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CORPORATE CRISIS AND BUSINESS INSOLVENCY FORECASTING MODELS: EMPIRICAL EVIDENCE BY THE FINANCIAL STATEMENTS ANALYSIS AND THE Z-SCORE MODEL.

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1. Introduction

The last decade has been characterized by the presence of a structural crisis accompanied by a severe global recession, that, with particular reference to the Italian context, has led to the standstill of entire economic sectors in terms of sales and wealth produced. In addition to the economic stagnation, there have been strong transformations concerning the economic system, such as changes in the production processes, shifts in consumer habits and tastes, a growing globalization affecting both the productive and the financial markets. The sum of these events has put businesses to the test, so much so that nowadays business crisis is considered an integral part of the company's life cycle. Corporate crisis no longer represents an extraordinary and exceptional event; on the contrary, its growing recurrence has led to consider it as a "normal" moment that any company can face. This new conception has stimulated a line of research aimed at the timely forecasting of the crisis, since it is assumed that signals linked to detectable symptoms can be captured and quantified with appropriate instruments. Identifying in time the premonitory signs can be of great help for the management, which, aware of the critical situation, can apply the necessary corrective measures. The importance of monitoring the company's conditions and preventing the state of crisis is underlined also by the recent Italian Bankruptcy Reform, through which the Legislator has developed additional tools to the "classic" ones, to anticipate the emergence of difficulties and to facilitate the recovery process. Regarding the Italian context, the systematic use of business crisis forecasting tools, accompanied by their continuous development to adapt to the changing contexts, is fundamental as the number of companies in difficulty is growing fast in our Peninsula. To get an idea, just look at the official website of the Italian Ministry of Economic Development (https://www.mise.gov.it/index.php/it/impresa/imprese-in-difficolta) containing the countless resumes of the companies for which a "table of crisis" has been opened. On average, every year 146 companies of significant size inform the Government of the decision to reduce or close their activities in Italy, with a total of employees affected ranging from 118,000 to 180,000. The number of companies "officially" declared in crisis at the Ministry has increased over the years: today they are 149, belonging to the most varied sectors. For some, disputes have been pending for even more than seven years.

Considering the economic framework just described, there is a clear need to develop and to apply efficient crisis prevention tools endowed with good predictive effectiveness. Among the most "famous" in literature and the most widespread in practice, there are the Z-score Model and the Financial Statements Analysis, object of the present work. The aim is to evaluate, from an empirical point of view, the validity of the Financial Statements Analysis and the Z-score

Model as crisis prevention instruments. Both tools have not been free from criticism in the past years: the Z-score Model has been reformulated several times to adapt to new application contexts, but its configurations date back to not very recent years and rarely have been applied to the current Italian entrepreneurial panorama; the Financial Statements Analysis, although still today constitutes the starting point for the formulation of a judgment on the company's state of health, lacks reliability for many people, due to the often altered accounting documents and the weak ability to highlight the crisis before its degenerative phase. To have an empirical evidence of their validity, both models will be applied to a sample of Italian companies for which a table of crisis has been opened at the Ministry of Economic Development. If the analysis does not demonstrate a good predictive capacity, further reformulations and modifications will be necessary to adapt the models to the Italian reality.

The present work is organized as follows: Chapter 2 deals with the theme of corporate crisis, analyzing its evolution stages, warning signals, and describing causes and possible solutions. In Chapter 3 the most "famous" crisis forecasting models from the literature are presented, divided into models belonging to the *model-based approach* and models belonging to the *non model-based approach*. In particular, the Z-score Model and the Financial Statements Analysis will be studied in more detail as objective of analysis for the empirical evidence. The Chapter ends with a paragraph dedicated to the new alert system (the so-called "red flags") that the Italian Legislator has implemented through the recent Bankruptcy Reform (*decreto legislativo n. 14/2019*). Chapter 4 describes the research methodology that allows building the final test sample to which models will be applied. Finally, Chapter 5 reports the results obtained from the application, respectively, of the Z-score Model and the Financial Statements Analysis. Where obtained results differ from expected results, an attempt has been made to give a possible explanation of the limitations of the model and to propose an improvement for further developments or reformulations in the future.

2. The corporate crisis

2.1. Definition of corporate crisis

In all market economies, the life of the company is characterized by the alternation of positive and negative phases: in this sense, it is possible to state that corporate crises are permanent components of the modern system (Guatri, 1995).

Especially in recent years, the recurrence of crisis situations has led to a "normalization" of the crisis phenomenon, considered no longer as an exceptional and extraordinary situation, but, on the contrary, a frequent phase in the company's life cycle. Recent literature moved in this direction, modifying the concept and definition of crisis: there has been a shift from the concept of *crisis management*, as a sporadic moment of emergency, to the concept of *crisis risk management*, thus focusing attention on the ability to interpret warning signals and to intervene promptly with appropriate and standardized corrective tools.

The alternation of successful and crisis phases in the life of a company can take place cyclically (temporally) or can be structural.

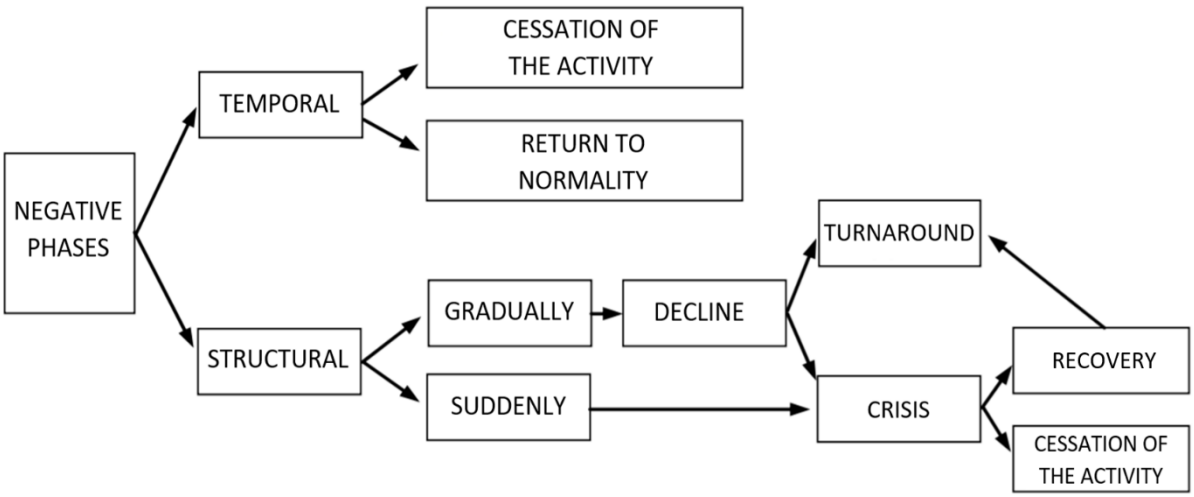
- Negative phases of *temporal or cyclical nature* are characterized by a periodic rhythm in the company's life, according to which positive phases alternate with negative ones. The company must react to these negative situations to avoid exclusion from the competitive context. Since it is used to this alternation, it equips itself in advance with the appropriate and necessary tools to overcome the unsuccessful periods. Following these cyclical negative phases, the company can return to normal or, in the worst case, ceases its activity.
- Negative phases of *structural nature* are the most dangerous. Usually, causes of crisis remain hidden for a long time, especially if linked to a deep and radical change in the business context; then they appear suddenly and in an unexpected way, requiring a change to the business strategy.

  Negative circumstances of structural nature can be distinguished by different degrees of intensity of manifestation. They can take place *gradually* over time, and therefore progressively lead to a state of crisis. In these cases, crisis is anticipated by an intermediate phase called *decline*, accompanied by warning signals that appear quietly and progressively intensify. There is not always a marked discontinuity between decline and crisis, and for this reason the separation between the two is not easy to identify. Decline harms the company's equilibrium conditions: if not appropriately thwarted, decline can degenerate into crisis. Decline is a phase of great interest, at the base of the

new concept of *crisis risk management*: its analysis allows to promptly and efficiently identify any symptoms of crisis, as well as the appropriate corrective measures to be implemented to avoid its degeneration. If decline is identified in time and is still reversible, the company can adopt a turnaround process, which corresponds to the set of all systematic recovery and revitalization processes put in place during the decline phase, before this last degenerates into crisis. In the worst case, when appropriate corrective measures are not implemented or these measures are ineffective, decline can turn into a crisis. Crisis is characterized by a series of significant economic and capital value losses, repercussions on financial flows, and a loss of confidence by all stakeholders. The crisis state can lead to the choice to cease the activity when its continuation is impossible, or to the adoption of a *recovery plan* (which can be followed by a turnaround when economic conditions are re-established).

Negative phases of structural nature can also take place *suddenly* over time. In these cases, the normal operation of the company is directly replaced by a state of crisis, in rare instances preceded by a rapid decline. Since the premonitory warning signals do not occur, possible alternatives consist of the cessation of the activity when the company's equilibrium conditions are irreversibly compromised, or a recovery plan.

Figure 1: Development path of negative phases



Source: adaptation from E. Giacosa, A. Mazzoleni (2012), *Il progetto di risanamento aziendale*, cit., p. 56.

It is difficult to give an exhaustive definition of corporate crisis, which includes all the different realities of the phenomenon. Here, the definition of crisis in terms of "Value Theory" by the Economist L. Guatri is proposed.

According to the Value Theory, the firm persists and develops only by generating new value: its sole purpose and its essential reason for the survival is the continuation of existence through

the ability to self-generate over time, which occurs through the continuous creation of economic value. Given the fundamental equation of value

$$W = \frac{R}{i}$$

where:

- W is the firm's value;
- R is the income (or financial) flow;
- i is the discount coefficient that considers the risk;

the company is not able to satisfy its purpose of self-generation over time when there are null or negative increases of W. Crisis and decline are related to negative variations of value, which may depend on a decrease in flows (internal event) and/or on a change in the risk conditions (external event). As previously mentioned, there is not always a clear-cut separation between decline, where present, and crisis.

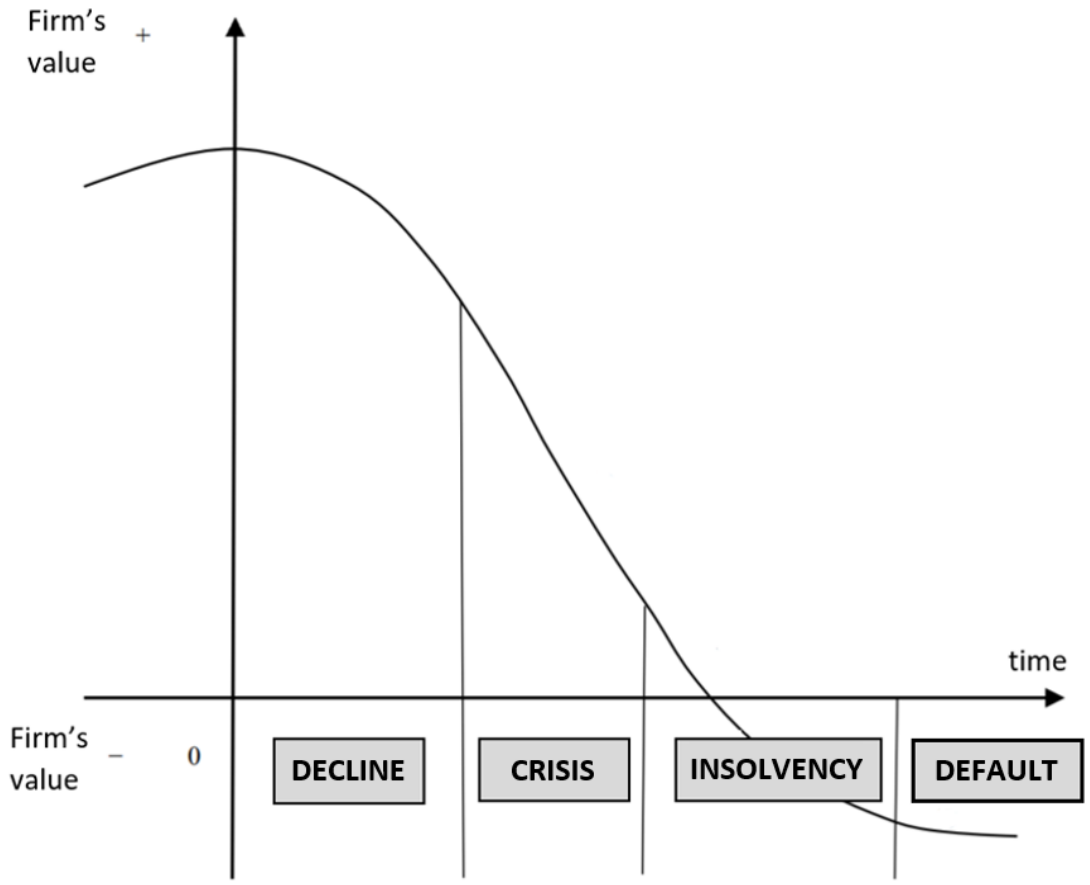
The concept of *decline* is linked to the idea of negative performance in terms of change in value: the company does not create value, but destroys it, firstly toward shareholders and secondly towards other stakeholders. This occurs not only when the firm's economic flows become negative, but also if a prospective reduction of positive economic flows is foreseen, provided that these losses are irreversible and systematic in the absence of corrective measures. The extent of value destruction is measured over a certain period, usually annual or pluriannual. Therefore, the company is in a phase of decline when it loses value over time.

