant functions gradually decreases for higher distances from the date of the failure. All the data were later formalized in an Excel file, in order to proceed with the proper analysis. Below the results of the first year prior the bankruptcy.

Company	Altman	Alberici	Bottani	Ohlson	Legault	Springate	Status
VINCENZO ZUCCHI S.P.A.	0,70	-0,01	-1,29	0,43	-1,35	0,15	A
ALFATHERM S.P.A.	0,45	-0,04	5,85	-4,58	-2,83	-0,32	A
M.E.C. S.P.A.	0,69	-0,05	3,61	-2,08	-2,41	-0,09	F
ANDELINI S.R.L.	1,13	-0,03	4,11	-3,36	-2,12	0,46	F
BENELLI Q. J. SRL	1,51	-0,48	5,93	-3,11	-1,87	0,78	A
BRENDOLAN PROSCIUTTI S.P.A	1,00	-0,10	5,71	-6,06	-2,15	0,50	F
CANTIERE NAVALE DE POLI S.P.A.	0,53	-0,27	2,73	-3,73	-2,63	0,39	F
CANTIERE NAVALE DI PESARO S.P.A.	0,62	-0,49	2,20	-3,50	-2,41	0,48	F
CONSORZIO PADANO ORTOFRUTTICOLO SOCIETA' AGRICOLA	0,51	-0,07	3,26	-4,83	-2,43	0,19	A
FADALTI S.P.A.	1,37	-0,07	5,34	-4,38	-1,66	0,64	F

FONDERIE DI ASSISI S.P.A.	-3,82	0,15	-21,74	7,37	-7,14	-4,03	A
FONTANA - SOCIETA' PER AZIONI	1,73	-0,06	7,52	-3,47	-2,05	0,90	A
IMT S.P.A.	0,62	-0,08	3,79	-3,72	-2,41	0,24	A
ITIN S.P.A	0,15	-0,10	0,57	-5,26	-2,60	0,11	F
KEYMAT INDUSTRIE S.P.A.	1,50	-0,06	5,07	-4,26	-1,02	0,66	F
LINEAPIU' - S.P.A.	0,65	-0,07	2,41	-4,36	-2,32	0,30	A
M V AGUSTA MOTOR S.P.A.	0,25	-0,06	4,33	-5,97	-2,24	-0,32	A
OLIO DANTE S.P.A.	0,29	-0,06	-0,27	-2,51	-1,48	-0,23	A
PACIOTTI S.P.A.	2,35	-0,12	9,80	-4,16	-1,24	1,32	A
PDC S.P.A.	1,29	-0,07	6,69	-5,36	-2,11	0,53	F
PM OIL & STEEL S.P.A.	0,99	-0,06	4,71	-5,57	-1,99	0,46	A
SEMIO S.P.A.	1,91	-0,08	7,37	-2,85	-1,81	0,89	F
SICA S.P.A.	0,83	-0,08	3,53	-2,49	-2,27	0,16	F
SIRMA S.P.A.	1,40	-0,06	6,11	-3,71	-1,41	0,72	F
PARMACOTTO S.P.A	1,21	-0,06	5,77	-2,72	-1,98	0,58	A
POLTI S.P.A.	1,16	-0,05	3,65	-5,43	-2,26	0,44	A
SADAM S.P.A.	1,04	-0,07	3,65	-5,83	-0,26	0,41	A
UNITESSILE SRL	0,90	-0,10	5,69	-6,75	-2,08	0,46	F
VISMARA S.P.A.	-3,49	0,08	-27,82	10,97	-4,68	-4,24	A
ALBATROS INDUSTRIA CONCIARIA S.P.A.	1,20	-0,12	5,12	-3,30	-2,04	0,65	F
COMPAGNIA GENERALE METALLI S.P.A.	0,04	-0,09	3,05	-3,66	-3,11	-0,45	A
DOLCIARIA LOMBARDA S.P.A.	1,31	-0,09	5,57	-3,06	-1,95	0,58	F
EUKEDOS S.P.A.	1,31	-0,07	5,06	-3,52	-0,14	0,46	A
LMV S.R.L.	1,26	-0,08	6,61	-5,30	-2,21	0,61	F
MAGLIFICIO CALZIFICIO TORINESE SPA	1,57	-0,11	5,82	0,19	-1,75	0,85	F
MELEGATTI S.P.A.	1,05	-0,06	5,83	-5,00	-2,27	0,40	F
MOLINI TANDOI S.R.L.	1,33	-0,05	7,14	-3,65	-1,95	0,47	A
PRECA BRUMMEL S.P.A.	2,06	-0,10	7,12	-8,13	1,20	1,93	A
SATURNO - S.P.A. MATERIE PLASTICHE	1,44	-0,07	6,59	-4,20	-1,60	0,70	F

SIM S.P.A.	1,70	-0,13	7,76	-3,08	-2,06	0,88	F
OLMETTO - S.P.A.	1,14	-0,06	4,27	-2,06	-1,92	0,55	F
ORAN S.P.A.	1,73	-0,43	7,18	-4,38	-1,00	0,91	F
A.B. FIBRE SPA	2,71	-0,39	10,34	-2,75	-1,29	1,33	F
ACON S.P.A	2,30	-0,57	10,80	-5,61	-1,38	1,60	F
ADALTIS ITALIA S.P.A.	0,98	-0,05	3,44	-3,27	-2,28	0,62	F
BIOERA SPA	0,83	-0,05	1,01	-1,26	-0,44	-0,05	F
GATTO ASTUCCI S.P.A.	1,91	-0,08	9,99	-4,04	-1,81	0,97	A
GRUPPO FINI S.P.A.	0,70	-0,07	4,90	-4,56	-2,59	0,07	A
MEETING GROUP S.P.A.	1,04	-0,50	5,68	-4,33	-2,38	0,54	A
RCR CRISTALLERIA ITALIANA S.P.A.	-0,32	0,00	-4,95	-3,01	-2,55	-0,63	A
RICHARD-GINORI 1735 S.P.A.	-1,02	0,03	-8,89	1,75	-4,36	-1,40	F
SACHMAN RAMBAUDI S.P.A.	1,17	-0,23	5,01	-3,10	-2,00	0,72	F
TECNOMAGNETE SPA	1,26	-0,06	3,79	-2,75	-1,53	0,71	A
TECOPRESS S.P.A.	0,37	-0,05	3,06	-1,98	-2,98	-0,18	A
ALGAT INDUSTRIE S.R.L.	0,40	-0,03	1,77	-5,06	-2,61	-0,08	F
ARIX S.P.A.	1,58	-0,08	6,62	-3,69	-1,65	1,16	A
DOLCI BIELLONI S.R.L.	1,16	-0,09	5,24	-3,18	-2,24	0,59	F
I.S.E.A. S.P.A.	0,63	-0,15	2,44	-3,12	-1,50	0,17	F
MASCIONI S.P.A.	0,99	-0,05	5,09	-4,88	-1,72	-0,04	A
MOBILIFICIO FOGLIENSE S.R.L.	0,50	-0,06	2,49	-3,01	-2,43	0,15	F
SOLON S.P.A	0,35	-0,06	1,55	-3,33	-2,12	0,01	A
VISIBILIA S.P.A.	1,30	-0,25	3,58	-4,92	-0,90	0,73	F
AGAVE S.R.L.	0,98	-0,15	5,11	-5,02	-2,21	0,58	F
C.M.S. - S.P.A.	2,30	-0,08	6,03	-5,69	2,06	2,18	A
ITALVELLUTI - S.P.A.	1,87	-0,09	9,27	-3,91	-1,65	1,03	F
M.R.T. S.P.A.	1,13	-0,10	5,05	-2,68	-2,29	0,49	F
MARMI E GRANITI VOLARGNE S.R.L.	1,25	-0,11	6,92	-5,54	-2,35	0,66	F
MONTANARI S.P.A.	-0,43	-0,03	-0,56	-4,15	-3,68	-0,88	F
NEW MILL S.P.A.	1,37	-0,13	5,09	-3,37	-1,52	0,77	A
O.C.E.M. S.P.A.	1,02	-0,09	3,79	-2,74	-2,26	0,53	A
RAGAINI RADIATORI - S.P.A.	-1,47	-0,03	-2,06	-2,68	-4,37	-1,88	A

RENI ETTORE - S.P.A.	1,16	-0,05	4,84	-2,63	-2,01	0,47	F
S.E.C. - SOCIETA ESERCIZIO CANTIERI - SOCIETA' PER AZIONI	0,07	-0,16	1,54	-5,75	-2,74	-0,01	F
S.I.A.C. INDUSTRIA ACCESSORI CAVARIA S.P.A.	0,79	-0,11	3,57	-5,22	-1,66	0,38	F
TAGINA CERAMICHE D'ARTE S.P.A.	1,14	-0,12	8,03	-5,79	-1,98	0,44	A
TESTORI INTERIORS S.P.A.	0,91	-0,07	3,87	-3,13	-1,85	0,42	F
WICTOR S.P.A.	0,81	-0,05	3,80	-2,95	-1,61	0,24	F
ZADI S.P.A.	-0,89	-0,03	-3,06	-1,23	-3,87	-1,29	A
ALCEA S.P.A.	0,39	-0,01	2,13	-4,85	-2,99	-0,10	A
ASO SPS S.P.A.	1,42	-0,14	7,23	-5,29	-1,21	0,81	F
BALESTRINI CHIMICA S.R.L.	1,36	-0,06	6,70	-2,90	-2,36	0,29	F
COMPAGNIA GENERALE ALLUMINIO S.P.A.	0,56	-0,06	3,49	-3,19	-2,58	-0,24	F
C.G.R. CORNELIO GHINASSI RICAMBI S.P.A.	0,63	-0,09	2,74	-3,04	-2,02	0,25	F
CEMIT ENGINEERING & CONSTRUCTION S.R.L.	0,99	-0,03	3,80	-4,56	-1,91	0,62	F
GIPLAST GROUP S.P.A.	1,29	-0,04	4,76	-3,14	-2,04	0,56	A
GRUPPO FRATI S.P.A.	0,56	-0,09	2,97	-3,55	-2,34	0,00	F
HDI S.R.L.	1,42	-0,04	6,49	-3,67	-1,90	0,91	F
M & Z RUBINETTERIE S.P.A.	1,44	-0,11	8,06	-5,54	-2,17	0,77	A
SICHENIA GRUPPO CERAMICHE S.P.A.	0,62	-0,05	2,08	-4,51	-0,52	0,72	A
SIR S.R.L.	1,88	-0,03	7,33	-4,10	-1,82	0,87	F
STRATEX S.P.A.	0,67	-0,07	3,28	-2,71	-2,31	0,21	F
VITREX SPA	2,10	-0,12	7,64	-4,55	-0,62	1,20	F
ACCIAIERIE WEISSENFELS	-0,10	-0,08	1,17	-3,33	-2,88	-0,39	F
BECHER SPA	1,87	-0,09	9,23	-5,23	-1,02	0,88	A

COMMITAL - SAMI S.R.L.	1,18	-0,04	5,56	-2,95	-2,04	0,48	F
GATTO - S.P.A.	1,19	-0,06	5,59	-5,22	-1,55	0,57	F
GLENFIELD S.R.L.	1,14	-0,10	6,60	-4,10	-2,02	0,56	F
NEW STEEL S.R.L.	0,70	-0,21	2,95	-2,79	-2,13	0,24	F
SALUMIFICIO DEL MONTELLO - S.P.A.	2,13	-0,06	8,57	-2,10	-1,59	0,92	F
SANTAROSSA COMPONENTS S.R.L.	1,97	-0,09	8,15	-2,78	-1,85	1,02	A
TEUCO S.P.A.	0,27	-0,07	4,78	-5,21	-2,86	-0,52	F
AGRONOMIA S.P.A.	0,33	-0,03	2,51	0,30	-2,53	-0,11	F
BERTELLO S.P.A.	0,72	-0,09	2,67	-2,52	-2,08	0,44	F
BERTOLOTTI spa	3,12	-0,08	7,41	-5,84	0,03	3,75	A
JECKERSON S.P.A.	4,28	-0,09	4,63	-4,87	-1,28	0,22	A
LUIGI GERRI S.P.A.	1,20	-0,09	6,67	-3,72	-2,08	0,57	F
MAGGI GROUP S.R.L.	0,98	-0,07	5,32	-3,28	-2,23	0,48	F
MITENI SPA	0,94	-0,06	5,39	-5,20	-1,36	0,06	F
R.I. S.P.A.	0,56	-0,09	3,58	-3,68	-2,49	-0,03	F
WEGAPLAST - SOCIETA' PER AZIONI	1,16	-0,06	6,34	-4,96	-2,00	0,35	A
ACCORRONI S.R.L.	1,01	-0,07	4,93	-2,83	-2,34	0,48	F
BORBONESE S.P.A.	1,68	-0,21	6,07	-5,10	-1,09	1,09	A
CORRADI S.P.A.	0,97	-0,18	6,49	-4,33	-2,35	0,44	F
COSMETICA INTEGRATA S.R.L.	1,50	-0,08	6,02	-2,72	-1,83	0,75	F
ITALBOTTI - S.P.A.	1,32	-0,10	5,28	-3,21	-2,01	0,77	F
RADIM S.P.A.	1,51	-0,12	9,18	-8,10	-1,75	0,71	F
SICILMONTAGGI S.P.A.	1,07	-0,05	4,24	-2,86	-2,05	0,61	F
TK HOLDING S.R.L.	1,58	-0,14	7,06	-3,02	-2,01	0,91	F
BASLINI SPA	1,62	-1,40	7,48	-6,41	-1,82	1,11	A
CALZATURIFICIO MARCO BOTTI S.P.A.	1,17	-0,74	5,23	-2,54	-1,97	0,61	F
CAMASTRA PETROLI LOCRI S.P.A	1,68	-0,13	6,80	-1,79	-1,82	0,78	F
CANTINE BRUSA - SOCIETA' PER AZIONI	0,26	-0,02	1,99	-2,57	-2,20	-0,44	A
CELOTTO S.P.A. INDUSTRIA MOBILI	2,00	-0,06	7,82	-1,66	-1,81	0,90	F

COMPAGNIA ITALIANA INTIMO S.P.A.	1,13	-0,07	4,84	-4,14	-1,29	0,55	F
EMME E PI - S.R.L.	1,28	-3,40	5,37	-3,09	-1,99	0,73	F
ILMAS S.P.A.	0,71	-0,06	3,56	-5,06	-2,16	0,38	F
LATTE ITALIANO S.R.L.	0,78	-0,06	2,61	-2,33	-2,39	0,58	F
LAVORAZIONI INOX S.P.A.	0,38	0,09	-2,56	-1,10	-2,55	-0,61	A
MANGIMIFICIO SETTECOLLI SOCIETA' COOPERATIVA	2,29	-1,26	9,33	-3,82	-0,91	1,19	A
MANIFATTURA GOMMA FINNORD S.P.A.	0,91	-0,09	6,32	-3,99	-2,33	0,39	A
MONDIAL GROUP S.R.L.	1,09	-0,06	4,42	-5,00	-1,17	0,45	F
PAPALINI S.R.L.	1,03	-0,04	4,12	-2,38	-2,11	0,39	F
S.M. LEGNO S.P.A. IN LIQUIDAZIONE	1,66	-0,12	6,85	-2,50	-1,92	0,99	F
TECAR S.P.A.	0,94	-0,05	5,00	-3,12	-2,09	0,39	F
ARNETTA S.R.L.	0,72	-0,08	5,04	-3,34	-2,35	0,11	F
CANADOS INTERNATIONAL S.R.L.	0,21	-0,10	-0,04	-5,94	-3,07	-0,02	F
ELMARC S.P.A.	2,28	-0,54	8,45	-2,94	-1,36	1,44	F
FONDERIE ANSELMI S.R.L.	0,90	-0,05	5,16	-3,53	-2,45	0,15	F
FRANZ ISELLA S.P.A.	1,67	-0,06	10,10	-4,43	-1,96	0,69	F
FRIUL CASSETTI S.P.A.	1,28	-0,09	5,12	-2,59	-2,13	0,65	F
INDUSTRIE ALIMENTARI DI SIRONE S.P.A.	1,14	-0,05	4,78	-2,53	-2,04	0,45	F
INTEK 2000 S.P.A.	1,31	-0,06	5,45	-2,67	-1,78	0,61	F
KERNEL S.R.L.	1,68	-0,05	6,50	-2,82	-1,59	0,71	F
LEGNOFLEX - S.P.A.	1,70	-0,06	6,70	-3,29	-1,79	0,70	F
MABRUN S.P.A.	1,09	-0,08	4,95	-3,01	-1,96	0,53	F
PASTIFICIO BOLOGNESE SRL	1,25	-0,05	5,43	-2,01	-2,17	0,51	F
SIMOD S.R.L.	0,39	-0,07	4,87	-6,30	-2,53	-0,06	F
VEZZOLA METALLI S.P.A.	2,53	-0,28	12,25	-3,60	-1,69	1,28	A
VOLTA INDUSTRIES - S.R.L.	1,31	-0,06	6,47	-2,79	-1,97	0,49	F

BRANDONI - S.R.L.	0,99	-0,07	6,15	-3,45	-2,44	0,39	F
CONCERIA TRE EMME S.R.L.	0,67	-0,07	5,00	-3,12	-2,46	0,05	A
FRIULCO S.P.A.	0,56	-0,07	2,81	-3,07	-2,11	0,17	F
GEOPLAST S.P.A.	2,13	-0,29	9,45	-5,24	-1,35	1,63	A
INTIMFASHION S.P.A.	0,95	-0,08	3,10	-4,53	-1,53	0,55	F
LANIFICIO DI LESSONA - S.P.A.	0,85	-0,07	6,29	-5,05	-2,47	0,24	F
OTTOGALLI S.P.A.	1,18	-0,11	4,36	-2,46	-2,11	0,58	F
SOFIMEL S.R.L.	2,33	-0,10	9,50	-2,55	-1,48	1,27	F
UNI LAND S.P.A.	0,77	-0,06	3,08	-8,39	-0,38	0,24	F
3 SYSTEM SRL	2,30	-0,03	9,73	-2,06	-1,69	1,02	F
ATRA S.R.L.	1,67	-0,05	7,25	-1,74	-2,06	0,68	F
BRACESCO - S.R.L.	1,79	-0,06	7,48	-2,40	-1,78	0,74	F
CAFFE' MAURO S.P.A.	0,86	-0,05	4,22	-2,85	-2,10	0,39	A
FINOLI AGROALIMENTARE - S.P.A..	0,96	-0,04	4,45	-2,10	-2,13	0,30	F
ILUNA GROUP S.P.A..	0,25	-0,05	1,09	-3,58	-2,25	-0,16	A
INDUSTRIA PELLAMI VALDARNO INTERNATIONAL S.P.A.	1,01	-0,09	3,15	-2,49	-1,87	0,58	A
ITP BENELLI S.p.A	0,68	-0,10	2,94	-3,16	-2,14	0,46	F
MANIFATTURA DI STABBIA S.A.S.	1,16	-0,06	6,18	-4,88	-2,12	0,43	F
MB TRICOT S.R.L.	0,43	-0,02	2,05	-3,86	-2,46	-0,13	F
PONTELAMBRO INDUSTRIA S.P.A.	1,43	-0,07	5,40	-4,14	-1,65	0,63	F
S.I.C.E.M. SOC.COOP.A R.L.	1,10	-0,03	4,17	-2,93	-2,44	0,87	A
S.M.OVI.CA S.R.L.	2,85	-0,14	12,39	-2,60	-1,64	1,30	F
SIEL ELETTRONICA SRL	-0,20	-0,05	1,17	-5,12	-3,33	-0,51	F
SUGHERIFICIO GANAU S.P.A.					-3,04	-0,16	A
TACCONI S.P.A.	1,23	-0,09	5,28	-3,94	-2,14	0,64	F
UZZAUTO & IAZZETTA S.R.L.	2,00	-0,29	8,29	-3,39	-1,99	0,96	F
YACHTS CANTIERI S.R.L.	1,11	-0,11	5,20	-2,61	-2,27	0,47	F
BELTRAMINI S.P.A.	0,91	-0,07	4,32	-2,74	-2,03	0,28	F

CARTIERE CARIOLARO SRL	0,23	-0,07	1,76	-3,79	-2,43	-0,14	F
CESANA S.P.A.	0,55	-0,07	4,41	-3,90	-2,65	0,06	F
CESINOX S.R.L.	0,06	-0,03	3,93	-1,49	-3,24	-0,68	F
EUDOSIA SPA	1,20	-0,18	4,14	-5,47	-0,82	0,64	F
FABBRICHE RIUNITE METALLI IN FOGLIE E IN POLVERE S.P.A.	1,09	-0,09	5,20	-4,10	-2,45	0,51	F
LANERIE LUIGI BOGGIO CASERO - S.R.L.	1,77	-0,05	8,82	-4,83	-1,91	0,81	F
PLLB ELETTRONICA S.P.A.	-0,34	-0,07	3,39	-4,14	-3,50	-0,79	F
S.E. GROUP S.R.L.	0,40	-0,07	1,85	-2,13	-2,47	-0,02	F
S.I.P.A.L. S.R.L.	1,59	-0,48	5,68	-2,68	-1,56	0,91	F
STELLA 81 S.P.A.	-0,37	-0,05	1,11	-1,92	-3,02	-1,05	F
VILLA DEL SOLE S.R.L.	-0,37	-0,06	-0,72	-3,42	-2,99	-0,67	F
ASOLO S.R.L.	2,45	-0,15	12,05	-7,63	-1,42	0,92	A
CALZATURIFICIO RUGGERI S.P.A.	0,37	-0,06	2,92	-3,12	-2,81	-0,43	F
CESARE BONETTI SPA	-0,63	0,02	-0,58	-3,78	-3,55	-1,13	F
CIRCEO FILATI S.R.L.	1,48	-0,12	6,14	-3,93	-1,95	0,79	F
CONSORZIO COOPERATIVE GIOVANNI QUERZOLI	0,18	-0,11	1,42	-5,23	-2,98	0,13	F
FONDERGHISA - SOCIETA' PER AZIONI	0,51	-0,06	6,01	-5,90	-2,62	-0,08	F
INWOOL S.A.S.	1,32	-0,86	4,83	-2,80	-1,54	0,74	F
MANIFATTURA O. ARCOLIN S.P.A.	1,17	-0,09	4,16	-5,31	-1,40	0,68	F
MCR SPA	1,35	-0,07	5,84	-2,79	-1,96	0,59	F
PILOTELLI MACCHINE TESSILI SRL	0,64	-0,03	2,88	-3,12	-2,20	-0,03	F
S.A.M.M.O. S.P.A.	1,18	-0,08	5,77	-2,76	-2,21	0,70	F
STIMET PREFABBRICATI S.P.A.	-0,42	-0,01	-1,03	-3,35	-2,68	-0,77	F
TECNOS - SOCIETA' COOPERATIVA	1,08	-0,06	4,57	-2,21	-1,97	0,51	A
TGS S.P.A.	0,23	-0,02	2,01	-1,32	-2,71	-0,36	F

BERTOLINI WALTER S.R.L.	0,88	-0,07	4,42	-3,26	-2,43	0,23	F
CENTERPLAST srl	0,63	-0,07	4,19	-3,36	-2,53	0,19	F
INDUSTRIA ALIMENTARE MEDITERRANEA SRL	-0,89	-0,04	-8,05	0,00	-1,42	-0,60	F
ACC COMPRESSORS S.P.A.	0,78	-0,02	3,08	-5,16	-2,44	-0,15	F
AION RENEWABLES S.P.A.	0,40	-0,03	0,88	-6,12	-2,68	-0,04	F
ANTONIO MERLONI - S.P.A.	1,03	-0,06	4,13	-5,02	-1,93	0,36	F
B.E.I. S.R.L. - BUSINESS ENTERPRISE ILTE	1,38	-0,05	7,07	-4,51	-1,82	0,56	F
COOPCOSTRUTTORI	0,52	-0,16	2,68	-4,33	-2,66	0,34	F
FERRANIA S.P.A.	1,54	-0,08	6,77	-5,94	-2,04	0,82	F
FERRETTI S.P.A.	0,75	-0,03	2,84	-4,52	-1,75	0,38	F
FERROLI S.P.A.	1,04	-0,07	3,88	-5,91	-2,64	0,56	F
FINMEK S.P.A.	1,11	-0,15	4,26	-4,17	-2,05	0,68	F
FONDERIE MARIO MAZZUCCONI S.P.A.	1,30	-0,12	7,95	-4,14	-2,19	0,35	F
FORM S.P.A.	0,48	-0,03	3,36	-3,67	-2,29	-0,24	F
GRANDI MOLINI ITALIANI - S.P.A.	1,37	-0,08	5,74	-4,11	-1,11	0,61	A
INDUSTRIA MACELLAZIONE GHINZELLI MARINO - S.P.A.	2,44	-0,06	9,01	-4,21	-2,01	0,86	F
ITALCARNI SOCIETA' COOPERATIVA AGRICOLA	1,83	-0,06	10,03	-4,80	-2,04	0,48	F
ITALTEL S.P.A.	1,09	-0,07	4,50	-5,38	-2,25	0,51	F
ITTIERRE - SOCIETA' PER AZIONI	1,56	-0,27	7,80	-4,95	-1,52	0,76	A
MAFLOW S.P.A.	1,16	-0,06	6,70	-4,92	-2,17	0,50	F
MARIELLA BURANI FASHION GROUP	0,46	-0,05	3,16	-3,81	-2,71	0,01	F
MEDEGHINI S.P.A.	-1,99	-0,01	-5,13	-0,62	-3,96	-2,61	F
MYTHEN S.P.A.	1,76	-0,05	7,40	-3,98	-1,63	0,59	F
NEWLAT SPA	1,73	-0,06	8,84	-5,42	-1,29	0,79	F
NYLSTAR S.R.L.	0,63	-0,16	2,90	-4,35	-1,77	-0,14	F
OLD FAVINI S.R.L.	0,96	-0,06	4,67	-3,22	-2,37	0,35	F
OLDCOM S.R.L.	1,23	-0,04	4,50	-2,32	-1,74	0,46	F