The concept of *crisis*, as properly meant, is linked to further degeneration of decline. Crisis involves difficulties in restoring the ordinary business management and corresponds to a state of serious instability, due to significant economic losses in profitability and capital value, heavy repercussions on financial flows, loss of credit capacity, and loss of trust towards all stakeholders. Crisis is, therefore, the full-blown and outwardly apparent phase of decline, or, in other words, the continuation of a negative trajectory of business events in which the aggravation of economic and financial imbalances is externally fully perceived. These economic and financial imbalances, destined to remain over time if appropriate corrective actions are not implemented, will inevitably lead to a state of insolvency and successively to a state of default. *Insolvency* means the inability to regularly meet expiring payments, and corresponds to the most severe phase of crisis from a financial point of view. It is measured in terms of flows, and highlights a situation of financial tension where cash flows generated in the unit of time are not sufficient to fulfill obligations deriving from existing contracts. *Default* means a definitive capital imbalance and corresponds to the pathological phase of crisis, since

crisis is irreversible at this point. It is measured in terms of stock, and highlights a situation of corporate deficit such that the value of assets is not sufficient to guarantee debt repayments. Insolvency and default represent the most acute and dangerous symptoms of a crisis and are usually observable *ex post*, when the capacity to react and to manage the crisis is already limited.

In the company's life, the critical phase of crisis entails inevitably a worsening of the economic and financial balance; in other words, the company is not able to satisfy the expectations of stakeholders for a medium-long period. This situation is hardly connected solely to financial reasons: if that is the case, when the financial equilibrium is restored, also crisis disappears. In most cases, the state of crisis is mainly connected to economic reasons (inadequacy of the production mix, inefficiency of commercial policies, etc.), therefore restoring only the financial equilibrium will not be a definitive solution; on the contrary, economic causes below the crisis will generate other financial imbalances in subsequent times.

Figure 2: Stages of deterioration of the company's value



Source: adaptation from E. Giacosa, A. Mazzoleni, *La previsione della crisi d'impresa: strumenti e segnali di allerta*, cit., p. 10.

2.2. Warning signals

Crisis does not represent an inevitable fact in the life of a company, nor a sudden and unpredictable event. Both decline and crisis are anticipated and accompanied by warning signals: the former, although not exclusively, of a qualitative type, the latter of a quantitative type and, therefore, sometimes measurable. These indicators refer to "internal" phenomena to the company, thus leaving aside those macro-economic and sectorial events that are also possible factors of decline and crisis. According to Guatri (1995), among the qualitative symptoms which generally precede the decline phase, there are:

- *worsening in relations with suppliers*

This is certainly one of the worst. When suppliers demand short-term or cash payments, monitor customers' exposures regularly, or break collaborative relationships, it means that news of deterioration of the company's conditions has widely spread.

- *worsening in relations with the financial community*

Generally, banks and financial markets perceive almost immediately phenomena of decline and crisis, therefore there is a consequent worsening in conditions for obtaining credit (higher guarantees, higher rates, limitations on certain transactions) or for obtaining capital (bonds with high rates, convertible bonds with high exchange rates, share prices close to par value).

- *tensions in relations with employees*

Reduction or immobility of wages, lack of any type of stimulus, cut in resources invested in personnel training, inevitably lead to a reduction in the personnel or to the use of working forms with temporary suspension. Growing tensions that will arise are perceived externally as negative symptoms.

- *loss of important managers and highly qualified personnel*

The loss of important people not only undermines the image and reputation of the company, but also leads to an impoverishment of intangible resources with a consequent impact on the consensus of stakeholders.

- *lack of strategic capabilities*

This occurs when adopted strategies are unclear and improvised, or change too frequently. At the same time, the absence of shared strategic goals among human resources can cause problems in both the short and the medium term.

Among the quantitative symptoms which generally precede the crisis phase, there are:

- *loss of market share*

The loss of market share is quite evident when global demand is stationary, since the loss is accompanied by a decrease in sales. The signal is less clear when demand is gearing up: in this

case, the loss of market share is "hidden" by an absolute increase in sales. Once global demand has stabilized, the lower percentage development of the company, compared to its competitors, will lead to falling sales and approaching difficult conditions.

- *loss of profitability and negative cash flows*

In particular, situations in which the loss of profitability reduces cash flows, but does not make them negative, are the most dangerous: the top management is not harassed by financial pressures and can even postpone losses over time through questionable budgetary policies.

- *decrease in sales or worsening of the production mix*

Reduction in sales is always a negative sign, except in the cases where it is accompanied by an increase in prices and margins. Equally negative signs are the shift toward products with lower margins or when a lowering of the price is used to obtain new orders from customers: if the expendable margins are narrow, results will become negative soon.

- *absolute or relative worsening of productivity*

Absolute or relative losses of productivity often occur due to a prolonged lack of investments in new plants and machinery, the absence or ineffectiveness of R&D activities, or the decreasing motivation of personnel.

- *deterioration of the financial structure*

Each sector often requires an appropriate financial structure, both in terms of debt to equity ratio and in terms of composition of liabilities (short, medium, and long-term debt). A significant worsening of the financial structure, if not resulting from specific reasons such as policies for fiscal optimization or policies for the improvement of the company's value, is a negative signal to which companies must react promptly with adequate measures (capital increases, debt restructuring operations).

- *strong increase in debt and strong reduction in liquidity*

To maintain its normal operations, it is necessary for the company a balance between internal and external sources of financing, and a certain equilibrium among the different typologies of external sources. The increase in debt beyond certain thresholds and the decrease in liquidity below others are among the clearest signs of imbalances, which show a company whose survival is based on the dependence from external sources.

- *higher impairment on trade receivables*

High credit losses are usually linked to an inaccurate selection of customers by the company, dictated by the need to maintain or increase sales levels. Other times it is the evident weakness of the company that allows customers to obtain better prices, more deferred payment terms, heavier commitments and services. The loss of the company's bargaining power leads to a

worsening in the credit exposure, which, if it concerns only the single company and not the whole sector, will inevitably lead to a state of crisis in a short time.

As previously mentioned, the list refers to phenomena internal to the company. However, the severity and/or the recurrence with which these signals manifest themselves is linked not only to "internal" problems but also to the sector to which they belong. Some clarifications in this regard are necessary. Sectors are characterized by different stages of life (new sectors, expanding sectors, mature sectors), and warning signals occur with different intensities in all stages. There are imbalances related to the introduction and the novelty of the sector, such as negative cash flows, initially poor or negative profitability, great variability in prices and market shares, but also imbalances related to the development of the sector, especially if very rapid. Some sectors are characterized by a cyclical nature: obviously, imbalances will occur in the negative periods of the cycle, to be then reabsorbed in the positive ones. Since this "fluctuation" is predictable, it is unlikely that signals (if linked to the cyclical nature of the sector) are considered as precursors of a state of decline or crisis. Therefore, only extraordinary fluctuations in width and duration can be connected to crisis phenomena. Finally, there are sectors in which competition is more aggressive, due to the entry of foreign competitors operating with lower costs, to operations of merger and acquisition that increase the competitive strength of one group over another, or due to the entry of new national competitors. In these cases, the growth of the market share is pursued by some companies even at the cost of serious losses for several years: these losses are considered as a long-term productive investment.

Leaving out sectorial events, the list referred to internal phenomena, given its practical utility, can be considered as an excellent starting point for identifying the phases of decline and crisis; however, like lists of other authors, it is not exhaustive and, since each company is different, it cannot have a universal value. Each symptom does not contribute to the creation of value for the company or, in the worst case, leads to its destruction, therefore the real fundamental indicator of decline is precisely the *destruction of value*, detected by the already mentioned equation $W = R / i$. Insufficient, null, or even negative variations in W do not allow the company to achieve its objectives and to survive in the medium-long term. The Value Theory has been enormously successful in this sense, requiring periodic and systematic control of the value of the firm and of its main areas. The objective of the Theory is the systematic search of all the causes of destruction of value and their elimination, using the operational tools of the *Value Based Planning*.

2.3. Possible causes of corporate crisis

Identifying the symptoms of crisis is useful both for diagnosing its causes and for taking actions in a timely and effective manner. Regarding the first aspect, the state of crisis is hardly attributable to a single defined cause; on the contrary, there are usually several factors that generate it (we often refer to them as “micro causes”). These factors nourish one another and together contribute to the advancement of the crisis. Generally, the causes of a crisis must be sought where the sources of the company's competitive advantage reside.

2.3.1. Different approaches in causes identification

The identification and the analysis of the causes are fundamental to develop a correct diagnosis of the underlying problems and to design an efficient strategy for their resolution, with the identification of timing, objectives, policies, and measures. This analysis can be carried out by adopting two different, but contiguous, approaches: the subjective approach and the objective approach.

According to the *subjective approach*, the causes of the crisis are attributable to the behavior of the protagonists of corporate life (the so-called human capital), which are considered as the only source of corporate success or failure. When a state of crisis occurs, the "*bad management*" (or “*poor management*”) is the first to be accused: an inadequate composition of the management, an ineffective control of the financial aspects, an inaccurate investment policy, absence or ineffective sharing of strategic and operational choices with employees, errors in strategic planning and in the conduct of operations, unethical decisions, an inefficient management of resources which can be too expensive compared to the objectives to be achieved and to the results already obtained, are all factors that can compromise a good business performance. According to this approach, the *ownership* (*controlling interest*) is secondly impeached, usually because of its incorrect policies such as excessive dividend distributions, risk aversion, unwillingness to provide guarantees to creditors, incorrect management choices. Lastly, *all other human resources* operating in the company: the lack of preparation, training, and motivation, the lack of solidarity towards the lot of the company, the failure in sharing values, and a mindset far from the company’s logic of quality, can contribute to the development of negative circumstances for the firm. With the subjective approach, the elimination of people at different corporate levels (in particular management and ownership) and, therefore, of their incorrect behaviors, inefficiencies, and incapacities, would lead to the consequent elimination of the state of crisis. However, such approach is not exhaustive and, especially today, is not suitable for describing the complex reality of the crisis, given that some

events and forces could be "external" to the company and could escape the control of the management. So, the subjective approach must be integrated with the objective approach.

According to the *objective approach*, the corporate crisis may also depend on factors external to the company, uncontrollable and independent of individual behavior. Examples are the decrease in global demand for a product or a category of products, the increase in the cost of production factors, the effect of competition on sales prices. The corporate crisis is therefore a phenomenon linked to the dynamism and instability of the environment. Critical factors to be controlled must be sought-after where the sources of competitive advantage are located, and must be selected through appropriate analyses at a macroeconomic level (especially if the company operates in an international context), at a sectoral level, and at the company's level. According to this approach, there are five different typologies of corporate crisis, depending on the causes that cause them:

- *Inefficiency crisis*

Inefficiency crisis occurs when one or more sectors of the business operate with returns not in line with those of competitors. Costs are higher due to obsolete equipment, outdated technologies, incorrect location of production plants, inability or scarcity of the workforce, overuse of raw materials, excessive bureaucratic processes. The production area is usually the most affected, but inefficiency crises can affect also other functional areas: for example, a commercial inefficiency may occur due to the imbalance between marketing costs and results obtained (it is the case of an unsuccessful commercial campaign or an excessive dispersion of sale points that does not allow the generation of adequate results).

- *Overcapacity/inflexibility crisis*

Overcapacity/inflexibility crisis arises from one of the following situations:

  - lasting reduction in the volume of demand for the company due to production overcapacity at a sector level: in particular the crisis develops if, following this decrease in demand, the company is not able to adapt its cost structure (especially fixed costs) to the new lower revenues;
  - lasting reduction in the volume of demand for the company related to the loss of market share: in this case, crisis is more serious since it does not concern the entire sector (as in the previous situation) but only the specific company, which must quickly resort to a cost adjustment;
  - development of revenues lower than expected, due to fixed investments pre-built for greater dimensions.

A particular case of inflexibility crisis, not connected to overcapacity situations, results from cost increases not counterbalanced by corresponding price increases (which are subject to public scrutiny).

- *Products decay crisis*

Products decay crisis occurs when the reduction of positive margins between price and cost is below the limit necessary to cover fixed or common costs and to ensure a sufficient profit. This type of crisis manifests itself at first with imbalances, and later with economic losses. Indicators to keep under control to avoid the crisis are the *gross margin* and the *contribution margin*, the contraction of which may depend on factors such as the achievement of the maturity stage of the product, or the market entry of new and more competitive foreign competitors.