OMBA IMPIANTI & ENGINEERING S.P.A	2,42	-0,19	10,13	-6,41	-1,21	1,77	F
OP COMPUTERS S.P.A.	-0,97	0,01	1,21	-4,54	-4,31	-1,93	F
OTEFAL S.P.A.	0,99	-0,06	4,40	-3,21	-2,26	0,34	F
PARMALAT S.P.A.	1,19	-0,13	6,36	-6,46	-2,05	0,84	A
PARTECIPAZIONI INDUSTRIALI S.P.A.	1,47	-0,07	9,91	-8,79	-2,32	0,61	F
PASTA ZARA S.P.A.	0,03	-0,06	1,61	-3,31	-2,29	-0,57	F
PRIMA SOLE COMPONENTS S.P.A.	1,56	-0,13	7,51	-4,86	-2,10	0,94	A
S.T.F. SALVATORE TRIFONE E FIGLI S.P.A.	0,36	-0,07	1,40	-5,73	-2,67	0,36	F
SEVES SOCIETA' PER AZIONI	6,71	-0,04	16,38	-4,48	2,23	2,74	F
SITINDUSTRIE TUBES & PIPES S.R.L.	1,29	-0,06	6,50	-4,66	-2,04	0,59	F
SIXTY S.P.A.	0,06	-0,04	2,51	-4,38	-3,17	-0,36	A
SOCIETA' ITALIANA CUPRO S.P.A.	0,67	-0,04	4,83	-3,46	-2,51	-0,11	F
S.I.S.A.S. - PER AZIONI	1,01	-0,06	5,49	-4,03	-1,83	0,37	F
STG GROUP S.P.A.	1,02	-0,04	5,19	-2,48	-2,29	0,11	F
VINYLS ITALIA S.P.A.	0,01	-0,02	3,86	-2,92	-2,46	-1,09	F
ADRIATICA S.P.A.	0,81	-0,05	4,69	-5,33	-1,86	0,23	A
ALBISETTI S.P.A.	1,04	-0,33	7,23	-4,83	-2,61	0,41	F
ARTENIUS ITALIA SPA	2,02	-0,04	10,02	-3,76	-1,57	0,32	F
AVICOLA MARCHIGIANA - SOCIETA' COOPERATIVA	0,43	-0,03	3,68	-2,18	-2,96	-0,34	F
BERTANA S.P.A.	2,58	-0,08	9,87	-4,72	-1,23	1,11	F
BIALETTI INDUSTRIE S.P.A.	-0,66	-0,01	-2,19	-2,72	-3,78	-1,18	A
CABLELETTRA S.P.A.	0,77	-0,22	4,67	-4,05	-2,43	0,46	F
CHATEAU D'AX S.P.A.	-2,46	-0,01	-2,10	-0,57	-5,45	-3,08	A
CP INTERNATIONAL S.P.A.	1,66	-0,06	6,82	-3,02	-1,90	0,73	A
E-MOTION S.R.L. IN LIQUIDAZIONE	3,33	-0,08	13,71	-2,54	-1,39	1,32	F
EMERISQUE ITALIA GROUP S.P.A.	1,69	-0,30	7,44	-5,57	-1,99	1,10	F

ENIFTECH S.P.A.	1,79	-0,18	7,28	-2,79	-2,03	0,74	F
FINMEK ACCESS S.P.A.	1,78	-0,04	6,01	-4,80	-1,20	1,09	F
FONDERIE S.P.A	1,02	-0,09	5,43	-3,30	-2,51	0,18	F
FRANGI S.R.L.	1,89	-0,09	9,44	-3,51	-1,95	0,68	F
GROTTO S.P.A.	2,02	-0,10	10,13	-5,60	-1,73	1,27	A
IAR - SILTAL S.P.A.	-0,47	-0,06	-1,50	-4,21	-3,88	-0,93	F
INTERSIDER ACCIAI S.P.A.	-0,08	-0,02	-1,19	-4,14	-2,85	-0,61	F
IRPLAST - S.P.A.	0,38	-0,05	2,39	-2,80	-2,54	-0,09	F
ITALIANA COKE S.R.L.	1,51	-0,10	7,10	-3,85	-1,74	0,72	A
LAMIER S.P.A.	1,41	-0,08	6,12	-4,30	-2,13	0,63	F
LEDIBERG S.P.A.	0,99	-0,11	5,08	-6,11	-2,47	0,62	F
METALCAM S.P.A.	1,27	-0,10	-2,81	-3,79	-0,62	1,00	A
PIAGGIO AERO INDUSTRIES SPA	-1,30	-0,04	-4,18	-4,24	-3,74	-1,48	F
PLUS IT - SOCIETA' PER AZIONI	2,29	-3,48	10,35	-5,04	-1,19	1,46	F
ROBERTO CAVALLI S.P.A.	0,37	-0,04	6,94	-7,32	-3,06	-0,36	A
SANAC S.P.A.	2,53	-0,12	12,48	-6,04	-1,58	1,58	F
SELECO S.P.A.	0,35	0,01	2,13	-4,92	-3,61	-0,33	F
SILPA SRL	2,58	-0,03	10,48		-1,72	1,06	F
SOILMEC SPA	0,64	-0,03	1,30	-3,85	-1,95	0,20	A
STEFANEL SPA	0,71	-0,14	4,02	-5,24	-1,04	0,46	A
TARGETTI SANKEY S.P.A.	1,58	-0,08	8,40	-4,89	-1,83	0,87	A
TECNOSISTEMI S.P.A. TLC ENGINEERING & SERVICES	0,53	-0,05	1,92	-3,18	-2,18	0,27	F
TEKFOR S.P.A.	0,64	-0,01	2,75	-4,30	-2,14	-0,17	F
VELA PREFABBRICATI SRL	0,63	-0,05	6,68	-5,02	-2,62	-0,02	F
ZEN SRL	0,16	-0,01	-4,62	0,94	-2,84	-0,17	F
AAT SOCIETA' PER AZIONI	-0,63	0,09	-1,79	-2,92	-3,63	-1,02	F
AETHRA S.R.L.	1,21	-0,08	5,84	-5,17	-2,24	0,60	F
ALBIS S.P.A.	0,48	-0,05	2,69	-3,54	-2,49	-0,02	F
ALUMINIUM PIEVE S.R.L.	1,61	-0,07	8,85	-4,44	-2,45	0,47	F
ANGELUCCI HOLDING S.R.L.	1,11	-0,09	6,88	-4,37	-2,24	0,58	F

ANTICHI PELLETTIERI S.P.A.	0,47	-0,03	-0,56	-4,89	-2,12	-0,10	F
BLUTEC S.P.A.	0,60	-0,05	4,20	-4,67	-1,83	0,18	F
C.V.S.-S.P.A.	1,04	-0,04	4,60	-4,49	-2,07	0,28	F
CAFFARO CHIMICA S.R.L.	-1,11	0,01	-2,39	-2,79	-3,57	-1,80	F
CANTIERI NAVALI RIZZARDI S.R.L.	0,48	-0,04	3,56	-3,29	-2,60	0,01	F
CARTIFICIO ERMOLLI S.P.A.	0,07	-0,04	2,28	-2,67	-3,11	-0,58	F
CDC POINT SPA	-2,28	0,08	-6,78	2,77	-7,41	-2,75	F
GALLAZZI S.P.A.	0,73	-0,04	3,89	-4,46	-2,63	0,15	F
IANUA S.P.A.	1,14	-0,05	4,63	-2,13	-2,19	0,45	F
INDUSTRIES SPORTSWEAR COMPANY S.R.L.	1,79	-0,29	8,04	-5,28	-2,04	1,04	F
LA PERLA S.R.L.	-0,91	-0,01	-7,55	-2,87	-1,49	-1,15	F
MANDELLI INDUSTRIALE - S.P.A.	13,00	-23,44	5,41	-3,36	-2,54	0,45	F
MANIFATTURA DI LEGNANO SRL	0,63	-0,06	4,16	-3,65	-2,67	0,13	F
MANZONI GROUP S.P.A.	0,78	-0,05	3,99	-3,36	-2,31	0,24	F
MONDO S.P.A.	1,19	-0,07	6,70	-4,28	-2,14	0,62	A
MX GROUP S.P.A.	1,35	-0,08	5,87	-3,56	-1,96	0,65	F
NUOVI FILATI CELL. S.P.A.	0,70	-0,02	2,93	-2,76	-1,82	-0,06	F
OFFICINA METALMECCANICA ANGELUCCI S.P.A.	1,04	-0,11	6,33	-4,19	-2,15	0,53	F
PRINCIPE DI SAN DANIELE S.P.A.	1,61	-0,14	6,88	-3,41	-1,91	0,84	F
RAFFINERIA METALLI CAPRA - S.P.A.	1,25	-0,05	6,84	-3,70	-1,80	0,31	F
REALFOOD S.R.L.	0,71	-0,03	3,66	-2,44	-2,99	-0,42	F
RUMMO S.P.A.	0,74	-0,06	1,52	-4,15	-1,24	0,20	A
SAFWOOD S.P.A.	0,94	-0,06	6,24	-5,06	-1,92	0,30	F
SAN DIEGO S.R.L.	1,28	-1,94	5,26	-4,07	-1,10	0,66	F
SERINODATA S.P.A.	1,51	-0,08	6,47	-3,01	-1,86	0,57	F
SILMAR - S.R.L.	1,83	-0,08	7,64	-3,42	-1,15	0,66	F
SNAIDERO RINO S.P.A.	1,47	-0,07	5,21	-5,64	-1,84	0,65	A
TECNOGAS S.P.A.	1,06	-0,03	3,83	-3,71	-1,88	0,36	F
TOORA S.P.A.	0,51	-0,09	4,73	-5,37	-2,34	0,08	F

TREVISAN COMETAL S.P.A.	-120,28	-10,91	4,24	-3,65	-2,33	-0,48	F
UTIL INDUSTRIES S.P.A.	0,42	-0,01	2,97	-3,71	-3,04	-0,34	A
AEROSOL SERVICE ITALIANA S.R.L.	-1,03	-0,03	-2,11	-2,66	-3,48	-1,53	F
AKKABI S.R.L.	-0,29	0,43	1,77	-2,56	-3,90	-1,01	F
ALESSIA LEATHERS S.R.L.	0,34	3,00	2,53		-3,49	-0,77	F
ATS SPA	2,02	-0,05	7,87	-2,71	-1,39	1,08	F
AZUGROUP S.R.L.	1,88	-0,08	8,25	-1,74	-2,02	0,87	F
B.T.G. ITALIA S.R.L.	0,11	-0,04	2,91	-2,14	-2,18	-0,57	F
BASITALY S.R.L.	0,34	-0,06	2,41	-2,77	-2,48	-0,14	F
BORG S.R.L.	-0,60	-0,03	-4,19	-2,15	-2,57	-1,03	F
BRADBURY GROUP ITALY S.R.L.	-0,84	0,13	-5,63	-0,76	-3,82	-1,44	F
C.R. S.R.L.	4,55	-0,16	20,32	-5,65	-0,66	2,97	F
CALZATURIFICIO EIFFEL S.R.L.	-1,38	0,07	-3,76	0,71	-4,81	-1,86	F
CALZATURIFICIO MILLY S.R.L.	1,84	-0,12	7,84	-2,36	-1,98	0,90	F
CALZIFICIO FRANZONI - S.R.L.	1,31	-0,06	5,17	-5,11	-0,71	1,99	F
CO.RI.MA. SRL	1,20	-0,08	5,48	-2,18	-2,23	0,56	F
CONTI3 S.R.L.	-0,20	-0,02	1,64	-2,33	-3,64	-0,88	F
DUECENTOTRENTA-A-ERRE S.R.L.	0,57	0,04	3,46	-4,30	-2,93	-0,14	F
DUPOL S.R.L.	0,25	-0,02	1,52	-3,40	-1,59	-0,43	F
ETISERVICE POMEZIA SRL	1,23	-0,03	5,00	-2,16	-2,29	0,76	F
FANTINI S.R.L.	0,80	-0,18	1,61	-6,30	-2,62	0,48	F
FARO SOCIETA' COOPERATIVA AGRICOLA PER AZIONI	0,37	-0,07	-1,38	-2,86	-2,64	-0,34	F
FILOSOPHY S.R.L.	1,29	-0,22	4,69	-2,07	-1,99	0,66	F
FIO S.R.L.	1,70	-0,03	7,78	-1,59	-2,07	0,76	F
FORNITURE ELETTROFUSIONI MILANESI S.R.L.	4,56	-0,10	17,84	-7,38	-1,45	2,72	F
G.M.G. GENERAL MONTAGGI GENOVESI S.R.L.	1,17	-0,16	8,99	-5,01	-2,48	0,54	F
G.N.G. SOCIETA' A RESPONSABILITA' LIMITATA	1,77	-0,04	7,41	-2,32	-1,56	0,91	F
GLAM S.R.L.	0,10	-0,04	2,19	-3,28	-3,03	-0,46	F

GRANT S.P.A.	-0,18	-0,06	2,68	-3,89	-2,66	-0,62	F
LAMAPLAST 2000 S.R.L.	0,51	-0,01	3,28	-4,48	-2,85	-0,14	F
M.I.A. INTERNATIONAL S.R.L.	6,24	-1,23	24,38	-5,64	0,67	4,14	F
MARTINELLI ETTORE S.R.L.	-3,52	0,26	-8,25	3,46	-7,84	-3,80	F
MAXILINE ITALIA S.R.L.	1,06	-0,67	5,43	-2,04	-2,53	0,41	F
MINUTI ARREDAMENTI S.R.L.	1,69	-0,35	6,95	-2,55	-1,93	0,95	F
MON & TEX S.P.A.	-1,63	-0,01	-2,30	-2,30	-4,26	-2,10	F
NOAL S.R.L.	2,13	-1,05	8,57	-1,74	-1,86	1,12	F
NUOVA ZAMA S.R.L.	0,91	-0,06	5,18	-2,17	-2,34	0,28	F
OPERA S.R.L.	0,92	-0,05	4,43	-1,37	-2,36	0,37	F
P.L. SOLUTIONS SRL	2,94	-0,12	12,07	-2,58	-1,18	1,54	F
PARMA ANTONIO E FIGLI S.P.A.	1,02	-0,84	4,24	-3,52	-2,28	0,60	F
S.E.P. CONSTRUCTION S.R.L.	-2,05	0,80	-6,42	1,85	-5,35	-2,42	F
S.I.C.C. S.R.L.	0,02	0,06	-11,07	1,76	-2,03	-0,48	F
SIMTEL S.P.A.	0,93	-0,29	3,74	-3,10	-2,27	0,71	F
T.E.S.T.A. TESSITURA E STAMPA TESSUTI E ABBIGLIAMENTO S.P.A.	0,43	-0,23	4,24	-4,46	-1,90	-0,27	A
T-PROGETTO S.R.L.	1,95	-0,11	7,91	-2,52	-1,53	1,05	F
TEXTEAM - S.R.L.	1,77	-0,15	7,24	-2,18	-1,93	0,86	F
TONON FORTY S.P.A.	0,92	-0,06	4,07	-4,11	-1,14	0,11	F
VIVA S.R.L.	-1,78	-0,03	-4,11	-0,46	-4,57	-2,12	F
VR S.R.L.	1,34	-0,08	5,18	-2,07	-1,90	0,68	F
A.D.EN. S.R.L.	2,90	-0,14	12,86	-3,80	-1,18	1,76	F
AVANTGARD S.R.L.	0,33	-0,01	1,78	-2,46	-3,37	-0,46	F
BICOLD ENGINEERING S.R.L.	1,44	-0,75	8,05	-3,41	-2,33	0,89	F
C.L.C. SRL	0,38	-0,03	3,70	-3,48	-2,80	-0,11	F
C.S.I. S.R.L	0,93	-0,09	4,58	-2,96	-2,57	0,59	F
CACCIA ENGINEERING S.R.L.	1,13	-0,07	6,12	-2,59	-2,31	0,50	F
CALZIFICIO MURA S.P.A.	0,10	-0,14	2,83	-4,38	-3,02	-0,19	F

CERAMICHE MAC 3 S.R.L.	-4,07	0,09	-14,28	6,19	-6,79	-4,16	F
CIESSE S.R.L.	0,72	-0,07	3,99	-2,75	-2,65	0,23	F
COOPERATIVA AGRICOLA VALVERDE	0,75	-0,05	3,66	-1,42	-2,90	-0,39	F
CORTEPACK S.P.A.	0,47	-0,06	4,28	-4,59	-2,56	0,03	F
COSTRUZIONI ELETTRICHE VENETE S.R.L.	-2,60	0,17	-4,98	3,06	-6,60	-3,21	F
EMA srl	1,10	-0,04	4,73	-1,07	-2,20	0,36	F
FERRERO RUBINETTERIE S.R.L.	2,87	-0,03	2,94	-3,64	0,87	3,05	F
FORNACI IONICHE - S.R.L.	-1,13	0,01	-16,48	4,03	-2,97	-1,58	F
FRIUL ENERGIE S.R.L.	0,89	-0,05	3,65	-1,40	-2,23	0,26	F
GLAMOUR ITALIA S.R.L.	-0,17	0,01	1,74	-1,14	-3,71	-0,99	F
HEINTZMANN ITALIA S.P.A.	1,00	-0,53	3,72	-2,76	-1,81	0,63	F
INDUSTRIE MECCANICHE SCARDELLATO S.R.L.	1,20	-0,02	4,97	-1,03	-2,17	0,52	F
ICONE' SRL	0,88	-0,03	7,00	-2,07	-3,10	-0,05	F
INTERCOSMETICS S.R.L.	1,02	-0,03	4,55	-3,27	-2,38	0,50	F
INTERNATIONAL COLOR S.P.A.	0,90	-0,02	3,74	-3,65	-1,87	0,40	F
LA NUOVA SIPOM S.R.L.	1,10	-0,11	4,84	-2,40	-2,31	0,62	F
LA ROSA S.P.A.	0,48	-0,05	1,52	-2,76	-2,06	0,12	F
LILLY CONFEZIONI SRL	1,81	-0,05	7,56	-1,74	-1,86	0,89	F
MAIFRINI INDUSTRIA CARNI S.R.L.	1,37	-0,05	5,93	-1,25	-2,27	0,46	F
MAIOR CUCINE S.P.A.	0,89	-0,07	5,78	-3,35	-2,17	0,30	F
MONDIAL TEMPRA S.R.L.	0,98	-0,03	6,87	-3,92	-2,30	0,45	F
NEBROLAT S.R.L.	2,19	-0,23	11,09	-4,87	-1,69	1,52	F
NEGRI ALIMENTI S.P.A.	1,22	-0,03	6,02	-1,29	-1,99	0,35	F
NEWTON SERIGRAFICA S.R.L.	0,37	-0,03	2,06	-3,19	-2,50	0,12	F

NO.NO. S.R.L.	0,84	-0,06	3,33	-2,71	-2,03	0,37	F
NUOVA BSC SRL	2,66	-0,15	13,82	-5,03	-1,63	1,44	A
PR S.R.L. IN LIQUIDAZIONE	1,25	-0,03	5,13	-0,99	-2,21	0,51	F
RM FIRENZE S.R.L.	0,90	-0,05	5,39	-1,14	-2,74	0,06	F
SALUMIFICIO SANVITO S.R.L.	1,90	-0,27	8,01	-2,17	-2,03	1,09	A
SAPA S.R.L.	1,37	-0,04	5,60	-2,12	-2,03	0,73	F
SEA SRL	1,83	-0,05	7,40	-0,76	-1,99	0,81	F
AGRITAL - S.R.L.	4,93	-0,08	21,05	-3,18	-0,10	2,45	F
ALTA ALTENE SRL	0,18	-0,04	1,29	-4,83	-2,47	-0,32	F
ANTICHE TIPOGRAFIE S.R.L.	0,93	-0,05	4,32	-1,22	-2,29	0,37	F
AQUEO DESIGN S.R.L.	0,61	-0,05	3,01	-1,91	-2,53	0,23	F
ARSOM S.R.L.	0,83	-0,03	3,44	-1,69	-2,33	0,35	F
BEATRIX S.R.L.	0,96	-0,07	3,84	-1,86	-2,01	0,51	A
BORSCI S.MARZANO 1840 S.R.L	1,39	-0,06	10,74	-6,45	-2,41	0,29	F
BREM MECCANICA S.R.L.	4,83	-0,65	20,79	-6,80	-0,88	2,86	F
CALZ. SANTINO QUAGLIA S.R.L.	0,97	-0,05	3,71	-2,54	-2,34	0,41	F
CAMPOLO S.R.L.	-1,69	0,04	-5,49	-0,73	-4,52	-1,91	F
CASEIFICIO AGRILAT SOCIETA' COOPERATIVA	2,52	-0,03	8,40	-2,43	-1,31	1,33	F
COSMONOVA S.R.L.	1,11	-0,01	3,93	-2,11	-2,41	0,85	F
F.K.F. S.R.L.	1,67	-0,04	7,86	-1,59	-2,11	0,75	F
F.M.I. S.P.A.	-8,14	0,30	-26,32	13,56	-11,22	-8,01	F
FABER OFFICINE MECCANICHE SRL	-0,09	-0,02	-3,33	-1,75	-3,09	-0,60	F
FEA S.R.L.	0,88	-0,06	5,16	-3,31	-2,44	0,54	F
FONTANA DI PAPA SRL	-0,42	0,00	-1,44	-3,27	-3,24	-0,86	F
FRATELLI BRANDELLERO S.R.L.	1,06	-0,03	4,49	-1,88	-2,33	0,51	F
GORY CUCINE S.R.L.	1,21	-0,52	4,66	-3,12	-1,82	0,83	F
MODA FASHION S.R.L.	0,20	0,26	0,82	-3,57	-2,79	-0,04	F
NEBIOLO S.R.L.	0,82	-0,07	5,93	-3,03	-2,44	0,32	F
NIBA ILLUMINAZIONE S.R.L.	1,02	-0,02	4,28	-1,86	-2,30	0,57	F

NUOVA EDART S.R.L.	-1,16	0,61	-7,31	0,04	-4,02	-1,46	F
NUOVA MARELLI SRL	-0,04	-0,02	0,71	-2,17	-2,59	-0,51	F
PAVIMENTI MODULARI SPA	0,70	-0,07	4,86	-4,04	-2,34	0,06	F
PRONTOGEL ALIMENTI S.R.L.	0,35	-0,01	3,43	-1,08	-2,85	-0,31	F
R.& D. PLASTIC S.R.L.	1,69	-0,05	8,36	-3,43	-2,02	1,03	F
REV-AVIATION S.R.L.	-0,61	-0,04	-1,11	-0,93	-2,84	-0,93	F
SAEM S.R.L.	0,93	-0,07	4,85	-3,12	-2,11	0,65	F
SAG S.R.L.	-2,02	0,11	-14,24	4,65	-4,46	-2,60	F
SINTEA PLUSTEK S.R.L.	-1,30	1,83	-13,72	2,59	-4,93	-1,58	F
STEELYACHT SRL	1,11	-0,01	4,83	-3,53	-2,32	0,32	F
SYLCOM S.R.L.	1,67	-0,12	8,39	-3,31	-2,31	0,98	F
TECNOSERVICE S.R.L.	0,91	-0,04	4,22	-1,75	-2,23	0,28	F
TEMCO S.R.L.	-0,33	-0,05	3,77	-1,39	-3,64	-0,91	F
UGOLOTTI S.R.L.	1,37	-0,03	5,81	-1,03	-1,92	0,40	F
ABBIGLIAMENTO G. & G. S.R.L.	1,12	-0,05	5,00	-1,49	-2,03	0,44	F
ALBOR - S.P.A.	0,15	-0,06	5,35	-4,65	-2,90	-0,47	F
ARTEMIDE S.R.L.	1,01	-0,08	4,17	-1,35	-2,21	0,38	F
ATS SRL	1,69	-0,08	7,77	-2,49	-1,86	0,92	A
AZ STEEL S.R.L.	-7,66	0,15	-24,47	17,48	-11,51	-8,47	F
AZIENDA CHIMICA EMILIANA S.R.L.	0,97	0,14	4,05	-4,26	-2,59	0,33	F
B & D S.R.L.	-0,98	0,55	-2,03	0,82	-4,47	-1,66	F
BOMPANI S.R.L.	-2,21	0,41	-6,07	2,59	-5,65	-2,62	F
BRILLANTE MAGLIERIE S.R.L.	1,03	-0,19	4,72	-1,22	-2,28	0,47	F
CALZATURIFICIO LOREX S.R.L.	-2,68	0,02	-8,29	5,02	-6,22	-3,37	F
CANTINE DRAGANI S.R.L.	-0,60	0,00	-0,95	-2,25	-3,54	-1,11	F
CARTOTECNICA MAESTRELLI S.R.L.	-2,14	-0,01	-2,17	-1,08	-5,11	-2,56	F
CASATEX S.R.L.	-1,19	4,04	-6,94	-0,43	-4,13	-1,32	F
MANIFATTURA DI SETTALA S.R.L.	-3,95	0,26	-13,51	4,15	-5,91	-4,02	F
D.M. AUSILI S.R.L.	1,06	-0,03	4,17	-1,54	-2,24	0,53	F
E.A.A. S.R.L	-0,89	0,03	-1,09	-2,42	-4,21	-1,28	F
EDILTUBI S.R.L.	-1,72	0,06	-26,76	9,90	-2,87	-2,45	F

ERICA LEEMAN S.R.L.	0,98	-0,02	4,05	-1,18	-2,34	0,36	F
ERREZETA S.R.L.	-6,03	0,66	-18,29	8,18	-9,11	-5,86	F
F.T. COSTRUZIONI S.R.L.	-1,44	0,06	-3,32	0,32	-4,59	-1,90	F
FALCONE COSTRUZIONI IN ACCIAIO S.R.L.	-4,83	0,28	-13,61	9,93	-8,79	-5,60	F
FILLING SYSTEMS S.R.L.	-1,19	0,14	1,51	-1,21	-4,91	-2,26	F
FORLIORO GROUP S.R.L.	1,08	-0,04	4,12	-1,66	-2,25	0,55	F
G. FURLAN S.R.L.	0,87	-0,04	6,80	-5,36	-2,42	0,27	F
IGECART S.R.L.	1,29	-0,19	5,26	-0,78	-2,14	0,40	F
ITAL S.R.L.	-1,39	0,01	-1,37	-0,46	-4,43	-1,92	F
ITS S.R.L.	0,46	-0,06	1,79	-4,23	-1,88	0,19	F
LAURA GIGLIOTTI S.R.L.	-0,71	-0,01	0,17	-2,07	-4,07	-1,10	F
LEGNO S.R.L.	-0,07	-0,04	-1,14	-3,76	-2,38	-0,57	A
LEM S.R.L.	0,03	-0,03	4,14	-2,89	-3,12	-0,55	F
MARETTO MARFLEX S.R.L.	0,28	0,00	1,21	-1,84	-2,66	0,14	F
MAXITECH S.R.L.	-1,27	-0,02	-3,51	-0,98	-4,29	-1,46	F
METALLEGNO S.R.L.	0,53	-0,04	-0,06	-3,75	-2,47	0,01	F
PENNY JEANS S.R.L.	1,34	-0,03	5,38	-2,40	-2,15	0,57	F
PIGNAGNOLI S.R.L.	-2,50	0,01	-3,83	0,88	-5,73	-2,91	F
RIGEL SISTEMI S.R.L.	1,13	-3,86	4,05	-2,79	-1,56	0,73	F
ROSTAN S.R.L.	0,28	-0,01	0,38	-5,43	-2,63	0,07	F
SERRAVALLE PREFABBRICATI S.R.L.	0,80	-0,02	3,58	-1,13	-2,31	0,24	F
TECMON S.R.L.	1,24	0,00	4,99	-4,52	-2,32	0,45	F
TECNOTELAI COMPONENTS S.R.L.	-0,81	-0,02	-0,32	-1,45	-3,95	-1,34	F
TOPAN S.R.L.	1,43	-0,08	6,52	-1,62	-2,20	0,68	F
ULIVELLI S.R.L.	-3,50	0,03	-25,89	10,69	-5,30	-3,92	F
3D GROUP S.R.L.	0,91	-0,03	4,20	-0,46	-2,23	0,11	F
A.M. PEDERZANI SRL	-1,16	0,15	-3,18	2,02	-4,69	-1,90	F
ARVE S.R.L.	-1,77	-0,04	-4,09	1,22	-5,03	-2,32	F
ASSO IMBALLAGGI S.R.L.	2,07	-0,20	8,85	-2,78	-1,86	1,17	F
CALZATURIFICIO BASE SRL	-2,41	0,01	-6,75	2,32	-5,85	-2,72	F