- *Lack of planning/innovation crisis*

Regarding planning, a crisis can result from the inability to adapt the company's management to environmental changes. Companies, therefore, operate looking only at the short term, at the expense of medium-long term results, and totally neglecting the preparation of the necessary conditions to face the future. Often the lack of programming derives from the inability to involve people in the company's management: the absence of training programs and clear objectives means that the personnel is not encouraged to participate in the management or that it participates but with little commitment and with the idea of not being able to obtain advantages. Regarding innovation, poor or inadequate innovation policies in products and processes lead to a loss of competitiveness for the company. New ideas, which translate into the identification of new products, new markets, new production methods, new ways of presenting and distributing products, new tactics for increasing the customer's loyalty, are essential to maintain (and to increase) market shares and to be always at the forefront compared to competitors.

- *Financial/capital imbalance crisis*

Financial imbalance crisis derives from high debt, high cost of capital agreed with lenders, and consequently unsustainable financial charges. Specifically, factors that can contribute are:

  - serious lack of own funds (capital) and corresponding net prevalence of debt;
  - marked prevalence of short-term debt compared to other categories of debt;
  - insufficiency or non-existence of liquidity reserves;
  - little or no ability of the company to negotiate the conditions of the credit, given its need to dispose of it at any cost;
  - difficulty to meet deadlines, with the consequent delay of some categories of payments (suppliers, loan reimbursements, social security contributions, wages).

Financial imbalance is the typical cause of a crisis and generates economic losses. Sometimes financial imbalance is associated with a capital imbalance. Capital imbalance crisis occurs when funds bound to the company (capital and reserves) are scarce compared to other components of the Balance Sheet (assets and liabilities). The scarcity of own funds does not allow the absorption of any economic losses, thus exposing the company to a greater risk of crisis and compromising the equilibrium between assets and liabilities.

All these factors are linked by interactions and cause/effect relationships: the financial imbalance, for example, is generated by one or more of the other crisis factors, but in turn involves a further aggravation of these; in the same way, the lack of planning and innovation can cause products decay and inefficiencies, which in turn develop both financial imbalance and inflexibility. Although the objective approach is today the most widespread, analyzing the causes of crisis does not mean identifying only its objective causes: subjective components must always be considered, to ascertain which ones can be eliminated and which ones cannot. Therefore, only through the joint use of approaches, it will be possible to achieve an overall picture of the causes and contributing factors that lead to the crisis phenomenon. Whatever the cause, crisis develops progressively within the company, but usually it gets evident when the situation has become almost irreversible.

2.3.2. Types of corporate crisis

The causes leading to a crisis are a combination of events linked to each other, and a distinction as the one reported in the previous paragraph is difficult. Therefore, different classifications of types of crisis are proposed below, based on parameters such as the source of the crisis, the manifestation of its causes, the moment in which it originates, and the object affected by the crisis.

According to *the source of the crisis*, it is possible to distinguish:

- *crisis with external source*

  When crisis has an external origin, factors that can be controlled by the management are few. These crises usually involve one or more economic sectors, and for this reason require a strategy of productive reconversion as solution. Among them, there are:

  - *economic crisis*, such as the drop in demand, the increase in unemployment, the increase in prices of raw materials, the weakness of financial markets, the inadequacy of the banking system, unfavourable changes in sector legislation;
  - *ecological crisis*, that is, phenomena that cause damage to the environment and that consequently have repercussions on the business activity (the explosion of a nuclear

power plant or the spillage of oil into the sea);

- *catastrophic crisis*, which is linked to accidental damages such as an earthquake, a tsunami, a flood, or linked to wars and terrorist attacks.

- *crisis with internal source*

  Crises have internal origin when they are caused by strategic and organizational errors by the management. Among factors of an internal crisis, there are:

  - *strategic error*, when the definition of the mix of investment portfolios is not correct;
  - *positioning crisis*, since the company made mistakes in choosing the market segments and the niches to serve (a repositioning strategy of the production range is necessary);
  - *dimensional crisis*, where the surplus or the shortage of resources, or the lack of flexibility of the structure as against changing external events, cause the company to be undersized or oversized compared to the production needs and to the results achieved (here the company has to adopt a restructuring strategy);
  - *inefficiencies crisis*, when there is an imbalance between incurred costs and obtained results, that can be solved through a reorganization strategy.

Referring to Bibeault's well-known research in *Corporate Turnaround*: *how managers turn losers into winners* (1982), the decline and the subsequent phase of crisis would be mainly attributable to causes of internal nature in 4 out of 5 cases. However, it should be noted that in recent decades causes of external nature, such as macroeconomic, political, and social factors, have accentuated their weight throughout the world as a result of the growing globalization.

According to *when causes of crisis occur over time*, there will be:

- *crises generated by first-line factors*, which are at the origin of the crisis and are represented by lack of planning/innovation, products decay, and inefficiencies;
- *crises generated by second-line factors*, which come into play at a later time, aggravating the situation. Among these, overcapacity, inflexibility, and financial imbalance.

According to *when crisis originates*, it is possible to distinguish:

- *birth crisis*, which is due to errors made in the establishment and the design of a new company, such as strategic mistakes related to its creation phase;
- *management crisis*, which is due to events occurred during the management of the company.

Lastly, according to the *object affected by the crisis*, there are the following typologies:

- *widespread crisis*, when it affects entire sectors or industries;
- *specific crisis,* when it affects specific weak companies.

2.4. Evolutionary stages in the corporate crisis

According to Buttignon (2008), it is possible to identify three different stages in the corporate crisis: potential crisis, governable crisis, and irreversible crisis.

- *Potential crisis*

Potential crisis is characterized by negative expected operating cash flows or by positive expected operating cash flows destined inertially to decrease over time. Negative projections regarding cash flows are due to specific market and company's phenomena, such as slump in demand, pressure on prices, loss of products competitiveness, obsolescence of assets, scarce investments in R&D. Especially in this phase, it is crucial the ability of the management to perceive and capture the first signs of a crisis, which often appear in a mild form and whose recognition is hindered by the dominant culture of the company, conditioned by its story, its past successes, or its consolidated methods for running the business.

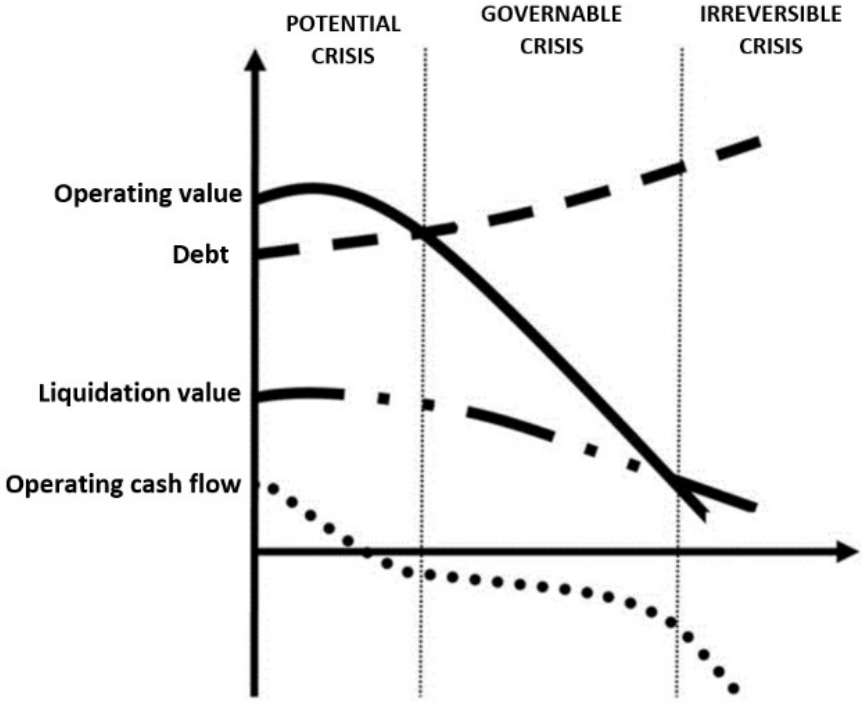
In general, the corporate operating value moves in close relation with the expected evolution of operating cash flows, accentuating its dynamic. In listed companies, this trend is particularly evident as it is reflected directly, even if according to imperfect logics, in the stock market prices, stimulating response actions by the management (this is one of the advantages of the listing). On the contrary, in unlisted companies, the corporate operating value can be only estimated and, as such, it may differ from subject to subject.

The first stage of potential crisis is characterized by a corporate operating value higher than value of debt, but with a negative trend that could lead in a short time horizon (1 or 2 years) to the critical point of the crisis, where the company's operating value equals the value of debt. When crisis reaches its critical point, the value of the share capital is zeroed and crisis becomes "actual", with the potential transfer of control rights over corporate assets from shareholders to creditors. In Figure 3, value of debt is exemplified growing, given the possible financial needs induced by negative operating cash flows. However, it may be that, in some situations, debt is constant or even decreasing (this occurs when, for example, "ancillary" assets are sold). Characteristics of debt are also important: in general, the longer the debt is long-term, with periodic repayments rather than a single one, and at price and repayment conditions independent of management dynamics (case of absence of covenants), the greater the strategic-operational

and financial flexibility available to the management. This flexibility has both positive and negative aspects. The management, possessing more information and knowledge about the company, could recognize crisis with less difficulty and could intervene promptly with an efficient recovery plan, without waiting and being hindered by the intervention of creditors. On the other side, this flexibility can be used by the management to delay the recognition of crisis and to postpone a possible action, largely exceeding the critical point in the worst cases. The management could also implement certain behaviors to the detriment of creditors, such as the perpetuation of obsolete business models and management logics, or the pursuit of high-risk actions, relying "only" on possible positive results, given that the negative ones would fall exclusively on creditors.

In the stage of potential crisis, it is possible to reverse the negative dynamic of the company through both internal management operations, such as the restructuring plan or the strategic-operational turnaround, and external management operations, among which there are alliances, partnerships, transfer of control (desirable when the transfer price is higher than the current operating value, taking into account also the internal restructuring plan). It is also possible to implement financial measures, like the request to redefine the duration of debt (rescheduling) and its price conditions, or injections of new capital to support the necessary investment operations for the restructuring.

Figure 3: Evolutionary stages in the corporate crisis



Source: adaptation from F. Buttignon, *Il governo delle crisi d'impresa in Italia alla luce del nuovo quadro normativo: una riflessione introduttiva. Rivista dei dottori commercialisti*, cit., p. 256.

- *Governable crisis*

If the potential crisis cannot be solved, because of the corporate inertia or because of the failure of planned measures, the second stage of governable crisis is outlined.

This stage is characterized by a corporate operating value lower than debt, but higher than the liquidation value. In Figure 3, as mentioned before, value of the debt is increasing in the light of the growing financial needs, while the liquidation value is shown decreasing due to the probable negative effects also on this value caused by the current crisis.

As in the stage of potential crisis, possible measures to restore the normal positive dynamics will be the same; however, given the worsening of the situation, they will be inevitably more radical. Apart from the restructuring plan by internal management operations, alliances, and partnerships, there may be also the transfer of control to other parties, who take charge of the restructuring plan with or without the presence of the current shareholders and management. As in the potential crisis, the severity of the situation may require further capital injections (indispensable now), the rescheduling of debt, but also its reduction (debt write-off) in exchange for any concessions of rights on capital (shares, warrants, convertible bonds, and other forms of options).

- *Irreversible crisis*

The last phase of irreversible crisis is characterized by a liquidation value higher than the operating value, therefore the use of a strict liquidation procedure is here justified. If there are no prospects of recovery of the operating cash flows and if the liquidation value is substantial, it resorts to a process of disintegration of the corporate system, placing the various assets promptly to the highest bidder.

Obviously, the liquidation value of the single asset depends on its characteristics. The more the asset is specific (such as bound production plants, with high disposal costs and limited possibilities of allocation to other uses), the lower the liquidation value (in certain cases even negative if the disposal costs exceed the gross liquidation value). On the contrary, it is possible that intangible assets, such as brands, licenses, patents, and distribution networks, present a high market value even in the event of liquidation. Particularly interesting are those "hybrid" situations where, despite the entry into the irreversible crisis phase by the company, there are still sub-complexes of assets with a potential operating value higher than the liquidation value. These assets (generally intangible assets), if combined with other corporate elements (first of all the personnel), but disconnected from pre-existing negative factors (obsolete plants, incompetent top management), have a substantial operating value that would be wasted with a

pure liquidation process. In these situations, “hybrid” solutions for managing the crisis, aimed at splitting the company and the potentially functioning sub-complex, could be very efficient.

2.5. Solutions to the corporate crisis

2.5.1. Recovery Plan and Turnaround

As highlighted in paragraph 2.1., possible alternatives to the state of crisis consist of the cessation of the activity, when the company’s equilibrium conditions are irreversibly compromised, or a recovery plan, which can be followed by a turnaround process.

The two concepts of recovery and turnaround are closely interconnected and linked by a precise temporal sequence: the *turnaround* refers to those interventions that are implemented during the decline (therefore before the company enters the real crisis phase), or after the recovery plan, when the basic economic conditions have been re-established; the *recovery process* takes place after the declaration of the state of crisis, and requires emergency measures that imply sacrifices to almost all stakeholders.

Recovery process and turnaround differ in the following aspects:

- *degree of voluntariness in making choices*

The recovery plan provides for choices resulting from negotiations among all stakeholders, while the turnaround is the synthesis of the choices made between management, shareholders, and, sometimes but not always, other stakeholders.