CALZATURIFICIO FLOWER S.R.L.	1,67	-0,10	8,63	-2,89	-2,14	0,78	F
CALZOLARI MECCANICA SRL	1,54	-0,07	6,44	-0,70	-2,13	0,69	F
CARPENTERIA DEL GOLFO S.R.L.	-2,00	0,49	-5,23	3,63	-5,67	-2,72	F
CARROZZERIA MARAZZI SRL	0,72	-0,03	3,24	-3,57	-2,41	0,30	F
CIDNEO MECCANICA S.R.L	0,45	-0,05	5,47	-3,75	-2,41	-0,11	F
COBER S.R.L.	-0,70	0,00	-1,53	-1,47	-3,70	-1,11	F
CREATIONS S.R.L.	1,94	-0,06	8,47	-1,19	-2,06	0,77	F
DEL.VI COMPONENTI S.R.L.	1,26	-0,02	4,79	-1,75	-2,25	0,70	F
EMILPACK SRL	-0,39	-0,02	1,95	-2,36	-3,44	-0,87	F
FIA S.R.L.	-1,13	0,47	-9,22	3,27	-3,51	-1,46	F
FINAZZI SRL	1,82	-0,02	6,32	-2,67	-1,76	1,06	F
FUSIONI MICHELANGELO S.R.L.	1,14	-0,02	4,78	-0,22	-2,26	0,35	F
FUTURA S.R.L.	4,31	-0,61	18,16	-4,91	-0,21	2,47	F
GIALBRI' S.R.L.	1,30	-0,08	6,43	-1,70	-2,36	0,48	F
GRES SATIN ITALIA SRL	0,82	-0,03	4,92	-1,09	-2,52	0,02	F
HOME RELAX S.R.L.	-0,54	0,00	3,96	-0,96	-4,35	-1,64	F
I DOLCI SAPORI SRL	0,99	-0,06	3,79	-2,43	-2,18	0,44	F
ICF S.R.L.	-1,89	0,42	-16,37	5,04	-4,55	-2,25	F
LAMANNA F.LLI - S.R.L.	0,68	-0,05	3,79	-1,94	-2,50	0,39	F
LUROVA S.R.L.	0,97	-0,10	4,03		-2,38	0,39	F
MANIFATTURA S.R.L.	1,17	-0,09	6,66	-4,43	-2,34	0,69	F
METALCAVI WIRE ROPES S.R.L.	0,05	-0,04	2,89	-1,58	-2,99	-0,42	F
MI.MA.RO. S.R.L.	6,11	-0,71	23,11	-6,26	1,18	3,96	F
MONDIAL SUGHERO S.R.L.	-5,63	0,41	-18,64	7,45	-8,56	-5,46	F
OFFICINE LEONCINI E C. S.R.L.	-4,70	0,10	-11,15	3,18	-7,85	-4,62	F
P.G.H. S.P.A.	-2,70	0,15	-20,45	4,06	-2,66	-2,82	F
PORFIDI ROSSO GRIGIO S.R.L.	1,56	-0,09	6,94	-2,14	-1,87	0,85	F
PRONTO STAMPA S.R.L.	1,13	-0,03	5,08	-3,08	-2,19	0,51	F
SALUMIFICIO TORRESANO S.R.L.	0,92	-0,04	3,78	-2,07	-2,19	0,12	F

TECHNOLOGY DESIGN S.R.L.	0,59	-0,02	3,07	-0,98	-2,55	0,03	F

4.2 RESULTS DISCUSSION

Once the data have been formalized in the excel file, it has been proceeded with the calculation of the variables in order to find the values of the several Z score. This phase was purely finalized to the evaluation of the models' efficacy of predicting the bankruptcy and which function better describes the future trend of the company through a comparative analysis. As previously mentioned, because of the lack of consecutive financial information with the increase of the distance from the date of the failure, the population decreased from 513, first year prior the bankruptcy, to 404, fifth year prior the bankruptcy.

The outcome of the analysis identifies the Legault and subsequently the Altman's Z scores as the most accurate and consistent, since they show the highest percentage of correct classifications, respectively 82,65% and 80,90%, and the lowest volatility over the whole period taken into consideration, or rather an average decrease of respectively 0,49% and 1,10%. On the other hand, the Alberici's and the Ohlson's discriminant functions were revealed as the most unreliable models for the research purpose due to their correct classification percentage below 25%. The inefficacy of the Alberici's models has been certified also by another research made on Emilian companies by the professor Salvatore Madonna and published in the European Scientific Journal, where the number of incorrect classifications for the last year of activity was equal to 96% and 100% in the following years[50] (Madonna S. et Cestari G., 2015). Anyway, in agreement with the creator's research, each model loses its efficacy and increases its probability of misclassification once the firm's analysis, so its score calculation, is done in a period distant from the failure. In other words, it can be said that the efficacy of the discriminant functions is inversely proportional to the distance from the date of the bankruptcy, tying the models to un intrinsic level of uncertainty.

The Ohlson' s Z score was not expected to be efficient since it was created for listed company and, due to the wide range of the period, the X1 variable's divisor was assumed to be the average of the yearly GNP price level index from 1991 to 2018; on the contrary, the Alberici's

[50] Madonna S. et Cestari G., 2015, *"The accuracy of bankruptcy predicting models: a comparative analysis of multivariate discriminant models in the italian context",* European Scientific Journal, Vol. 11, no. 34

function could have been a plausible method to predict insolvency since the objects of the research were small and medium enterprises operating in the Italian market. Another intrinsic issue related to this last, it was the existence of several functions, each one created on the basis of the distance from the date of the failure. As a matter of fact, whether it is possible to utilize this model from a back looking perspective, in other words when the company has already gone to bankruptcy, it is not efficient and convenient to use it from a forward looking dimension, due to the impossibility to predict the exact date of the firm's insolvency.
Moreover, it has to be reported how the outcomes of these two models were only companies classified as "safe", especially for the fifth year prior the bankruptcy, where the number of firms categorized as insolvent were zero.

Anyway, it has to be highlighted how each Z score follows the assumptions exposed in the model presenting paragraphs, in other words their loss of efficacy for analysis made in periods distant from the failure, but also that, the discriminant functions meet some difficulties in the identification of active companies, in the case they are in financial distress. As a matter of fact, taking into account the population made up of companies categorized as non-insolvent by the models, on average, the error of misclassification is equal to 80% in the last year of activity. Moreover, even the most performing Z scores, in other words the Atman and Legault, reveal disappointing outcomes in the distinction of safe companies. Indeed, concerning the former, the misclassification error reaches 88%, while the latter 75%.
Even if, in quantitative terms, the number of these enterprises is quite low, on average 0,9% of the whole population in the period "t-1", the impact in a real context can be huge and devastating. As a matter of fact, it could lead to ignore all the firms classified in the "safe zone", as possible future failures, even in the last year of activity.

ACCURACY					
Altman	t	t-1	t-2	t-3	t-4
TRUE	415	382	360	329	309
FALSE	98	94	89	96	95
N	513	476	449	425	404
Prob corr.	80,90%	80,25%	80,18%	77,41%	76,49%
Alberici	t	t-1	t-2	t-3	t-4
TRUE	88	82	76	74	71
FALSE	425	394	373	351	333
N	513	476	449	425	404

Prob corr.	17,15%	17,23%	16,93%	17,41%	17,57%
Bottani	t	t-1	t-2	t-3	t-4
TRUE	377	333	297	264	227
FALSE	136	143	152	161	177
N	513	476	449	425	404
Prob corr.	73,49%	69,96%	66,15%	62,12%	56,19%
Ohlson	t	t-1	t-2	t-3	t-4
TRUE	118	87	73	75	71
FALSE	395	389	376	350	333
N	513	476	449	425	404
Prob corr.	23,00%	18,28%	16,26%	17,65%	17,57%
Legault	t	t-1	t-2	t-3	t-4
TRUE	427	386	366	344	326
FALSE	86	90	83	81	78
N	513	476	449	425	404
Prob corr.	83,24%	81,09%	81,51%	80,94%	80,69%
Springate	t	t-1	t-2	t-3	t-4
TRUE	395	356	311	284	245
FALSE	118	120	138	141	158
N	513	476	449	425	403
Prob corr.	77,00%	74,79%	69,27%	66,82%	60,79%

Year	Classification	Altman	Alberici	Bottani	Ohlson	Legault	Springate	Average
t	Failed	496	3	420	39	508	434	
	active	17	510	93	474	5	79	
	true f	423	3	356	36	445	372	
	true a	2	85	21	82	2	23	
	type I error	85,3%	100,0%	84,8%	92,3%	87,6%	85,7%	89,3%
	type II error	11,8%	16,7%	22,6%	17,3%	40,0%	29,1%	22,9%
t-1	Failed	460	0	373	11	446	402	
	active	16	476	103	465	10	74	
	true f	380	0	312	8	385	338	
	true a	2	82	21	79	1	18	
	type I error	82,6%		83,6%	72,7%	86,3%	84,1%	81,9%
	type II error	12,5%	17,2%	20,4%	17,0%	10,0%	24,3%	16,9%
t-2	Failed	432	0	333	3	442	353	
	active	17	449	116	446	7	96	

	true f	358	0	277	0	366	294	
	true a	2	76	20	73	0	17	
	type I error	82,9%		83,2%	0,0%	82,8%	83,3%	66,4%
	type II error	11,8%	16,9%	17,2%	16,4%	0,0%	17,7%	13,3%
t-3	Failed	399	0	300	3	416	334	
	active	26	425	125	442	9	91	
	true f	327	0	245	2	343	272	
	true a	2	74	19	73	1	12	
	type I error	82,0%		81,7%	66,7%	82,5%	81,4%	78,8%
	type II error	7,7%	17,4%	15,2%	16,5%	11,1%	13,2%	13,5%
t-4	Failed	376	0	264	0	397	292	
	active	28	404	140	404	7	111	
	true f	307	0	210	0	326	233	
	true a	2	71	17	71	0	12	
	type I error	81,6%		79,5%		82,1%	79,8%	80,8%
	type II error	7,1%	17,6%	12,1%	17,6%	0,0%	10,8%	10,9%

Because of the lack of data covering the whole period of five years, so the decreasing population of the sample, a second analysis has been made considering only the best performing indexes, in order to have a better perspective of the efficacy of the models, so their accuracy, on the basis of the same number of the companies for each year taken into account. They have been considered only the Altman, the Legault and the Springate's z scores, since they have been revealed as the most accurate and constant. The outcomes obtained have been disappointed, since the adjustment of the population number, did not increase the index but, quite the opposite, it slightly decreased the ratio of 1%. In other words, the reduction of the sample led to the removal of companies correctly classified, instead of the opposite.

MODEL'S ACCURACY COMPARISON WITH THE THESIS ANALYSIS[51]										
	t-1	T-1	t-2	T-2	t-3	T-3	t-4	T-4	t-5	T-5
Altman	95%	81%	72%	80%	48%	80%	29%	77%	36%	76%
Alberici	86%	17%	86%	17%	83%	17%	69%	17%	79%	18%
Bottani	94%	73%	NA	70%	NA	66%	NA	65%	NA	56%
Ohlson	96%	23%	NA	18%	NA	16%	NA	18%	NA	18%
Legault	83%	83%	NA	81%	NA	81%	NA	81%	NA	81%
Springate	83%	77%	NA	75%	NA	70%	NA	67%	NA	61%

[51] T-n = results from the analysis

It has to be highlighted that the models that better predicted the bankruptcy where the less complex, therefore the easiest to utilize, and that one that considered above all the profitability and efficiency indexes. As a matter of fact, the three Z scores take into consideration especially the ability of generating incomes and revenues in relation to the total resources of the firm. Whether it was not the case, they considered a variable that is directly influenced by the net income, in other words the shareholder's funds[52]. As a matter of fact, this item increases in case of positive incomes and decreases in the opposite case.
The efficacy of these variables can be justified due to their connection to the company's ability of covering expenditures and obligations, so, in a macro dimension, to the *"going concern".*
To be noticed that among the variables of the Z scores, the only element that considers the effects of liabilities to the business operating is the working capital over total assets.

After the exposure of the results obtained, it can be said that the only models that can be supposed as "predictors" of the bankruptcy are the Legault and the Altman's Z score due to their correct classification percentage of almost 80% for the whole period of five years. They have been excluded from this category the Springate and the Bottani's models due to its inconsistency over time, so the ability of correctly classifying firms only in the last year of activity, even if it should be considered that its efficacy in this period reached only 77%. Concerning the remaining discriminant functions[53], it can be concluded that they are totally unable to give a correct judgement about the future existence of the firm.
To conclude, in order to give a final judgment about the Z score models, it has to be considered that every company taken into consideration for the analysis, was under insolvency proceedings and in last years of activity, therefore with balance sheet items deteriorated by the past performances.
Therefore, the "successful" results of some discriminant functions are due to the companies' conditions and situations that could have only positively influenced the final score of the firm. This last thought can be verified through the models' inability and unreliability of giving a correct judgement about non insolvent companies, so through the analysis of the type II error. In other words, whether an enterprise shows some positive values the discriminant functions

[52] Patrimonio netto
[53] Alberici, and Ohlson's Z score

are totally unable to correctly classify the firm, making superficial and almost useless their utilization.

It has been written before that the uncertainty is linked to the period taken into consideration for the analysis, this characteristic is further intensify by the idea that the calculation of the Z score for a company can be realized anytime during its whole life time period, without knowing ahead of time, its future status of insolvency or not. As a matter of fact, this analysis, such as that ones that led to the ideation of the models, has been realized knowing, before its beginning, the actual firm's state of activity, in other words in back looking perspective, tying the outcomes to a certain level of "safety", such that an accuracy ratio of 80%, that can be psychologically relevant, is seen as a symptom of the bankruptcy prediction. On the opposite, whether the analysis is adopted in a forward-looking dimension, the interpretation of the results can radically change, especially if the status given by the calculation revealed as non-insolvent, due to the value of the type II error demonstrated before.

In other words, in the case of the utilization of one of these models[54], the final judgement of the firm's status should be integrated with further and more in depth analysis, in order to avoid to give un incorrect opinion about the future operativity of the company, making superficial the first application of the Z scores.

Another important point about these models that should be highlighted concerns an intrinsic aspect that composes them, in other words their "timeless predicting ability". As a matter of fact, without considering their negative results regarding prediction and supposing the case that their predicting ability is confirmed, they are, in any event, unable to show and tell us how far or how close is the bankruptcy, in other words they cannot report the date of the failure, making the above mentioned ability worthless under the perspective of a possible utilization in correction to the disappointing firm's performances.

This aspect is further amplified by the same researches of the economists that formulated these functions, due to the decreasing predicting ability over the years prior the date of the failure. In other words, these models reveal an acceptable accuracy rate only when the situation is almost too critical to be corrected, namely when the crisis is irreversible, therefore there could have been utilized other non-mathematical tools to predict the bankruptcy, so to balance the company's situation.

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[54] In this assumption the models taken into consideration are only the Legault, Altman, Springate and Bottani Z scores. They are excluded the Ohlson and Alberici discriminant functions due to the demonstrated inability of predicting bankruptcy

In connection to what it is written in the chapter I, so about the crucial role of internal agents in noticing the arise of the crisis, these last can deploy systems and tools able to make suppose the possibility of failure at earlier stage rather than the models analyzed.

As a matter of fact, the internal subjects are aware of data and information that are not always available to the external and can be fundamental in the detection of the arising crisis. The information for example can be correlated to the frequency and delay of payments or the efficiency in the production, management and organization.

4.3 POSSIBLE CAUSES OF THE INEFFICACY OF THE MODELS

Firstly, it has to be recalled that models performed in different ways and showed different outcomes, some of them have been totally unable to give suppositions about company's insolvency while others lacked in the identification of non-insolvent firms. More precisely, while Ohlson and Alberici's Z scores can be considered as incapable to classify enterprises, the others can be evaluated as unreliable tolls to predict bankruptcy, obviously with different intensity.

It has been exposed in the previous paragraph that the high accuracy rate for the best performing functions is due to the deteriorated situation that the company is facing, in order to clarify this last point, it will be provided an example.

COMPANY ALPHA	
PPE	70
Current assets	30
Total assets	100
Shareholders' funds	15
Current liabilities	60
Non-current liabilities	25
Sales	450

EBIT	50
EBT	-5
Net Income	-10

The example can be taken to the extremes, supposing that for the last two years the fake firm has been being in loss, for the purposes of the explanation it is not necessary to give a value since the idea is to demonstrate how the models are influenced by variables in a way that can be considered as "irrational" and they are not a reliable tool to predict insolvency, since they do not take into accounts the past performances and balance sheet items highly decisive for the supposition of the bankruptcy.

The results obtained from the application of the Altman, Legault and Springate's Z scores, revealed that for each model the company is non insolvent, even if it represents clear symptoms of financial distress, such as current liabilities higher than current assets, negative net income and the unsustainability of the operating activity due to the past losses.

VALUES OBTAINED		
	Z score	Cut off point
Altman	5,78	2,675
Legault	0,162	-0,03
Springate	2,95	0,862

It has to be highlighted that, whether the starting value of sales is modified to 401, the only model that suggests the bankruptcy is the Legault's one, revealing its higher predicting ability compared to the other Z scores. In addition, the Altman's model supposes the failure once the sales reach 128 while the Springate's one for values below -73.

It should be noticed that the first model classifies the firm as insolvent for higher values rather than the others because of to the lower effect of sales to the function's outcome due to the coefficient that multiplies the ratio, that is lower than the other models. At the same time, the Legault's function is critically influenced by the EBT/Total assets, so that, whether they are changed the balance sheet items, the results obtained could have been the same.

In relation to the example, it can be said that it is more efficient and accurate utilizing ratios that take into accounts costs and future cash outflows rather than sales, since they are an item

too general and superficial to make a judgement about the company and they do not represent the real firm's efficiency, especially in managing costs.

Another cause that can have affected the negative performances of the models, is the date of the researches that led to the formulation of the same Z score. As a matter of fact, each model, with the exception of the Bottani's one, was created around the '80s, a period that is far away from the date of the bankruptcy of the companies taken into consideration for the analysis. Along the timeline, the managing systems and the same variables' effect could be changed, so that the models were efficient for the past period, but they are not for the actual one. In other words, the discriminant functions should be modified in accordance to the actual enterprises' conditions and structure.

Another cause that could have influenced the first results obtained by the economists, is the population of the sample that has been taken into consideration for the statement of the discriminant functions. As a matter of fact, with the exception of Ohlson's Z score, each model has been created on the basis of an analysis and research made up of less than 100 firms. Indeed, a number so restricted, could have not represented in the best manner the characteristics of the companies, altering the results and same functions, especially the coefficients that multiplies the ratios, creating the issue exposed in the first paragraph.

Finally, concerning the issue founded out during the analysis related to the incorrect identification of firms classified as non-insolvent that in the end went to bankruptcy, the main reason can lie in the complexity of the nature of companies and in external aspects that, with different levels of intensity and probability, can be predicted or not. In other words the reality is too complex to be predicted with accuracy and the models have been formulated as a simplification of the context in which the firms operate, so that they cannot incorporate all the possible variables and factors able to affect the going concern and, whether it is the case, for sure they do not influence the business operativity with the same strength.
To conclude, the utilization of the bankruptcy models previously analyzed is not the best matter to predict insolvency for manufacturing companies, not only due to their disappointing and unreliable efficacy, but, above all, because of their decreasing efficacy and accuracy over time. As a matter of fact, as exposed in the Chapter I, the main purpose of the alert systems and the related early warning instruments is to act preemptively before the arising of the crisis, or, in case it is revealed, before it turns into an irreversible state therefore the nature of the

discriminant functions do not accomplish the objective. Indeed, the Z score functions allow, moreover with several limitations, to be aware of the possible future bankruptcy in a period of time to close to the above-mentioned date to realize correcting actions to balance the firm.
Moreover, the availability of different tools able to make suppositions about the future company's status would have led to the same final judgement before the use of the Z scores making possible the actualization of the proper correcting plans. In order to be more clear, as suggested and required by the Italian Insolvency Code, just the analysis of the expired or the non-fulfillment of the obligations would have led to the same conclusion but, it would not have been incorporated with the analysis through Z score, or it would have had a superficial impact on the final classification, due to the previously demonstrated non equitable effects of the variables, especially that one related to liabilities.

5. FAILING COMPANIES CHARACTERISTICS

Once it has been exposed the inadequacy of the Z scores models in predicting bankruptcy, it should be shown the characteristics and the trend of the companies that went to failure in the analysis of the previous paragraphs. This subchapter develops into the evaluation of the companies' ratios and balance items values from the first year prior the bankruptcy, in order to better comprehend what are the elements more commonly related to insolvency and the factors that lead to the failure. For the analysis are taken into consideration indexes directed to the evaluation of the profitability, operating efficiency and debt and financial position, moreover it is included also a study about the shareholders' funds and net income, since they are two elements taken into accounts by the Italian insolvency code as early warning tools. Some results obtained by calculations have been excluded from the analysis since value they could have misrepresented the final outcome, so the whole research, due to their too high or, on the other case, too low values.
This last analysis is finalized to the comprehension of the failing companies' trend, understanding whether it exists a correlation between bankruptcy and ratios and how these lasts act over time, so whether their value is directly correlated to the probability of default.
In order to reach this purpose, the companies' indexes have been calculated after their balance sheets were inserted into a file excel and lately, through the IF function, it was analyzed their trend over time, so whether they decreased or increased with the proximity of the bankruptcy date. Obviously, the hypothesis is that the closer distance to the date of the failure influences

the outcomes and it is reflected to the ratios' values, so that they should reveal a declining tendency from period t-5 to period t-1 whether the index is directly correlated to the positive evaluation of the firm and the opposite if the ratio is inversely correlated.
The analysis follows the ratios utilized in the Dupont analysis, substituting the "owner's equity" with the "share capital" where required, and takes into account the cash conversion cycle and the variables used by the Z score models.

5.1 OUTCOMES FROM THE ANALYSIS[55]

Starting from the profitability dimension, they were utilized Return on Equity[56], Return on Invested Capital, asset turnover, operating profit margin and Profit Margin. The choice of these ratios was led by their capability to give an idea about the failing firm's ability to generate revenues and, possibly, the processes that corrode sales, so where are located higher costs.

- ROE (ROShareCapital) = the ratio is commonly used to measure the overall profitability of the firm and it is calculated by dividing net income by shareholders' equity, in this case the share capital and it describes the company's efficiency in managing assets.
- $ROIC_{BT}$ = It is a profitability ratio that assesses the firm's efficiency in managing the investments. It is calculated by dividing Earnings Before Interest and Taxes by Net Operating Assets.
- Asset Turnover = Concerning this ratio, it should be highlighted that it is the outcome of the division between sales and Net Operating Income and it is used to assess the management efficiency in generating revenues in relation to its assets.
- Operating Profit Margin = regarding this ratio the divisor can be represented by Earnings Before Interest, Taxes and Depreciation and Amortization or the Earnings calculated after the subtraction of the Depreciation (EBIT), while for the dividend they are used sales. In both cases, the index is useful to assess the resulting margin after the operating expenditures. High values reveal the firm's managing cost efficiency while, on the contrary, issues related to the production process.
- Profit Margin = similarly to the previous ratio, this index addresses the percentage of revenues on sales. Even in this case the result is directly correlated to the firm's efficiency.

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[55] Bozzolan S. et Paolone F., n.d., slides from "*Financial statements and performance measurement"* course;
[56] For the calculation of the ratio, the equity was substituted by share capital since the firms analyzed were not listed companies

Beginning from the Return on Equity, it has been calculated considering as divisor the share capital and then the shareholders' funds, so the first element affected by the past and actual net income. In the last case all the values obtained by negative net income and negative shareholders' funds have been excluded since the results would have been a positive return.
The calculation of the ratio reveals how the average value is -3,91% in the case of share capital as divisor and -18,60% in the other case. The large difference is probably due to the fact that in this case both the dividend and divisor can be negative, influencing the final sign of the ratios, so that there are more negative values than in the first case. In both cases the trend the average trend in the first year prior the bankruptcy is declining and almost 60% of the companies show a value lower than the preceding year.

Concerning the Return On Invested Capital, it was calculated two times, considering the EBIT and the EBITDA and the outcomes show how the average returns for the companies analyzed is 0,07% in the first case and 7,21% in the second one, with an average decrease of respectively 4 and 5 percent over the five years. Even in this case almost 60% of the firms show a declining value in the last year of activity. The difference in the returns discloses the critical effects of depreciation and amortization in relation to the sample analyzed.

Regarding the asset turnover, the results calculated reveal an average value of 3,06 influenced by a decreasing trend over the five years of 19%. In this case, differently to the previous one, 52% of the companies in the first year prior the bankruptcy is affected by a ratio lower than the previous one.
Finally concerning the profit margin ratios, extremely useful to comprehend the real profitability of a firm and its management efficiency, it should be highlighted how the results obtained from the analysis show a declining average on the bases of the choice of the dividend, namely between EBITDA, EBIT and Net Income. Respectively, the values calculated are 2,49%, -2,13% and -6,25%, revealing a declining trend over the period of, going in order, -2,38%, -3,14% and -3,54%. Regardless the choice of the dividend, in the first year prior the failure 63% of the firms shows a lower value than the preceding year. The results obtained show how the operating costs intensively cut the revenues from sales that is further deteriorated by Depreciation and amortization and financial expenses.

Regarding the financial and debt dimension, they have been utilized the debt ratio, financial costs ratio, tax effects ratio and an analysis about the net working capital trend. Regarding the tax effects and financial cost ratios, has been removed from the final results all the values of the companies that showed a negative balance sheet item both as dividend and divisor, since the results would have been a positive number, representing a better economic situation than reality. Concerning the indexes:

- The debt ratio = it is calculated by dividing total liabilities by total assets and it expresses the financial stability of a firm. It is directly correlated to the risk, so that high values of the index represent a precarious situation

- The financial costs and tax effect ratios represent respectively the effects of financial expenses and taxes to revenues, more specifically, to the EBIT and EBT.
- A specific analysis about Net working capital has been chosen since the item represent the firm's capacity to fulfill the short-term obligation without requiring external funds. It is calculated through the difference between current assets and current liabilities.