- *depth of choices*

The recovery plan provides for strong and very incisive interventions, which have an impact on the capital, managerial, and organizational structure; on the other hand, turnaround interventions are generally less invasive.

- *timeliness in choices*

Since the interventions of the recovery plan are aimed at healing a company whose short-term survival is not certain, the negotiations, the implementation of necessary measures, and the highlighting of the first results must be timely; on the contrary, the turnaround allows longer times, as there is no absolute urgency.

- *form*

Although there is no specific legislation to refer to, the form of the recovery plan is rather standardized. The turnaround process, on the other hand, is implemented through a plan whose form is usually less rigid and generally on an out-of-court basis.

- *subjects involved*

The recovery phase involves several external subjects with high skills on specific issues. These subjects, such as temporary or turnaround managers, financial advisors, legal advisors, and industrial advisors, have as their focus the realization of the project and its timely execution, and once the objective has been reached, they usually interrupt their collaboration. The turnaround project is, instead, entrusted to internal managers, who focus on the long-term development of the company, with the help of external professionals for the preparation of the economic and financial plan.

Recovery plan and *turnaround* are sequential activities, where the former becomes the prerequisite for the latter. In the event of corporate crisis, first of all it, will be necessary to obtain the recovery, that is, to guarantee the restoration of the conditions of the economic and financial equilibrium; subsequently, it will necessary to develop and to start the turnaround process, to take the company beyond the objectives of simple survival, pursuing new medium-long term objectives. The recovery phase can be divided into two sub-phases, according to their different objectives and needs: the emergency phase and the stabilization phase. In the *emergency phase* of recovery, the goal is to guarantee the survival of the company through the search for minimum cash flows to meet non-extendable needs (productivity usually remains negative at this stage). In the *stabilization phase*, the previous financial logic is substituted by the economic logic, and the conditions for the company to return to profitability are created. Table 1 shows the objectives, strategies, duration, and tools available for the recovery plan (in its two sub-phases) and for the subsequent development (turnaround).

Table 1: Recovery and Turnaround

	RECOVERY:		**TURNAROUND**
	EMERGENCY PHASE	STABILIZATION PHASE	
Objectives	Survival; obtaining the monetary equilibrium	Return to profitability; regaining the trust of stakeholders	Growth and development of the market share; confirmation of the medium and long-term objectives
Strategies	Divestitures; disposals; reduction of non-core costs	Divestitures; products valorization; enhancement of operational conditions; profitability analysis and assessments of economic convenience	Acquisitions; development of new products or of strategic business areas

Duration	6-12 months	12-36 months	3-5 years
Audit and control	Financial planning; daily and weekly reports	Management control; gap analysis; monthly and quarterly reports	Management control; gap analysis; quarterly and six-monthly reports; review of the strategic plan

Source: adaptation from D. B. Bibeault, *Corporate Turnaround: how managers turn losers into winners*, cit., p. 239.

2.5.2. Alternatives for managing the corporate crisis

Alternatives for crisis management, whether in-court and out-of-court, should be aimed at the optimal allocation of resources accumulated by the company (*efficiency principle*), starting from the macro-distinction between restructuring, transfer of control, and liquidation. The order is not random if we assume that the company is capable of accumulating specific resources that are difficult to reproduce, endowed with an economic operating value as a complex or as a system of business components.

- *Restructuring*

With the restructuring, the potential of the company is expected to be internally reconstructed and available, preserving the current ownership/control structure. It consists of an intervention project aimed at improving the conditions of use of the company's assets and at exploiting their potential (currently partially or completely unexpressed) to generate economic value.

The *strategic-operational restructuring* may not involve drastic interventions on the financial structure if the expected cash flows from post-restructuring operations, considering the initial financial situation, are such as to allow creditors' expectations to be met (in terms of debt repayment and remuneration). It will be sufficient for creditors to share the expectations expressed by the project, renouncing to possible actions envisaged by pre-existing debt contracts (for example, those related to the non-compliance with covenants).

On the other hand, when the strategic-operational restructuring plan does not allow compliance with the remuneration and/or repayment terms of the pre-existing debt, also a *financial restructuring* is necessary. Considering the dynamics of the operating cash flows, the financial restructuring plan may include a simple rescheduling, a more severe request for debt write-off, or a debt-to-equity conversion, sometimes accompanied by the request for the granting of new finance or additional funds to make investments or to bear the costs of the operational restructuring. In the event that current shareholders refuse to subscribe new capital increases, even and especially if requested by creditors themselves, it is possible to envisage the entry of

new shareholders in the company structure (obviously, the company and the restructuring plan must show a reasonable level of attractiveness for these entering subjects). If capital increases by new shareholders change the company's control structure, the restructuring alternative coincides with the transfer one.

In general, the choice of the best operational solution should not depend on the financial restructuring alternative (debt rescheduling, debt write-off, debt conversion, capital increase), which instead would "follow" the operational management choices. However, this separation between operational and financial choices is not easy to accept: the best operational management alternatives for a certain category of subjects could differ from those of other categories of subjects, taking into account, for example, their different time horizon and their different attitude towards risk.

- *Transfer of control*

With the transfer of control, the restructuring process is entrusted to other subjects (new ownership and probably, but not necessarily, new management), to be pursued in conjunction with other existing activities, in search of synergies. The new entrepreneurial actors, to whom the control of the corporate assets is transferred, bear both costs and benefits from the restructuring project: these subjects can be competitors, other industrial players, financial companies, or individual investors that can act in combination. The new control group may combine corporate assets with pre-existing economic realities, looking for synergistic effects, or may propose new management methods, which exploit the wealth of knowledge, skills, and relationships of the new ownership and/or of the new management.

- *Liquidation*

The liquidation process is to be considered when the destruction of the value of the business complex is an irreversible phenomenon. The alternatives of restructuring and transfer of control would be useless in this context, therefore individual assets (or their minimal combinations) are sold singularly in the market. Liquidation is typically the "last choice" alternative since it is generally assumed that the net present value obtainable from it is lower than the one obtainable from other options.

With respect to this schematization, it is evident that different combinations of these alternatives can be found in concrete business realities: restructuring, transfer of control and liquidation could be adopted for different business areas in which the same company operates, or for different sub-complexes within the company's individual business areas.

2.6. Guiding principles in crisis management

Considering what has been said so far, this last section contains the three guiding principles for the corporate crisis management. These principles have necessarily universal value: the behavior of any person, internal or external to the company, should be guided at any time by these principles in identifying and resolving the crisis.

- *Efficiency*

Efficiency in managing the crisis means reflecting on the best ways to use corporate assets available to the company. The best solution is the one that provides for the allocation of assets in their most productive configuration (in other words the allocation that generates the greatest value), taking into account not only the value of the single assets (*atomistic value*), but also and above all their combinatorial properties. This principle guides all the solutions, both out-of-court and in-court, to allow the optimal allocation of assets among the available alternatives (restructuring, transfer of control, and liquidation).

The efficiency calculation has the objective of maximizing the total value of assets (*enterprise value*), and should be founded on:

- the net present value of expected cash flows from the company's operations (implementing the internal restructuring plan, with related costs and investments);
- the net present value of expected cash flows from the transfer of control of the business complex (sale price net of sale costs);
- the net present value of expected cash flows from the liquidation process (net sale price of assets).

Strictly speaking, the calculation should also consider the value of the exercise option of other alternatives following the choice of a specific crisis solution. In particular:

- the net restructuring value should include the values of the transfer option and the liquidation option that remain in existence in any subsequent phases;
- the net sale value should include the value of the following liquidation option, from the perspective of new owners.

This principle is valid also in the presence of a total value of assets (even in their optimal allocation) lower than debt: an agreement with creditors (the so-called "request for sacrifices") appears necessary to recover value through the pursuit of the best possible alternative, albeit to the detriment of creditors. Indeed, theoretically (but also in practice) the optimal solutions are those characterized by the highest enterprise value, regardless of the distribution of this value among the various subjects.

- *Timeliness*

Timeliness is the declination of the concept of efficiency in a dynamic sense: the more the crisis passes from potential to actual as it intensifies and worsens, the higher the risks of an impoverishment of the company's values (operating value, sale value, and liquidation value) will be. Timeliness relates to the awareness of the crisis (not always easy to recognize in the early stages and/or hidden by the internal subjects to external ones), the identification of its causes, and the definition of its lines of actions.

The firm is a very "delicate" system, whose functioning is based on the level of reputation and trust that it has against all stakeholders. However, this reputation/trust can be undermined by the tendency of the crisis to persist: external subjects (customers and suppliers) may be reluctant to operate with the company or my impose worse conditions, the internal climate may worsen and the most valuable employees may seek for other jobs, investment processes may find substantial realization limits. The combination of all these factors (loss of trust/reputation and fall in the quali-quantitative level of internal resources and skills) inevitably leads to a rapid deterioration of the economic value of capital.

While timeliness-oriented crisis management is key, the timely declaration of the state of crisis and the use at the right time of measures to counter it are never taken for granted: not so rare are those situations in which main actors involved in the company's management delay crisis recognition and actions to recover value, to the detriment of other stakeholders including primarily creditors and minority shareholders.

- *Fairness*

Crisis management is a complex issue since the interests of actors inside and outside the company do not always move in the same direction regarding the convenience of declaring the crisis status and of identifying the lines of actions. For this reason, the principle of timeliness, albeit linked to that of efficiency (in a dynamic sense), is detached from it to take into account the fairness, that is, the ways of allocating costs and advantages deriving from the crisis management process.

In the concrete pursuit of the principles of efficiency and timeliness, the first key aspect is the identification of those subjects called to the design of the restructuring project and to the selection of alternatives to solve the crisis. This so-called *power of intervention* is usually exercised by shareholders that hold the absolute or relative majority in the shareholding structure: controlling shareholders have, therefore, the possibility to make the first move, holding an advantage over other subjects in the choice of the moment in which to communicate the state of crisis and the proposed solution. In taking decisions and designing possible actions,

it would be appropriate to consider and use not only the knowledge of the ownership, but also the management's one, as it represents a precious resource. Both stakeholders are in fact endowed with distinctive skills and knowledges (*know-how*). However, it is out of the question that subjects involved in the crisis start from positions very distant from each other regarding information available, with consequent *information asymmetries* that can negatively affect the efficient, timely and fair management of the crisis. Shareholders, for example, could be incentivized not to communicate the state of crisis, they could pursue high-risk investments whose negative effects would fall only on creditors, or they could renounce those investments whose benefits would only benefit creditors. Given that in a state of crisis all stakeholders are involved and will probably bear the consequent costs, such information asymmetries must be minimized.

Clarified these three concepts, it is now necessary to understand the relationship between the principles of efficiency, timeliness and fairness: how to equally distribute the sacrifices necessary to solve the crisis, while pursuing the best solution (which overall generates the greatest value), within the appropriate time limits? It is noted that *ex ante* unfair solutions, because favorable at first instance only to the controlling shareholders and/or to the management, could allow the recovery of the operating value in a way that better satisfies the interests of other stakeholders, compared to other *ex ante* fairer, but less efficient, solutions. In these situations, it would be appropriate to consider a series of safeguards for those stakeholders less involved, such as creditors: the right to have a transparent and timely information, the right to (partially) supervise and control corporate operations, also connected to the possibility of intervening in the case of deviant behavior with respect to the decided restructuring plan. In other words, fairness should be judged in the light of the prospects for recovering efficiency: the more the crisis is faced in stages prior to the irreversible one, the more the solutions should aim at efficiency (and timeliness), even at the expense of fairness, following the idea that, in this way, the recovery of the operating value can ultimately benefit even the most "sacrificed" creditors.

Considering what has been said before, it is possible to conclude that only from the search for an acceptable combination of efficiency, timeliness and fairness, concretely achievable solutions can emerge for the corporate crisis management.

3. Corporate crisis prevention

3.1. The culture of crisis

Preventing a corporate crisis is not an easy process. Companies are in continuous evolution, inserted in an increasingly complex environment, and crisis can derive from a plurality of causes, both internal and external; therefore, it becomes critical to implement a strategic control system through which assessing threats from the environment and taking advantage of its opportunities.

In one of his publications, S.A. Booth talks about an actual “lack of culture of the crisis”, and the consequent difficulties from subjects involved in realizing it. Warning signals that accompany the phases of decline and crisis are often misinterpreted, underestimated, or even ignored by the management and the ownership, since considered transient or aimed at disappearing without the need for intervention. Regarding the Italian entrepreneurial panorama, dominated by small and medium-sized family businesses, the literature attributes the role of prevention, timely identification of crisis, and analysis of collected data, to the entrepreneur-founder. The "family" entrepreneur constitutes a bivalent attribute for his own company: if it is true that he is the soul without which the company would not exist, on the other hand he can be an obstacle to the detection of the crisis and its solution. The entrepreneur sees the company as a projection of himself, and for this reason there is a real attitude of “refusal” in considering a crisis as a possible event in his life. The psychological aspect of this identity between the entrepreneur and the company has, as consequences, the underestimation of the problem, which is traced back to endogenous and transitory factors (*optimistic bias*), and subsequently the silence aimed at not spreading outside the news of a precarious condition of the company, since the initiation of any procedure would be seen as an "entrepreneurial defeat" (*procrastination bias*). Communicating externally the state of crisis would also mean the loss of reputation and the consequent impairment of goodwill and related intangible assets, such as the brand. The loss of reputation could in turn incentivize the flight of creditors (*rush to the exit*), who, in the face of growing difficulties, could initiate enforcement actions to recover the outstanding receivables. Moreover, the entrepreneur could believe that only his entrepreneurial skills, which have made the company grow, are suitable for its recovery: the *overconfidence bias* could not only induce the entrepreneur not to ask for help from external professionals, but also could induce him to take high-risk initiatives to restore the business.