Regarding the first ratio, the results obtained revealed an average value of 90% with a growing trend over the five years period of 4%. It has to be highlighted how the final value, in the first year prior the bankruptcy, increased on average of 10% and was higher than the previous year in 66% of the firms analyzed, revealing a huge increase of liabilities or decrease of assets in the last year of activity.

Concerning the financial expenses and taxes effects the values calculated reveal respectively their ability to reduce di Earnings before interest and taxes of 80% and the Earnings before taxes of 89%, even if in the first case the trend is positive and characterized by an average growth of 7% through the whole period while, in the second one, the positive growth is just about 1,6%. Regardless these last positive elements, the total effects on earnings is highly negative, due to the amount of earnings left after these expenditures.
To conclude, regarding the net working capital, the results reveal how this item on average decreased of 6,7% over the period analyzed, highlighting an increase of current liabilities or a reduction of current assets. This can be due to the incapacity of the firm to repay the obligations due to the deteriorated economic situation. 66% of the sample in the last year of operativity is characterized by an NWC value lower than the previous year.

Another step of the analysis involved the evaluation of the cash conversion cycle whose expresses the amount of time spent by the firm to convert the investments into cashflows. The formula is the subsequent:

$$CCC = DSO + Days\ in\ inventories - Avg.\ payments\ period$$[57]

Where:

- DSO represents the number of days before a firm collects a sale and it is obtained by dividing the accounts receivables by daily sales;
- Days in inventories is the average amount of days spent by the firm to transform raw materials and work in progress into the final product;
- Avg. payment period shows the average days before a purchase is settled;

According to the results obtained by the calculations of the above-mentioned elements, their average values are respectively 126 for DSO, 132 for Days in inventories and 140 for Average payments period, therefore the final value of the cash conversion cycle is 120.

To conclude the overall analysis about failed companies, it has been made a study concerning the trend of the sales, liabilities and net income. The purpose is to understand whether they are able to contribute to failure. Going in order, the analysis that covered the whole period from the first to the fifth year prior the bankruptcy, revealed an increase of 12,70% of sales but, on the other hand, an average growth of total liabilities of 15% and an average reduction of -403% of the net income. Obviously, this last value has been heavily influenced by some firms whose faced a decline of earnings that turned into a negative value from a positive one. Concerning the net income, 62% of the firms analyzed, in the last year of activity were characterized by a value lower than the previous year.

In conclusion, according to the realized analysis, it can be said that common and unique characteristics able to associate failing companies do not exist due to the different causes that led the firm to failure. To be clearer, a company can face a positive net income, but it still cannot afford to sustain its activity. Despite this thought, there are elements that are more likely correlated to bankruptcy, as it has been shown in the above analysis.
Following the order of the previous study, it can be mentioned the importance of the profit margin and the connected low or negative net income, rather than the overall sales of the firm.

[57] Bozzolan S. et Paolone F., n.d., slides from "*Financial statements and performance measurement"* course;

More specifically it should be evaluated the trend of these items, so that it can be made a clearer idea of the company's conditions and position. As a matter of fact, according to the research, on average the total sales faced a growth during the period, but this effect was completely cut down by low margins, that often turned the final value, so the net income, into negative.
Other important elements that should be taken into consideration for the evaluation of the firm are the evolution of the total liabilities that, according to the calculations, would face an increase during the crisis period, marking the business activity unstable and uncertain.

In the end it should be exposed that the prediction of the insolvency is almost impossible due to the several variables related to the going concern, nevertheless there can be made several assumptions about the business stability, focusing on the indexes previously analyzed and the past trends of the company, without forgiving to assess the possible future prospectus.

6. CONCLUSION

The aim of the thesis was to assess the efficacy of the bankruptcy predicting models in order to utilize them as possible early warning tools in accordance with the art. 3 of the new Italian Insolvency Code.
To reach this purpose, all the data downloaded from the Orbis platform have been analyzed in an excel file providing in this way the outcomes exposed in the previous chapter.
The overall results reveal how the models are characterized by different levels of accuracy, some of the such as the Alberici's Z score are totally unable to make a correct classification of the enterprises while, others, such as the Altman and the Legault's ones, present an accuracy ratio of around 80%; it has to be highlighted how the last one show also consistency over time.

The outcomes provided by the analysis, in order to make a correct final judgement about these models, have to be linked with the nature and the purpose of the alert systems, in other words the identification of the arising crisis at early stage and in a timely manner. It has been demonstrated how the models lose their efficacy over time, so that the accuracy is inversely correlated to the increase of distance from the date of the failure, colliding with the objective of the article 3 of the Italian Insolvency Code. This discrepancy is further intensified by the possibility of using substituting methods and tools to detect the risk of insolvency more promptly than the Z scores, just following the directions and indexes exposed in the Chapter I.

To conclude the bankruptcy predicting models previously analyzed are not an efficient tool to be used as early warning tool. Anyway, it should be noted the performances of the Legault Z score, that showed the best accuracy and consistency over time even if characterized by difficulties in identifying active companies, so that it can be classified as an unreliable system to predict insolvency.

7. SUMMARY

The enterprise crisis is a well renowned phenomenon by the corporate and bankruptcy law spheres, especially after the 2008 crisis, due to the increase of companies that went to bankruptcy and the negative effects concatenated. The situation seemed to improve but, according to the research made by Cerved[58] (Cerved, 2015), between July and September of 2019 the number of liquidations reached 2291, with an annual growth of 4,2%, softening the positive trend that characterized the past five years.

The aim of the thesis is to provide an in-depth analysis about the efficacy and the efficiency of the bankruptcy predicting models, in order to be used as possible alert systems, introduced by the Art. 13 of the new Italian insolvency code. The prospect of using these kinds of tools, whether the analysis results favorable, it will be useful to improve the Italian industrial environment, identifying and assessing the probability of default before the crisis becomes irreversible. As a matter of fact, thanks to a forward-looking and preventive approach, it is possible to remove or, at least, weaken the negative effects correlated to the suspension of the firm's economic activity, since it does not concerned only the involved company, but it can indeed provoke a "domino effect", creating other entrepreneurial instabilities to other parties, unable to retrieve what they have lent[59] (Marco Cian et al, 2018).

In other words, the availability of tools disposable by internal and external agents, it can prevent the negative consequences of the bankruptcy, allowing a preventive intervention, able to balance the financial distress before it becomes irreconcilable and damages other parties.

One of the first economist that formulated models with the capability of predicting, or at least signaling, the risk of insolvency has been Edward Altman in the 1968, followed by others that modified its formula according to the subject of the analysis, such as SME or MNC.

The thesis is going to be divided into two macro-sections, the first one exposes the characteristics of the new Italian insolvency code, focusing on the, above-mentioned, "alert systems", the second one, analyzes the efficacy of the z score models, formulated by Altman, Taffler, Alberici, Bottani, Ohlson, Springate and Legault.

Due to the Italian industrial composition, the research takes into account only the manufacturing companies, excluding the third sector, due to the differences in the balance sheet item's composition, structure and organization.

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[58] CERVED, (2015), *"Fallimenti, procedure e chiusure di imprese",* December 2015, N°40

[59] Marco Cian et al, 2018, "Manuale di diritto commerciale", second edition, 7th section

Before the introduction of the new Insolvency Code, the bankruptcy has been being regulated by the Bankruptcy Law since 1942, that was born with the scope of managing the debt position of the entrepreneur, thought a coactive and simultaneous procedure[60] (Marco Cian et al, 2018). Moreover, in the old bankruptcy law, the benefits from the balance of a firm in a status of crisis were subdued by the intention of protecting creditors' losses and guaranteeing their satisfaction, punishing at the same time the insolvent entrepreneur, while, on the contrary, the new legislation is directed to a premature diagnosis of the company's financial distress and the entrepreneurial safeguard, creating in this matter, the proper conditions for the firm balancing and reorganization before the situation turns into irreversible[61] (Mininno R., 2020).
In other words, while the old legislation was directed to punish the debtor and safeguard the creditors, the new one is wholly focused on the principle of the going concerns that is reflected on every single procedure, providing actions and devices to act promptly before the situation turns into irreversible and finalized to the rescue of the firm in state of crisis.

The Italian Insolvency Code, replacement of the "Bankruptcy Law", is based on the work that comes from the "Rordorf commission", a ministerial commission established by the ministry of justice on 2015 with the participation of representative of the CNDCEC[62] ("National Council of Chartered Accountants and Accounting Experts"), with the purpose of rewriting the legislation about bankruptcy proceedings[63] (Il sole 24 ore, 2018) and takes inspiration, at least for what regards the alert procedures, from the French reform that came into force in the 80s. It is furthermore influenced by the European Union recommendation number 135 of the 2014 and by the European Union regulations number 848 of the 2015, both concerning the insolvency proceeding. Another important role has been played also by the international guidelines, concerning the insolvency, elaborated by the UNCITRAL, United Nations Commission on International Trade Law[64] (Bernardi D. & Talone M., n.d., p. 54). The recommendation n. 185 by the European Commission is directed to "*ensure that viable enterprises in financial difficulties… have access to national insolvency frameworks which enable them to restructure at an early stage with a view to preventing their insolvency, and therefore maximize the total value to creditors, employees, owners and the economy as a*

60 Marco Cian et al, 2018, *"Manuale di diritto commerciale"*, second edition, 7th section
61 Mininno R., 2020, "*CODICE DELLA CRISI D'IMPRESA: approvato dal Consiglio dei Ministri il primo decreto integrativo e correttivo",* Il sole 24 Ore
62 Consiglio Nazionale dei Dottori Commercialisti e degli Esperti Contabili
63 Il Sole 24 Ore, 2018, "Commissione Rondorf"
64 Bernardi D. & Talone M., "sistemi di allerta interna", book n. 71, ODCEC, p. 54

whole"[65] (European Commission, 2014) and it was established due to the lack of efficient procedures in some member states able to restructure businesses at earlier stage. Additionally, in the others the existing procedures concerning the insolvency proceeding can be actualized only at irreversible stage of the crisis. It is furthermore finalized to reduce the negative effects of the bankruptcy that damage the honest insolvent entrepreneur, giving him a second opportunity. Similar to the European decrees the "legislative guide on insolvency law" has been drafted by the "United Nations Commission on International Trade Law", in order to encourage and foster the adoption of efficient procedures on the subject of corporate insolvency law. The Guide, written by the United Nations' Entity, provides a set of feasible solutions and suggestions to the insolvency issue, balancing the debtor's and the creditor's needs, supporting the negotiation between the two parts and the business reorganization rather than liquidation. This last meets the purpose defined by the Report of maximizing the value of assets since, as written on key objectives section, *"creditors would not involuntarily receive less than in liquidation and the value of the debtor to society and to creditors may be maximized by allowing it to continue. This is predicated on the basic economic theory that greater value may be obtained from keeping the essential components of a business together, rather than breaking them up and disposing of them in fragments*"[66] (UNCITRAL, 2004, p. 11) it can be notice how this concept coincides with the purpose of the Italian insolvency code related to the going concern.

The guide suggests also the provision of processes able to increase the efficiency of the insolvency procedures without damaging the parts involved and the reduction of their costs and time, in a matter to support the theory about the maximization of the asset value.

In the previous paragraph, the insolvency code has been presented as an innovation in the Italian business-related law and directed to contain the negative effects of the bankruptcy; in the subsequent sections it will be exposed and explained the new introduction of the "Alert Systems and crisis composition", inspired by the French Legislation.

The article 12 explaines the tools able to facilitate the achievement of going concern principle. These ones are designated not only as economic or analytical actions, such as the business analysis, but also as all the procedures intended and directed to the warning of the firm's

[65] 2014/135/EU: Commission Recommendation of 12 March 2014 on a new approach to business failure and insolvency

[66] UNCITRAL, 2004, "Legislative guide on insolvency law", parts one and two, p. 11

anomalies and to commence the processes able to safeguard the business activity and operativity.

In order to do that, it is emphasized the role of the corporate monitoring bodies, in other words the internal and external auditors, whose has been assigned the responsibility of signaling in time the discovery of crisis symptoms and verifying the constantly evaluation, by the administrative body, of the financial and economic equilibrium; this evaluation has to take into account also the future firm's economic prospectus.

The article 12 effective provides also the establishment of an organism finalized to the assisted composition of the firm's crisis. This entity has the authority of creating a board composed by three experts, with the purpose of assisting the company on the subject of insolvency procedures and of crisis management and crisis controlling. This system is finalized to move the proceedings from the judicial sphere, in order to encourage its use by the enterprises.

Differently from the previous article the art. 13 exposes the indicators of crisis, constituted by financial and economic unbalances, and that take into account the characteristics and the date of establishment of the enterprise and the business in which the company operates.

The relevant indexes are that one able to evaluate the sustainability of the indebtedness through the generation of future financial flows. Additionally, according to the article 24, they are considered as indicators of crisis also the delay on payments and the existence of expired debt related to salaries and suppliers.

The new Insolvency Code introduces also the modification of procedures introduced by the old bankruptcy law such as the liquidation, the debt restructuring and the composition with creditors, changes finalized to enhance and increase the efficacy of the processes linked to the enterprise's crisis, so the going concern.

One of the most important introduction concerns the substitution of the "Bankruptcy" with a new procedure called judicial liquidation, finalized to the liquidation of the assets of the insolvent entrepreneur and it is applicated to the entrepreneurs whose are in state of insolvency and do not satisfy the criteria of the "minor enterprise"[67] (L.D. 12th january 2019 n. 14).