The problem, therefore, lies in these superficial and optimistic attitudes from the main actors within the company, which do not allow a timely identification of decline and crisis. Although

today the business crisis is no longer considered a sporadic and occasional event, but a widespread and looming phenomenon, the inability to perceive warning signals and consequently the impossibility of preventing the crisis are among the most difficult organizational problems to solve. In addition, the collection and the processing of information are themselves complex operations, and, despite the strict "self-assessment" obligations imposed by law, managers and owners still struggle to conduct an exhaustive analysis given the large number of data and variables. There is a real practical difficulty in managing this enormous amount of information, to which issues related to prospective forecasts are added.

Crisis prevention means the removal of the controllable causes that generate signals, or the adoption of measures to control, limit, and contain the effects of the uncontrollable causes: as can be easily deduced, crisis prevention is essential from the *company's internal point of view*. A timely and effective use of the crisis prevention system does not mean always that crisis will not arise or that will be resolved, but it does offer a possibility in this sense. At the same time, the research and the identification of the symptoms of decline and crisis respond to the needs of subjects other than the company (*company's external point of view*). In this case, *crisis prediction* is an activity conducted equally by creditors (banks, suppliers) and by those shareholders not involved in the management, to be able to move away from the company as soon as possible or to limit the negative consequences to their detriment.

Concerning the "cultural" attitude that companies take towards the risk of crisis, two different categories can be distinguished:

- companies with a *culture in favor of the preventive control of decline and crisis*
  These companies adopt tools to prevent decline or crisis. Generally, the greater is the experience of the management in the phases of decline and crisis, the greater is its willingness to invest resources in their prevention.
- companies with a *culture not in favor of the preventive control of decline and crisis*
  These companies do not adopt the necessary tools to prevent decline or crisis, as they consider investing resources for this purpose a waste of time and money. The management has a resigned and fatalistic attitude, and believes that such events are temporary or have a low probability of occurring.

Booth's 1993 survey shows that little more than one out of four companies has a sufficient culture about crisis prevention, ratio that, although improving, even today remains very low.

3.2. Business insolvency forecasting models

Today business crisis is no longer an unusual phenomenon far from the corporate reality, but, on the contrary, is considered a "normal" and recurring event. Now, more than ever, there is the need to equip companies with a system of monitoring, control, and prevention of the phases of decline and crisis, to start a recovery process as soon as possible. Therefore, it is the approach to the crisis phenomenon that changes, with the consciousness that companies could find themselves in difficult situations several times in their life cycle. Recent experiences show how the timing of the stages of the company's deterioration changes: in the past, the transition from the phase of decline to the phase of real crisis could take several years, while today, because of the advent of technology and the consequent digitalization of the businesses, times have been drastically reduced, sometimes without the occurrence of those typical warning signs. As emerged from an analysis carried out by E. Giacosa and A. Mazzoleni regarding Italian corporations in crisis since 2008 (*Il progetto di risanamento dell'impresa in crisi*, 2012), the late identification of the state of crisis represents the main cause of failure of the current in- and out-of-court procedures; furthermore, this late identification is the direct consequence of a scarce and not widespread corporate culture towards crisis prevention and recovery process. It becomes necessary to sensitize all company's actors to the regular use of models aimed at forecasting the insolvency.

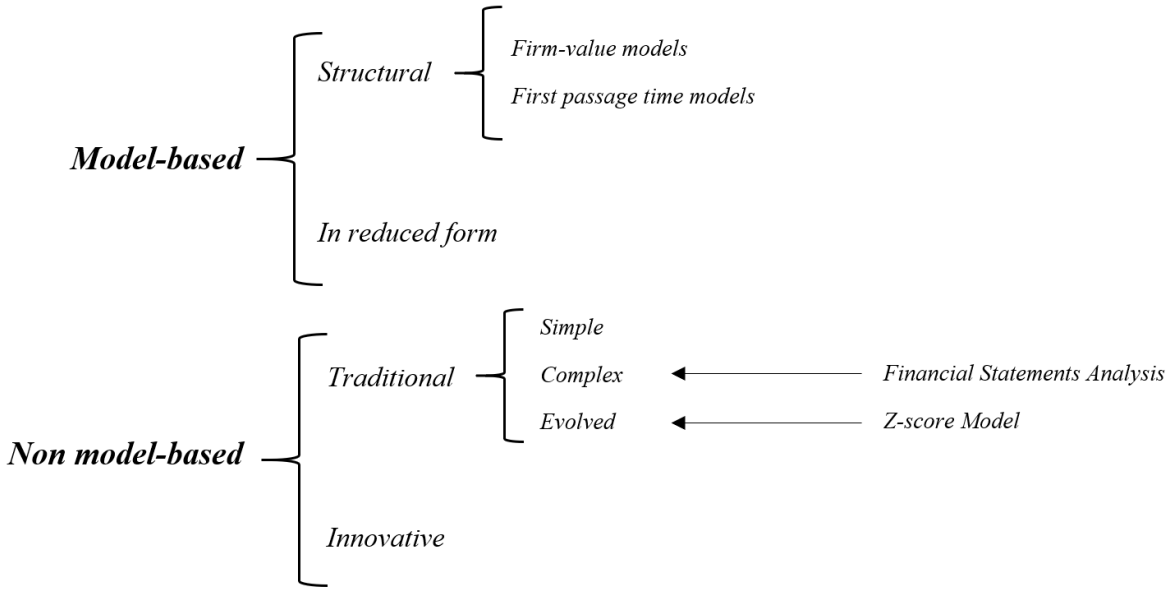
The first scientific contributions aimed at the corporate crisis prevention were based on a *look-backward approach*, where the final goal was to bring the company back to its pre-crisis state. This purely resolutive approach considered the crisis as a stimulus for the recovery of a structural condition of efficiency. But in the eighties, the advent of globalization, the intensification of the trade exchanges, the increasing international competition, and the technological improvement, "forced" the company to change, responding to new challenges and transforming itself into a production unit open to the markets and the environment. In this new and complex economic context, many companies started to lose market shares, underlining the ineffectiveness of those prevention systems based on the *look-backward approach*. Therefore, there was no longer the need to return to the pre-crisis situation and to recover from a crisis that had already begun; rather, new models, based on a completely different approach (the *forward-looking approach*), were needed to prevent and to foresee the disease of the company. These forecasting models are based on the company's historical and forecasted information, and, by producing appropriate warning signals, they express an opinion on the capital, financial, and economic situation of the company. An interesting aspect lies in the increasing reliability of these models: until a few years ago, traditional forecasting models were limited to assume only

the company's financial statements as information basis; on the other hand, in recent years, accounting data have been tried to integrate non-monetary quantitative information and qualitative information. Examples of information of qualitative nature are related to:

- *characteristics of the business management:* the degree of separation between the management and the ownership, the financial support from the ownership, the technological assets and the propensity to innovation, the openness to experience, the knowledge of the company's brand, the concentration of customers, the level of diversification of supply, the dependence on suppliers;
- *administration, finance, and management control:* the opinion about financial statements by auditors, any delays in filing, the presence of cash flow statements;
- *training and managerial knowledge:* the assessment of the skills of managers, their academic and extra-academic training, the quality-oriented policies pursued by the company, the training methods for employees, the marketing experience, the knowledge of the business area in which the company operates (Giacosa and Mazzoleni, 2018).

Over the years, the topic of forecasting the corporate crisis has stimulated the interest of scholars and researchers, who tried to develop models that would allow its prevention somewhat. The literature traditionally classifies models for forecasting corporate insolvency into two macro-categories: the *model-based* approach and the *non model-based* approach.

Figure 4: Classification of business insolvency forecasting models



Source: adaptation from E. Giacosa, A. Mazzoleni, *La previsione della crisi d'impresa: strumenti e segnali di allerta*, cit., p. 81.

It should be recalled, as Professor S. Coronella points out in *The forecasting models of corporate crises: some reflections* (2009), that "forecasting corporate *insolvency*" is a commonly used terminology, but it would be more correct to talk about "forecasting corporate *crisis*" since insolvency is nothing more than one of the two stages of degeneration of the crisis.

3.2.1. The model-based approach

The model-based approach considers two types of models: structural models and models in reduced form. The most representative models are those of Wilcox (1971) and Scott (1981).

- *Structural models* estimate *ex ante* the probability of default of a company with a definite capital structure, through a purely deductive approach. They are divided into firm-value models and first passage time models.
    - *Firm-value models* estimate the probability of default based on the evolution over time of the capital invested in the company, and on the evaluation theory of financial options developed by Black & Scholes.
    - *First passage time models* estimate the probability of default based on the probability that the value of the invested capital falls below a certain threshold called “default boundary”.
- In *models in reduced form*, crisis is understood as an event completely independent of the capital structure, and therefore traced back to market factors.

Both structural models and models in reduced form are defined "market models" since their application requires the availability of information deriving from financial markets, and therefore they apply only to listed companies. However, the model-based approach has not been particularly successful and is rarely used in practice as it does not allow the symptoms of the crisis to be predicted in advance, but only in the terminal phase of the process.

3.2.2. The non model-based approach

The non model-based approach uses historical data from financial statements, making use of an inductive approach. The idea behind the numerous models of this category is that there are significant differences between healthy and unhealthy companies, and that it is possible, through their comparison, to identify quantitative and qualitative variables to work on. The identification of these critical variables is carried out using statistical techniques. The non model-based approach considers two types of models: traditional models and innovative models.

- *Traditional models* are divided into simple, complex, and evolved models.
    - *Simple models* include the summary analysis and the scoring technique.

      The *summary analysis* consists of identifying and interpreting a series of factors common to all companies regardless of the size, without proceeding with further processing. The search for information takes place using different sources, which differ for the ease of access, for the timeliness in obtaining them, and obviously for the cost. The main sources include accounting documents, commercial information (punctuality in payments, volume of purchases made, duration of relationships with credit institutions), information provided by specialized companies, and information from institutional channels (ISTAT, court where the company has the registered office). If the company is listed, further useful information is provided by the ratings from Moody's, Standard & Poor's, and Fitch Ratings, relating to outstanding bonds, market prices of bonds, market prices of stocks, and their performance over time. Although it is easy and not so expensive, assessing the status of a company based solely on a summary analysis allows reaching a modest level of reliability, in some cases even misleading.

      The *scoring technique* allows to assign a score, corresponding to the probability of insolvency, based on the answers provided by the company to a questionnaire. The company answers a series of questions such as the geographical area of operation, the business name under which it operates, the number of banks with which it has relationships, the incidence rate of short-term debts on the total, the number of employees, etc. According to the answers, single percentage scores are assigned to them: when added together, these scores correspond to the overall probability of insolvency attributable to the specific company. However, experience teaches that the scoring technique is not a rigorous forecasting methodology as the final score is greatly influenced by the type and number of questions.
    - *Complex models* substantially include the *Financial Statements Analysis*. The Financial Statements Analysis starts from the reclassification of Financial Statements (primarily the Balance Sheet and the Income Statement) to arrive at the formulation of an overall judgment on the state of health of the company using accounting indicators. Results obtained are then compared with ideal,

indicative, or average results, to provide a company's overview of its economic, capital, and financial situation.

The Financial Statements Analysis, as one of the business forecasting insolvency models used in the present work for the empirical analysis, will be further analyzed in paragraph 3.3.

- *Evolved models* include the univariate analysis and the multivariate analysis, which provide for the application of statistical methodologies to the Financial Statements Analysis.

  - *Univariate analysis*

The univariate analysis consists of the application of univariate statistical techniques to the Financial Statement Analysis. Indicators are considered individually and, according to the values assumed, it is possible to distinguish between healthy companies and companies in difficulty. Among the main studies concerning the univariate analysis, the one of W. Beaver is worth mentioning, dating from the second half of the sixties. Beaver's work constituted an important starting point for subsequent studies, even if there was no lack of criticism of the univariate analysis method. These criticisms primarily concern the assumptions underlying the model. The univariate analysis assumes that there is a linear relation between the values assumed by indicators and the health status of the company: in other words, the status of the company will improve or worsen depending on the variation of the indicator. However, it has been observed that some indicators do not follow a linear relation, so the company could be, for example, in a state of difficulty when the values of the same indicator are both very low and very high. The univariate analysis also assumes that the distribution of indicators is a Normal distribution, but this is not true for all the indicators, which can follow distributions different from the Normal one. Finally, the main criticism concerns the logic underlying the model: taking the variables individually, the univariate analysis does not consider the interdependence among them. The company represents a multidimensional and complex system, connected in all its parts, which cannot be analyzed by considering only one indicator each time. This limit was solved through the multivariate analysis.

  - *Multivariate analysis*

The multivariate analysis consists of the application of multivariate statistical techniques to the Financial Statements Analysis. Unlike the univariate analysis,

with this methodology indicators are analyzed simultaneously, thus considering their interdependence. Among the most used and widespread statistical techniques, there are the multivariate discriminant analysis and the conditional probability models.

The *multivariate discriminant analysis* classifies *ex ante* subjects into two or more groups (healthy and unhealthy companies in this context), whose distinction is maximum. The single subject (the company) is classified based on a single factor, called "discriminatory value". This value summarizes all the variables considered, which are linked by a linear combination. In its simplest form, the multivariate discriminant analysis is presented in the following form:

$$z_i = \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_m X_{im}$$

where

- z_i is the discriminatory factor (*Z-score*) for the *i-th* subject;
- i is the *i-th* subject ($i = 1, \ldots, n$);
- j is the *j-th* variable ($j = 1, \ldots, m$);
- x_{ij} is the value assumed by the *j-th* variable for the *i-th* subject;
- β_j is the discriminatory coefficient for the *j-th* variable.

The score attributed to each company summarizes the information obtained from the m common variables referred to the specific company and allows its classification in a determined group. The belongingness to one of the two groups occurs on the basis of a separation value called *cut-off point*: those with a value below this threshold will be classified as unhealthy companies, those with a higher value as healthy companies. In the context of multivariate discriminant analysis, the most famous works are attributable to E. I. Altman (1983) and R. J. Taffler (1983).

Altman's Z-score Model, as one of the business forecasting insolvency models used in the present work for the empirical analysis, will be analyzed in paragraph 3.4.

Conditional probability models have been introduced since the 1980s, in response to the need to set up a methodology that does not require the fulfillment of a series of conditions necessary for obtaining statistically correct results, but difficult to find in the real world. Conditional probability models include *Logit Models*, *Probit Models*, and *Linear Probability Models*. The Logit Models are the most popular, both for their easier construction and for their more correct

representation of results. They allow to calculate the probability that a company belongs to the group of unhealthy companies (P_i) or to the group of healthy companies (1 - P_i), using data and variables intrinsic to the company. In its simplest form, the Logit Models is presented in the following form:

$$P_i = E\,(\,Y = 1 \mid X_i\,) = \frac{1}{1 + e^{-\,(\,\alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_m X_{im}\,)}} = \frac{1}{1 + e^{-z}}$$

where

- Y is the binary variable, which is equal to 1 if the company is unhealty and 0 is it is healty;
- X_{ij} is the value assumed by the *j-th* index (j = 1, …, m) for the *i-th* company (i = 1, …, n);
- α is a constant;
- β_j is the weight associated to the index X_j.

It should be noted that in Logit Models, unlike in the discriminant analysis, the relationship between independent variables and the probability of default is no longer linear: a company with a high probability of default is affected in a more limited way by variations (both ameliorative and pejorative) of its indicators, compared to a company with a lower probability of default. In addition, Logit Models can consider as independent variables also qualitative variables, which, once inserted in the formula, will assume the values 0 or 1 (dummy variables).

- *Innovative models* are extremely numerous and different from each other, both for the type of information considered and for the level of information processing. They are based on particularly sophisticated statistical techniques, characterized by high degrees of complexity (*artificial intelligence*) and consequently by high costs. The following models are reported because of their interesting operational use or because they are potentially susceptible to future developments (as some are still in the embryonic stage).
    - *The Recursive Partitioning Algorithm Analysis* is a non-parametric computerized methodology designed by J. H. Friedman in the mid-seventies. Once relevant data on which to base the decision to grant credit has been acquired, the underlying logic consists of estimating costs and losses associated with the following three alternatives: granting the credit, refusing the grant, or postponing the grant decision after further information. In this way, the so-called "decision tree" is obtained, since, depending on the choice, a series of alternatives at different levels are opened, to be considered as a function of costs

and losses associated. Each "node" (in particular final nodes are called "leaves") will be assigned a score on which the judgment of the choice will be based. This model is optimal only if a high number of variables is used; however, it must be considered that as variables increase, costs increase, and obviously also the complexity of its use rises exponentially.

- *Neural networks* are non-linear dynamic systems with different degrees of freedom, used to solve particularly difficult computational problems. This method imitates how the human mind is believed to work, and therefore as humans acquire knowledge and manifest their intuitions. Neural networks, like the human mind, learn from the experience: they are instructed to recognize incoming information, to process it using rational techniques, gradually becoming “wiser” and making fewer errors on outgoing data. This methodology, despite being able to distinguish a healthy company from an unhealthy one even on the basis of qualitative information, requires a long time to develop and is subject to rapid obsolescence.
- *Genetic algorithms*, designed by J. H. Holland in the mid-seventies, replicate the mechanism of biological evolution of the species according to the Darwinian logic. These algorithms should identify the best companies and, by analyzing different combinations of variables of the population considered, should capture any symptoms of potential crises.
- *Fuzzy sets* were designed by L. A. Zadeh in the mid-sixties. The underlying "fuzzy" logic is in contrast with the classic Aristotelian logic, where everything oscillates between “yes and no” or between “true and false”. According to Zadeh, the binary logic can be applied to the artificial world of mathematics, but not to the real world, where the boundaries are not clear-cut and it is necessary to think in terms of “gray zones”. Fuzzy sets represent the new frontier of the forecasting models; however, given their high complexity and high costs, only large users as banks, financial companies, or rating companies, can afford them.

The non model-based approach is the only one to have been applied in practice with significant results. What is observed, with the development and refinement of technology, is an increasing complexity of all the models, correlated by a greater degree of reliability and inevitably by higher costs. For this reason, there has not been a parallel diffusion of these models in their most updated version. Furthermore, the level of uncertainty (physiological and congenital in any model) is destined to increase in historical periods such as the present one, in which the

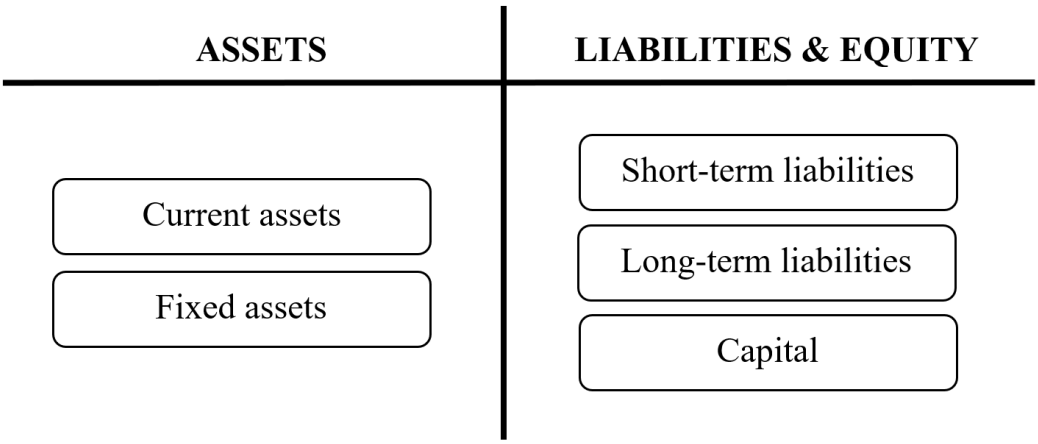
country is in a situation of deep crisis: variables considered are altered and this decreases the degree of reliability of any model.
Paragraphs 3.3. and 3.4. are dedicated respectively to the Financials Statements Analysis and the Z-score Model of Altman, as models used in the empirical analysis about the forecasting of insolvency of defaulted companies at the Italian Ministry of Economic Development.

3.3. The Financial Statements Analysis

Among the most widespread, but also most discussed, tools for identifying the signs of a potential crisis, there is certainly the Financial Statements Analysis. The Financial Statements Analysis provides information regarding the company's partial aspects or the company as a whole, allowing the assessment of its actual condition and, therefore, the co-presence of the capital, financial, economic and monetary equilibriums. Financial Statements are the starting point of the analysis. Their reading allows to obtain a valid diagnostic picture of the situation only if past trends are representative of current and future trends of the company. Consequently, statements of at least three consecutive years, before the current one, must be used to outline the most likely scenario for the development of the business. Only in this way a deep ratios analysis, carried out by observing their trend over time and their comparison with external benchmark parameters, provides a reliable opinion on the state of health of the company.

The economic and financial ratios necessary for the analysis can be obtained only after a correct reclassification of the Financial Statements through the information reported in the Notes. The first accounting prospectus, the Balance Sheet, is reclassified according to the *financial criterion*. Assets are classified on the basis of the time presumably necessary for their return in liquid form (*decreasing liquidity criterion*), showing first those assets that are already liquid or that will turn into liquid form within the next twelve months (*current assets*), and then those assets that will return to liquid form after twelve months (*fixed assets*). Vice versa, sources of financing are classified according to the time presumably necessary for their repayment (*decreasing eligibility criterion*), highlighting first funds maturing within twelve months (*short-term liabilities*), then funds maturing after twelve months (*long-term liabilities*), and finally sources whose reimbursement is not predeterminable (*equity* or *capital*).

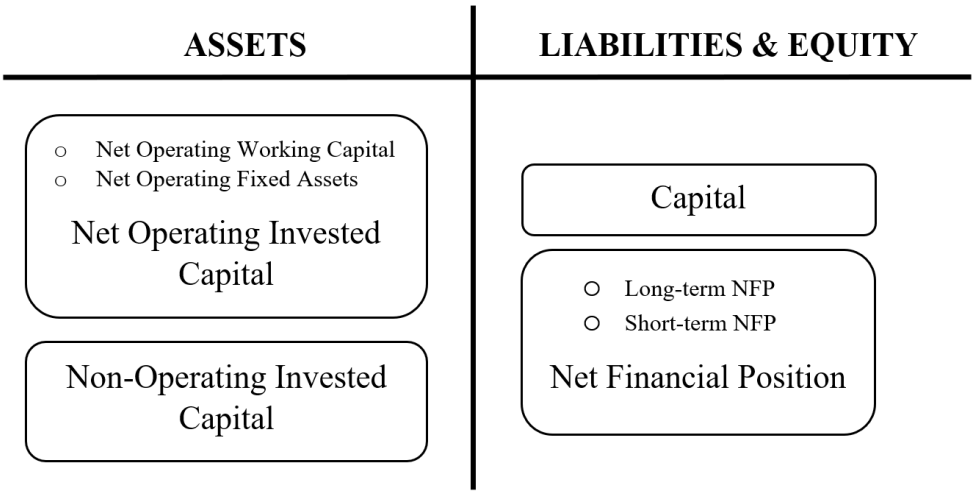
Figure 5: Reclassified Balance Sheet (financial criterion)



Source: personal elaboration.

The Balance Sheet can also be reclassified according to the *functional criterion*, which highlights the financial need related to the most significant management areas (operating area, non-operating area, financial area). It is fundamental to understand the extent to which management areas contribute to creating financial needs for which loans are raised. The management of financial needs is not only a warning bell to be observed to avoid crisis, but also a tool that can be used to prevent any imbalances. The reclassification of the Balance Sheet according to the *functional criterion* is shown here as highlighting the *Net Financial Position*, an extremely widespread indicator in the Financial Statements Analysis. The Net Financial Position, calculated as short-term financial liabilities plus long-term financial liabilities minus cash & cash equivalents, summarizes the company's ability to create liquidity and the tendency to increase or decrease the financial indebtedness. An increase in the Net Financial Position is viewed negatively as expresses a worsening in the financial requirements.

Figure 6: Reclassified Balance Sheet (functional criterion)



Source: personal elaboration.

The second accounting prospectus, the Income Statement, can be reclassified in three different ways, according to the objectives of the analyst. The three configurations differ from each other only for the reclassification of costs and revenues related to the characteristic area and, therefore, for the different methods of composition of the operating income; vice versa, financial and taxation areas maintain the structure already provided by the Legislator.

Figure 7: Reclassified Income Statement (respectively Cost of Sales structure, Contribution Margin structure, Production Value and Added Value structure)

Net Revenues	Net Revenues	Net Revenues
- Cost of Sales (Direct Costs)	- Variable Costs	+ Δ Inventories
Opening Stocks	= **Contribution Margin**	= **Production Value**
+ inventory purchases	- Fixed Costs	- Manufacturing Costs
+ direct manufacturing costs	= OPERATING INCOME	- Third Parties' Services
- Ending Inventory		= **Added Value**
- Depreciation & Amortization		- Labor Costs
= Manufacturing Income		= Gross Operating Margin
- General Expenses		- Depreciation & Amortization
(Indirect Costs)		= OPERATING INCOME
= OPERATING INCOME		

Source: personal elaboration.

Ratios that can be calculated during a Financial Statement Analysis are numerous and present innumerable variations: the present work is limited to addressing the most representative and preparatory ones for a timely detection of a possible state of crisis.