The evolution of this procedure is supervised by the figure of the insolvency administrator ("curatore"), who is elected by the judge appointed to the control of the correct execution of the procedure, plays an essential role in achieving the process' purpose of liquidation.

[67] L.D. 12th january 2019 n. 14, article 2

This subject, according to the article 128, obtains the administration of the debtor's assets and executes all operation of the procedure under the surveillance by the judge and the creditor's committee.

The "Order of Chartered Accountants and Auditors of Milan" (Ordine dei Dottori Commercialisti ed Esperti Contabili) in the Book n. 71, emphasizes the role of the control body in the detection of the crisis, especially due to its knowledge about the company and the business in which it operates.
On the same book are presented two suggested action plans developed for middle and big enterprises and for that one with smaller dimension, that should be followed by the control body, for internal audit tasks, and by external auditors. Each plan has been created in order to maximize the efficacy of the alert system for both types of companies, creating a simplified one for firms representing a less complex administration system.
These procedures follow 7 steps:

- Early warning: directed to find out anomalies related to payments, contracts and bank accounts;
- Data collection: composed by the data collection and work planning phase;
- Accounting review: concerning the balance sheet analysis;
- Performance analysis: focused on the analysis of bank accounts, payments and legal events;
- Economic and financial analysis: formed by "Test of control" and redaction of a prospectus;
- Qualitative analysis: finalized to the evaluation of management, governance, benchmark
- Final report: this last phase concerns the redaction of a report containing the final judgement about the company;

The bankruptcy predicting models taken into consideration for the analysis are the Altman, Alberici, Bottani, Ohlson, Springate and Legault's Z score.
Starting from the first one, it was developed firstly in 1968 and then adjusted in 1993; its final function is the following:
$Z=0.717X1+0.847X2+3,107X3+0.42X4+0.998X5$
Where:

- X_1 = Working Capital / Total Assets

- X_2 = Net Income / Total Assets
- X_3 = Earnings Before Interests and Taxes / Total Assets
- X_4 = Shareholders funds / Total Debt
- X_5 = Sales / Total Assets

Altman identified three sectors essential for the interpretation of the Z scores, in other words the "non-bankruptcy zone", the "gray zone" or "zone of ignorance" and finally the "bankruptcy zone". Concerning the first one, all the firms that show a value above 2,99 will not fall into bankruptcy, regarding the second one, the companies with values between 1,81 and 2,99 are characterized by an uncertain probability of bankruptcy, so in this section there can be errors of misclassification and finally all the values below 1,81 reveal a certain failure within one year.

It has to be highlighted that, regarding the gray zone, Altman fixed 2,675 as cut off point, in order to better classify the firms inside the section. This limit reveals that companies with values of the Z scores above the threshold are characterized by low probability of bankruptcy up to the value of 2,99, starting point of the "non-bankruptcy zone", while scores with a value below 2,675 are part of the insolvency zone.

The second model developed by Adalberto Alberici in the 1975, differently from the Altman's one, utilizes five different equations taking into consideration the five years prior the bankruptcy[68] (Madonna S. et Poddighe F., 2006):

Year $_{t-5}$

$$Z_{t-5} = -0{,}00401\ X_1 + 0{,}00203\ X_2 + 0{,}00346\ X_3 - 0{,}02201\ X_4 + 0{,}01374\ X_5 + 0{,}00108\ X_6 - 0{,}00417\ X_7$$

Year $_{t-4}$

$$Z_{t-4} = 0{,}00164\ X_1 + 0{,}00350\ X_2 - 0{,}01659\ X_3 - 0{,}04353\ X_4 + 0{,}04026\ X_5 + 0{,}00013\ X_6 + 0{,}00105\ X_7$$

Year $_{t-3}$

$$Z_{t-3} = -0{,}00213\ X_1 + 0{,}00319\ X_2 + 0{,}00421\ X_3 - 0{,}02482\ X_4 + 0{,}011613 X_5 + 0{,}00055 X_6 - 0{,}00319 X_7$$

Year $_{t-2}$

$$Z_{t-2} = 0{,}00004\ X_1 - 0{,}01528\ X_2 + 0{,}03013 X_3 - 0{,}07389\ X_4 + 0{,}07658\ X_5 - 0{,}000446 X_6 + 0{,}004828\ X_7$$

Year $_{t-1}$

$$Z_{t-1} = 0{,}00182\ X_1 - 0{,}02579\ X_2 + 0{,}00489\ X_3 - 0{,}05185\ X_4 + 0{,}00295\ X_5 - 0{,}03831\ X_6 - 0{,}01538\ X_7$$

[68] Madonna S. et Poddighe F., 2006, *"I modelli di previsione delle crisi aziendali: possibilità e limiti",* Giuffrè Editore

Where:

- X_1 = Net income / total assets
- X_2 = Total debt / total assets
- X_3 = Shareholders funds / PPE
- X_4 = Shareholders funds + long term debt / PPE
- X_5 = Current assets / current liabilities
- X_6 = Quick assets / Current liabilities
- X_7 = Current liabilities / Total assets

It has to be highlighted that Alberici's "cut off" values work in a different way, since, differently from Altman, the firms that cross the threshold are classified as insolvent while that ones that show a measure below, are classified as safe. According to Alberici, this limit is 5,494 for the fifth year, 34,229 for the fourth year, 120,221 for the third, 7.192,602 for the second and finally 92,708 for the first year prior the bankruptcy.

The third discriminant function is from the Bottani's research:

$$Z = 1{,}981\ X_1 + 9{,}841\ X_2 + 1{,}951\ X_3 + 3{,}206\ X_4 + 4{,}037\ X_5$$

Where:

- X_1 = Working capital / total assets
- X_2 = Other shareholders' funds[69] / total assets
- X_3 = EBIT / (total assets – cash and cash equivalents)
- X_4 = shareholders' funds / (Shareholders funds + total liabilities)
- X_5 = sales / total assets

Concerning the firm classification, similarly to the Altman's analysis, they are identified three sections delimited by the respective values obtained from the Z score equation:

- The insolvency zone, represented by values of the Z score lower than 4,846;
- The precautionary zone, define by values between 4,846 and 8,105;
- The safe zone that is composed by firms that obtained a value above 8,105;
- Finally, the "cut-off" point has been fixed by the value of 7,14;

[69] Other shareholder funds = *"Riserva legale"* + *"Riserva straordinaria"*

The fourth discriminant function developed by Ohlson is the subsequent:

$$P = -1{,}32 - 0{,}407\,X_1 + 6{,}03\,X_2 - 1{,}43\,X_3 + 0{,}076\,X_4 - 2{,}37\,X_5 - 1{,}83\,X_6 + 0{,}285\,X_7 - 1{,}72\,X_8 - 0{,}521\,X_9$$

Where:

- X_1 = log (total assets / GNP price-level index)
- X_2 = Total liabilities / Total assets
- X_3 = Working capital / Total assets
- X_4 = Current liabilities / Current assets
- X_5 = One if total liabilities exceed total assets, zero otherwise
- X_6 = Net income / Total assets
- X_7 = Cash flow from operations / Total assets
- X_8 = One if net income is negative for the last two years, zero otherwise
- $X_9 = (NI_t - NI_{t-1}) / (|NI_t| + |NI_{t-1}|)$
- The "cut off" point is set to the value of 0,038; for values greater than this the firm is classified as insolvent, safe otherwise.

The Springate's discriminant function is a simplified version of the Altman's Z score[70] (Lubawa, Louangrath, 2016):

$$Z = 1{,}03\,X_1 + 3{,}037\,X_2 + 0{,}66\,X_3 + 0{,}40\,X_4$$

Where:

- X_1 = Working capital / Total assets
- X_2 = EBIT / Total assets
- X_3 = EBT / Current liabilities
- X_4 = Sales / Total assets
- 0,862 represents the cut off points so that for values below the threshold the firm is classified as in bankruptcy risk;

Finally, the Legault's function is represented by:

$$CA = 4{,}5913\,X_1 + 4{,}5080\,X_2 + 0.3936\,X_3 - 2{,}7616$$

Where:

- X_1 = capital / Total assets

[70] Lubawa, Louangrath, 2016, *"Using Altman Z score to assessthe financial effects of multiple Loans on SMEs"*; *International journal of research & methodology in Social Science;* Vol. 2, No. 1, p.63;

- X_2 = EBIT + financial expenses / Total assets
- X_3 = Sales / Total assets
- The “cut off” point is determined by -0,03;
- The model shows the same accuracy of the Springate Z score, in other words 83%;

As briefly introduced on the introduction, the thesis is finalized to the evaluation of the predicting ability of the Z scores models previously exposed, for the purpose of being used as alert systems. In order to reach this purpose, they have been taken into account 513 Italian firms operating in the manufacturing industry with an insolvency proceeding. The data has been taken from the *Orbis* platform since it provides the financial statement, the income statement and the cash flow statement and, finally, the status of the company, in other words whether it went in bankruptcy or it is still existent. The available balance sheet data goes takes into account the period that goes from 1991 to 2018 and from the first year to the fifth year prior the bankruptcy. The outcome of the analysis identifies the Legault and subsequently the Altman’s Z scores as the most accurate and consistent, since they show the highest percentage of correct classifications, respectively 82,65% and 80,90%, and the lowest volatility over the whole period taken into consideration, or rather an average decrease of respectively 0,49% and 1,10%.

On the other hand, the Alberici’s and the Ohlson’s discriminant functions were revealed as the most unreliable models for the research purpose due to their correct classification percentage below 25%. Anyway, it has to be highlighted how, according the analysis, each Z score loses its efficacy in evaluating a firm in periods distant from the failure and finds some difficulties in the identification of active companies, in the case they are in financial distress. As a matter of fact, taking into account the population made up of companies categorized as non-insolvent by the models, on average, the error of misclassification is equal to 80% in the last year of activity. Moreover, even the most performing Z scores, in other words the Atman and Legault, reveal disappointing outcomes in the distinction of safe companies. Indeed, concerning the former, the misclassification error reaches 88%, while the latter reaches 75%.

MODEL'S ACCURACY COMPARISON WITH THE THESIS ANALYSIS[71]										
	t-1	T-1	t-2	T-2	t-3	T-3	t-4	T-4	t-5	T-5
Altman	95%	81%	72%	80%	48%	80%	29%	77%	36%	76%
Alberici	86%	17%	86%	17%	83%	17%	69%	17%	79%	18%
Bottani	94%	73%	NA	70%	NA	66%	NA	65%	NA	56%
Ohlson	96%	23%	NA	18%	NA	16%	NA	18%	NA	18%
Legault	83%	83%	NA	81%	NA	81%	NA	81%	NA	81%
Springate	83%	77%	NA	75%	NA	70%	NA	67%	NA	61%

After the analysis concerning the efficacy of the bankruptcy predicting models, a second study about the failed manufacturing companies has been developed. Below the results obtained.

	Average	Maximum value	Minimum value
TL	60.420.178,47	5.875.475.000,00	27.015,00
TL/TA	90,19%	848,35%	0,91%
DSO	126,25	455,89	0,25
Avg. PP	140,29	597,02	-365,99
Ds Inv.	131,71	605,98	0,22
CCC	120,04	947,80	-569,33
NWC	8.869.676,52	3.223.749.000,00	-331.086.000,00
NWC/TA	4,00%	739,15%	-544,57%
ROE share fund	-18,60%	1056,79%	-1907,35%
ROE	-3,91%	8256,77%	-4385,75%
NOA	43.899.892,26	6.940.784.000,00	-33.748.120,00
ROIC EBIT	0,12%	676,07%	-320,45%
ROIC EBITDA	7,21%	649,48%	-1350,91%
Fin. Cost ratio	20,37%	253,41%	-1503,73%
Profit margin	2,49%	69,81%	-158,44%
Asset turnover	3,06	104,37	-97,38
Op. Profit margin	-2,13%	62,34%	-275,77%
tax effect	10,97%	465,38%	-1728,89%
EBITDA/Sales	2,48%	69,81%	-158,44%
Op.cost/Sales	97,52%	258,44%	30,19%
Shareholders' funds/TA	9,81%	99,09%	-748,35%
NI/Sales	-6,25%	170,44%	-377,46%

[71] T-n = results from the analysis

The aim of the thesis was to assess the efficacy of the bankruptcy predicting models in order to utilize them as possible early warning tools in accordance with the art. 3 of the new Italian Insolvency Code.
To reach this purpose, all the data downloaded from the Orbis platform have been analyzed in an excel file providing in this way the outcomes exposed in the previous chapter.
The overall results reveal how the models are characterized by different levels of accuracy, some of the such as the Alberici's Z score are totally unable to make a correct classification of the enterprises while, others, such as the Altman and the Legault's ones, present an accuracy ratio of around 80%; it has to be highlighted how the last one show also consistency over time.

The outcomes provided by the analysis, in order to make a correct final judgement about these models, have to be linked with the nature and the purpose of the alert systems, in other words the identification of the arising crisis at early stage and in a timely manner. It has been demonstrated how the models lose their efficacy over time, so that the accuracy is inversely correlated to the increase of distance from the date of the failure, colliding with the objective of the article 3 of the Italian Insolvency Code. This discrepancy is further intensified by the possibility of using substituting methods and tools to detect the risk of insolvency more promptly than the Z scores, just following the directions and indexes exposed in the Chapter I.

To conclude the bankruptcy predicting models previously analyzed are not an efficient tool to be used as early warning tool. Anyway, it should be noted the performances of the Legault Z score, that showed the best accuracy and consistency over time even if characterized by difficulties in identifying active companies, so that it can be classified as an unreliable system to predict insolvency.

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