- *Liquidity Ratios*

The most evident external signal of an ongoing crisis is insolvency, that is, when the company is unable to meet its financial commitments. If insolvency is not healed, default is very likely to occur. Indicators on the degree of corporate solvency can be easily carried out starting from a reclassification of the Balance Sheet according to the *financial criterion*. If the Balance Sheet has been correctly reclassified, short-term liabilities represent the amount of debt payable within twelve months, while current assets represent the amount of investments that are likely to turn into cash within the same period. Analyzing the monetary equilibrium means evaluating the ability to meet short-term financial commitments with short-term resources. The analysis is based on the comparison between these two aggregates: a company is defined liquid if it virtually manages to repay liabilities due in the short-term without compromising the economic and capital equilibriums. Liquidity Ratios usually used are:

- *current ratio*

$$current\ ratio = \frac{current\ assets}{short - term\ liabilities}$$

When the current ratio assumes a value lower than 1, it means that current assets are not sufficient to fully repay debts in expiration. The full repayment of debts can only take place by resorting to the disinvestment of fixed assets, but this would compromise the future conditions of the economic and capital balance. Therefore, a company with a current ratio lower than 1 could be considered illiquid. The restoration of the equilibrium takes place through three types of intervention: debt-consolidation, which reduces the exposure in the short-term by taking on medium/long-term debts; the sale of non-instrumental assets, the proceeds of which cover the amount of short-term payables; otherwise, but with longer periods, the allocation of the free cash flow to cover debt, to the detriment of dividend policies or non-operating investments.

When the current ratio assumes a value greater than 1, the company is theoretically able to repay the short-term debt by disinvesting all or part of its current assets. As benchmark values, we consider 1.10 for large firms and 1.20 for smaller ones. In this case, it is possible to state that there is no financial disequilibrium in the short period, but, at the same time, financial equilibrium is not obvious: indeed the inventory (classified among current assets according to the *financial criterion*) could convert into liquidity after an operational process (production and sale, or only sale) which can take longer than twelve months. For this reason, before expressing a positive opinion on the liquidity of the company, it is useful to calculate the acid-test ratio, which does not consider the inventory to cover the short-term debt.

- *acid-test ratio (or quick ratio)*

$$acid-test\ ratio = \frac{current\ assets - inventory}{short-term\ liabilities}$$
$$= \frac{cash\ and\ cash\ equivalents + short-term\ loans}{short-term\ liabilities}$$

When the acid-test ratio assumes a value higher than 1, it is possible to state that the company is liquid. However, this ratio is rarely greater than 1: as benchmark values, we consider 0.83 for large firms and 0.79 for smaller ones. There could be interpretative doubts when the current ratio has values higher than 1, while the acid-test ratio lower than 1. In that case, it is necessary to compare the ratios and to look for solutions that reduce the average consistency of raw material inventories and finished goods.

- *Efficiency Ratios*

The judgment on the monetary equilibrium passes also through the so-called Efficiency Ratios, which assess the degree of efficiency of an investment or a source of financing involved in

operating activities. The higher the value, the faster the investment will convert into cash. Efficiency Ratios usually used are:

- *days receivables outstanding*

$$days\ receivables\ outstanding = \frac{average\ account\ receivables}{sales + VAT} \cdot 365$$

This ratio measures the average duration of the deferral granted to customers, that is, the time between the moment in which the revenue is recognized and that of its collection.

- *days payables outstanding*

$$days\ payables\ outstanding = \frac{average\ account\ payables}{purchases + VAT} \cdot 365$$

This ratio measures the average duration of the deferral granted by the suppliers, that is, the time between the moment in which the cost is recorded and that of its payment. The days payables outstanding must be compared with the days receivables outstanding: if the former are greater than the latter, most likely there will be a treasury gap and the company will have to resort to the banking credit.

- *days in inventory*

$$days\ in\ inventory = \frac{average\ inventory}{cost\ of\ goods\ sold} \cdot 365$$

- *Capital Solidity Ratios*

Liquidity Ratios compare current assets with short-term liabilities, therefore verify in specular terms whether permanent sources of financing (long-term liabilities & capital) are correctly synchronized with fixed assets. In fact, it is normally assumed that the extinction time of sources of financing (short-term and permanent) is homogeneous with the time required by assets (respectively current and fixed) to convert into liquid form. However, to affirm that a company is both liquid and solid, it is advisable to carefully evaluate the capitalization or the financial autonomy of the company; in other words, the degree of utilization of the shareholders' equity to cover operating investments. Ratios usually used for the capital-financial equilibrium are:

- *fixed assets coverage ratio*

$$fixed\ assets\ coverage\ ratio = \frac{shareholders'equity}{manifacturing\ facilities}$$

where manufacturing facilities correspond to those fixed assets involved in the operating activity. If the ratio tends to values considerably lower than 1, a recapitalization will be necessary.

- *equity guarantee*

$$equity\ garantee = \frac{shareholders'equity}{\Sigma\ liquidation\ losses}$$

The ratio verifies whether the net wealth of shareholders can cover the losses if the company were put into liquidation. Abandoning the concept of *going concern*, it is necessary to calculate as denominator the expected losses following a liquidation process: if the ratio is greater than 1, the company can be considered solid as it does not put its creditors at the risk of bearing liquidation losses.

- *Leverage Ratios*

The capital-financial equilibrium is assessed in the light of the Leverage Ratios. Among the most recurring and useful, there are:

- *leverage*

$$leverage = \frac{total\ assets}{shareholders'equity}$$

An increase in the leverage corresponds to an increase in the degree of corporate indebtedness: sources of financing from external third parties are boosting compared to shareholders' internal sources of financing. If the financial leverage is equal to 1, the company has not used third parties' capital (it has no debts); if the leverage is between 1 and 2, it means that equity capital is greater than debt capital; if the leverage is greater than 2, it means that the debt capital is greater than the equity capital. On average, the company is in a state of correct equilibrium regarding the sources of financing when the ratio assumes values between 1 and 2, otherwise, when values are greater than 2, the company is to be considered undercapitalized (insufficient equity capital), therefore a recapitalization process must be carried out.

- *debt to equity ratio*

$$debt\ to\ equity\ ratio = \frac{total\ liabilities}{shareholders'equity}$$

Also an increase in the debt-to-equity ratio corresponds to an increase in the degree of corporate indebtedness. Rarely companies show a debt to equity ratio lower than or equal to one: in general the ratio is considered acceptable if it shows values not exceeding 3, but evaluations are always necessary both on the sector to which the company belongs (which could exert a certain influence on the degree of indebtedness) and on debt sustainability.

- *interest coverage ratio*

$$interest\ coverage\ ratio = \frac{net\ operating\ income}{interest\ expences}$$

or

$$interest\ coverage\ ratio = \frac{gross\ operating\ margin}{interest\ expences}$$

The interest coverage ratio, in both its versions, measures the economic capacity to bear the cost of debt. Unlike the first version (the one with net operating income), in which the ratio is required to be at least greater than 1, in its second version (which will be used in the empirical analysis) it is not sufficient for the numerator to be higher than the denominator: the ratio is considered acceptable if it exceeds at least 4 or 5 times the value of financial charges, since it must cover not only interest expenses, but also all the other types of extra-operating costs and, at the same time, it must leave an appropriate remuneration to the capital investors.

- *financial debts / sales revenues*

$$\frac{financial\ debts}{sales\ revenues}$$

The ratio between financial debts and sales revenues represents a further indicator of debt sustainability: the amount of debt assumes worrying levels for a company if it exceeds the volume of revenues.

- *Profitability Ratios*

Profitability Ratios are constructed by placing an income flow in the numerator and the capital invested for its generation in the denominator.

- *ROE (Return on Equity)*

$$ROE = \frac{net\ income}{shareholders'\ equity}$$

ROE expresses the return on equity: it is mainly used by actual and potential risk capital investors to evaluate the convenience of an investment compared to another. For ROE, it is not possible to define *ex ante* thresholds or acceptability values, as this ratio is significantly influenced by the sector to which the company belongs and by the size of the company itself. By way of example, a 10% ROE indicates good profitability for a company in the catering sector, but very poor profitability for a company belonging to the commerce sector (Di Nardo *et al*., 2018). For this reason, to express an opinion on the health of the company, ROE must be compared with its value in the previous years, or with ROE of companies belonging to the same sector.

- *ROI (Return on Investments)*

$$ROI = \frac{operating\ income}{operating\ invested\ capital}$$

ROI is certainly the most used profitability indicator in the Financial Statements Analysis: ROI expresses the return on operating activity in relation to capital invested in its realization. The same considerations made for ROE apply to the threshold values of ROI.

Once the most significant indicators have been identified, it is possible to express an opinion on the company's state of health only after comparing its values over time and/or in space. *Comparison over time* consists of comparing indicators obtained from the Financial Statements of the previous years produced by the same company. This type of comparison is simpler to carry out and does not present complex problems regarding the availability of data and the homogeneity of the prospectuses. *Comparison in space* consists of comparing indicators of the specific company with those of competitors, average values, or aggregate data, relating to the same period. Comparison in space presents some complexities to which it is often difficult to find a solution. Searching for the data is more complex, and also the reliability of information collected is not taken for granted: companies could distort accounting data, showing a better situation than the current one. Furthermore, prospectuses are often characterized by scarce flexibility, that does not allow to reclassify external data with alternative criteria: this limits the number of statements that can be used and consequently the calculation of indicators. Finally, internal data and external data may be inconsistent: companies may have applied accounting principles in a different way (where these allow), they may have referred to different legal standards or currencies, or the non-homogeneity may refer to the terminology used or to the methods for presenting information in the prospectuses.

The Financial Statements Analysis represents today one of the most used tools to prevent the state of crisis, but its validity has often been discussed. Criticisms mainly relate to the reliability of accounting prospectuses and the lack of aptitude to promptly report crises. Regarding the first aspect, prospectuses are inevitably influenced by accounting policies, and cases in which the company decides to distort the data to give a better representation of the situation are not rare. About the second aspect, the Financial Statements Analysis does not have an excellent predictive capacity since often, when it indicates a symptom of crisis, causes may already be in the degenerative phase and therefore difficult to heal.

3.4. The Z-score Model

One of the most significant contributions in the multivariate discriminant analysis is Altman's Z-score Model. Altman was not the first to apply the multivariate discriminant analysis to the prediction of corporate crisis, but the results he obtained and the innovativeness of his formula made his model one of the most widespread in literature and most used in practice.

3.4.1. Altman's first configuration of the Z-score Model

In its first configuration, dating back to 1968, Altman used a homogeneous (in terms of year, sector, and size) sample of 66 listed American industrial corporations, of which 33 healthy and 33 bankrupted in the period 1946-1965. Altman started from a pool of 22 variables among the most popular in the literature and classified them into five standard ratio categories: liquidity, profitability, leverage, solvency, and activity. From the original list of 22 variables, five were selected. These five variables are not those that, considered individually, are most correlated to the event of default, but those that, combined in the discriminant function, do the best overall job together in the prediction of corporate bankruptcy. Appropriately weighted by coefficients, they provide a score that allows to ascertain the proximity of the company to a specific group (*Group 1 – Bankrupt Group* or *Group 2 – Nonbankrupt Group*). The discriminant function is as follows:

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

where

- X_1 = *working capital / total assets (WC/TA)*

  The working capital / total assets ratio is a measure of the net liquid assets of the firm relative to the total capitalization. Liquidity and size characteristics are explicitly considered. Working capital is defines as the difference between current assets and current liabilities; ordinarily, a firm experiencing consistent operating losses will have shrinking current assets in relation to total assets (Altman, 1993, p.186).

- X_2 = *retained earnings / total assets (RE/TA)*

  Retained earnings is the account which reports the total amount of reinvested earnings and/or losses of a firm over its entire life. It is affected by both corporate quasi-reorganizations and stock dividends declarations. The age of a firm is implicitly considered in this ratio: intuitively, a relatively young firm will show a low RE/TA ratio because it has not had time to build up its cumulative profits. It could be argued that, ceteris paribus, a young firm is somewhat discriminated against in this analysis, and its probability to be classified in the Bankrupt Group is higher than that of an older firm.

But this is precisely the situation in the real world: the incidence of failure is much higher in a firm's earlier years (Altman, 1993, p.186).

- *X_3 = earnings before interest and taxes / total assets (EBIT/TA)*

  This ratio is a measure of the true productivity of the firm's assets, abstracting from any tax or leverage factors. Since a firm's ultimate existence is based on the earning power of its assets, this ratio appears to be particularly appropriate for studies dealing with corporate failure (Altman, 1993, p.187).

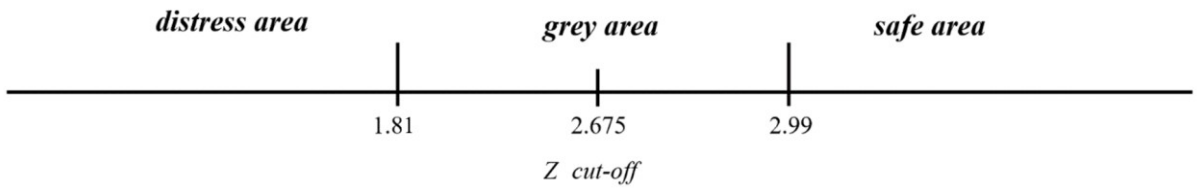
- *X_4 = Market Value of equity / Book Value of total liabilities (MV_E/TL)*

  The Market Value of equity / Book Value of total liabilities ratio shows how much the firm's assets can decline in value (measured by market value of equity plus debt) before the liabilities exceed the assets and the firm fails (Altman, 1993, p.187). In the second configuration of the model, Altman will replace the numerator Market Value of Equity with the Book Value of Equity, to apply the model also to privately held firms.

- *X_5 = sales / total assets (S/TA)*

  Finally, the capital – turnover ratio is a standard financial ratio illustrating the sales generating ability of the firm's assets. This ratio is the least significant on an individual basis: based on the statistical significance measure, it would not have appeared at all. However, because of its unique relationship to other variables in the model, the sales / total assets ratio ranks second in its contribution to the overall discriminating ability of the model (Altman, 1993, p.187). Since there is a wide variation among industries in asset - turnover, Altman will elaborate an alternative model in the mid-nineties, where such variable X_5 is absent.

Replacing the five variables with the corresponding accounting values, the equation produces a score (*Z-score*) which must be compared with a threshold value (*Z cut-off*) defined by Altman himself. In its first configuration, the Z cut-off corresponds to 2.675: companies with a Z-score higher than the Z' cut-off will be classified as potentially healthy; vice versa, companies with a Z-score lower than the Z' cut-off will be classified as potentially anomalous, with a high risk of default. A *gray area* (or *ignorance zone*) is also identified. Here misclassifications are more probable: the *grey zone* is between 1.81 and 2.99 and includes medium-performing companies with high risks to be further investigated.



This first configuration has a good predictive capacity up to two years before the default event; then this predictive capacity disappears, as from the third year it correctly classifies less than 50% of corporations (see table below).

year prior to the default	*% of correct classifications*
1	95%
2	72%
3	48%
4	29%
5	36%

3.4.2. Altman's second configuration of the Z-score Model

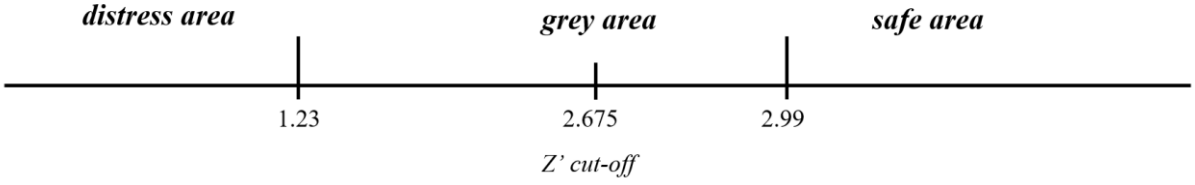
The second configuration of Altman's Z score model dates to 1983 and, unlike the first configuration, allows to consider both listed and unlisted companies. The discriminant function is as follows:

$$Z' = 0.717\,X_1 + 0.847\,X_2 + 3.107\,X_3 + 0.42\,X_4 + 0.998\,X_5$$

where

- X_1 = *working capital / total assets (WC/TA)*
- X_2 = *retained earnings / total assets (RE/TA)*
- X_3 = *earnings before interest and taxes / total assets (EBIT/TA)*
- X_4 = *Book Value of equity / Book Value of total liabilities* (BV_E/TL)
- X_5 = *sales / total assets (S/TA).*

The application of the model also to unlisted companies required a change in variable X_4, where the Market Value of equity was replaced by the Book Value of equity. The cut-off point remains unchanged and therefore equal to 2.675, but the extremes of the *gray area* changed: the *ignorance zone* is wider since the lower boundary is now 1.23 as opposite to 1.81 for the original Z-score Model.



3.4.3. Altman's third configuration of the Z-score Model

A further revision of the model was developed by the author in 1995, to adapt it also to companies in emerging countries and not operating in the manufacturing sector. All the coefficient for variables X_1 to X_4 were changed, while variable X_5 (*S/TA*) was eliminated since not significant in sectors other than manufacturing.

$$Z'' = 6.56\,X_1 + 3.26\,X_2 + 6.72\,X_3 + 1.05\,X_4$$

3.4.4. Bottani, Cipriani, and Serao's configuration of the Z-score Model

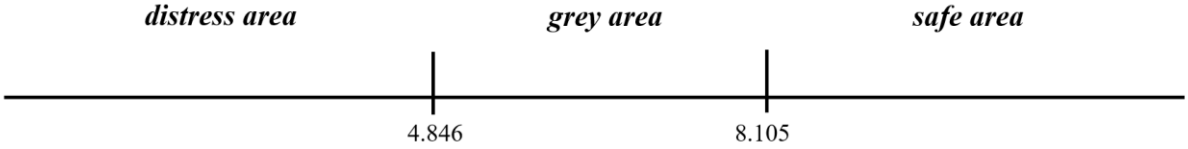
In 2004, three Italians (Pietro Bottani, Letizia Cipriani and Francescomaria Serao) further modified the latest version of Altman's Z-score Model, to adapt it to Italian small and medium-sized enterprises. Based on a sample of 66 Italian companies, of which 33 bankrupted in 2002 and 33 healthy, the three authors obtained the following discriminant function:

$$Z = 1.982\,X_1 + 9.841\,X_2 + 1.951\,X_3 + 3.207\,X_4 + 4.038\,X_5$$

where

- $X_1 = \frac{(current\ assets - current\ liabilities)}{(tangible\ and\ intagible\ assets + ending\ inventory + current\ assets + cash\ \&\ cash\ equivalents)}$
- X_2 = *(legal reserve + extraordinary reserve) / total assets*
- $X_3 = \frac{net\ operating\ income}{(tangible\ and\ intagible\ assets + ending\ inventory + current\ assets)}$
- X_4 = *Book Value of equity / total liabilities*
- $X_5 = \frac{sales}{(tangible\ and\ intagible\ assets + ending\ inventory + current\ assets + cash\ \&\ cash\ equivalents)}$

Once the equation is solved, the Z-score can outline three possible scenarios: when the it is lower than 4.846, companies have a high risk of insolvency; when it is higher than 8.105, companies are healthy; when it is between 4.846 and 8.105 (*grey area*), companies are performing on average, but there are still risks and for this reason they must be managed with the utmost caution. The Italian version of the Z-score Model shows a good predictive capacity, equal to 94% in the two years preceding the bankruptcy, and a higher percentage in the year preceding the crisis.



Regardless of the proposed configuration, the Z-score Model is an excellent warning tool, as the score obtained allows to identify any critical issues of the company. Although it still has limits today (such as not considering the value of intangibles or neglecting the different phases of the economic situation), it is used for its many advantages, including ease of use (the "judgment" of the individual company is reduced to the resolution of a first-degree equation), and the good ability to compare over time (same company, from year to year) and in space (different companies in the same year).

3.5. The new Italian Bankruptcy Law: the CNDCEC indexes

Still today most of companies do not have constant control and monitoring systems, aimed at predicting the onset of decline and crisis phenomena. Regarding the Italian context, the Legislator himself, aware of the absence or weakness of the warning systems within companies, has moved in this direction through the new Bankruptcy Law (*Legge Fallimentare*). Promulgating the *decreto legislativo n. 14/2019*, published in n. 38 of the *Gazzetta Ufficiale*, dated February 14, 2019, the Legislator has implemented the *legge delega n. 155/2017* containing the reform of the corporate crisis and insolvency, as well as the bankruptcy procedures. The novelty of this reform lies in the alert systems (the so-called "red flags"), aimed at a timely detection of the crisis in the perspective of the company's recovery and of the creditors' highest satisfaction. The Legislator calls for greater responsibility on the part of both internal and external parties within the company, which should result in an anticipated emergence of the crisis to make tools used to resolve it more effective.

Article 13(1) of the Crisis Code identifies the presence of a relevant state of crisis when one of the following situations occurs:

- non-sustainability of debt in the following six months;
- prejudice to the *going concern* in the current fiscal year or, if the duration of the current fiscal year is less than six months, in the following six months;
- the presence of repeated and significant delays in payments.

For this purpose, *Article 13(2)* delegates to the CNDCEC (Consiglio Nazionale dei Dottori Commercialisti e degli Esperti Contabili) the task of drawing up, at least every three years, those indexes that make it reasonable to assume the existence of a state of crisis. The alert system requires the notification to the OCRI (Organismi di Composizione della crisi d'impresa) of those companies that exceed the critical thresholds for the indicators. Indexes that suggest a reasonable presumption of a state of crisis are the following:

- negative shareholders' equity or, for corporations, an equity below the statutory limit;

- a six-months Debt Service Coverage Ratio (DSCR) lower than 1;
- whenever it is not possible to calculate the DSCR or the data necessary for its calculation are not considered reliable, the joint exceeding of the critical thresholds for the following five ratios:
  - *financial charges sustainability index* $= \frac{interest\ expenses}{net\ sales}$
  - *capital adequacy index* $= \frac{shareholders' equity}{total\ debts}$
  - *index of return of assets in liquid form* $= \frac{cash\ flow}{total\ assets} = \frac{profit + non\ monetay\ costs - non\ monetary\ revenues}{total\ assets}$
  - *current ratio* $= \frac{current\ assets}{short-term\ liabilities}$
  - *social security and fiscal indebtedness index* $= \frac{social\ security\ indebtedness + fiscal\ indebtedness}{total\ assets}$

The indexes system is hierarchical: if shareholders' equity is negative or below the statutory limit, the presence of crisis is conceivable; otherwise, the six-months DSCR is calculated. If the DSCR is higher than 1, the state of crisis cannot be assumed, and the five indexes listed above are considered together. For these indexes, different critical values are laid down according to the sector considered, ad only the joint exceeding of the relative critical thresholds leads to the notification to the OCRI as the state of crisis is conceivable.

Table 2: Critical thresholds for indexes by sector

Sector	*financial charges sustainability index*	*capital adequacy index*	*index of return of assets in liquid form*	*current ratio*	*social security and fiscal indebtedness index*
A. Agricoltura, silvicoltura e pesca	2,80%	9,40%	92,10%	0,30%	5,60%
B. Estrazione C. Manifattura D. Produzione energia/gas	3,00%	7,60%	93,70%	0,50%	4,90%
E. Fornitura acqua reti fognarie rifiuti D. Trasmissione energia/gas	2,60%	6,70%	84,20%	1,90%	6,50%
F41. Costruzione di edifici	3,80%	4,90%	108,00%	0,40%	3,80%
F42. Ingegneria civile F43. Costruzioni specializzate	2,80%	5,30%	101,10%	1,40%	5,30%
G45. Commercio autoveicoli G46. Comm. Ingrosso D. Distribuzione energia/gas	2,10%	6,30%	101,40%	0,60%	2,90%
G47. Commercio dettaglio I56. Bar e ristoranti	1,50%	4,20%	89,80%	1,00%	7,80%
H. Trasporto e magazzinaggio I55. Hotel	1,50%	4,10%	86,00%	1,40%	10,20%
JMN. Servizi alle imprese	1,80%	5,20%	95,40%	1,70%	11,90%
PQRS. Servizi alle persone	2,70%	2,30%	69,80%	0,50%	14,60%

Source: adaptation from CNDCEC (2019), *Crisi d'impresa: gli indici d'allerta*, cit., p. 18.

Beyond the useful indicators proposed by the CNDCEC, it is interesting to observe how the Legislator's attention to a timely detection of crisis permeates the entire regulatory framework: the objective becomes now that of "helping and healing" companies in difficulty, instead of the previous punitive system aimed merely at "ousting the bad company" (Commissione di Studio “Procedure concorsuali e giudiziarie”, 2019).

4. Research methodology

4.1. Predictive effectiveness of business insolvency forecasting models

After providing an overview of the main business insolvency forecasting models and the statistical techniques behind them, it is now intended to assess their predictive effectiveness. Models belonging to the *non model-based approach* are the only ones to have been applied in practice with significant results. However, leaving aside the *innovative models*, which are still in the development phase if not in the embryonic stage, the formulation of the remaining *traditional models* dates back to the Anglo-Saxon economy of the 1980s, in a very different context from the current one. Generally, the predictive effectiveness of these instruments is closely linked to the temporal, geographical, economic, and legal context of the companies considered (Giacosa & Mazzoleni, 2018). Some models have undergone various modifications over the years at the hands of their inventors and/or other authors, to adapt to the changing environmental contexts; for other models, modifications were minimal, and therefore their signalling capacity as the years passed was no longer sufficient.

The objective of this work is to evaluate, from an empirical point of view, the validity of the Financial Statements Analysis and the Z-score Model, considered particularly interesting among the traditional models both in terms of their diffusion in literature and their simplicity of use. The Financial Statements Analysis and the Z-score Model will be applied to the Italian business environment before the Covid-19 pandemic: a reformulation of all the models to consider the destructive effects of the pandemic on Italian and non-Italian companies is certainly necessary but would be premature at this point in time, as the whole world is still in the midst of the emergency phase. According to the results that will be obtained in Chapter 5, a weak predictive effectiveness or a limited signalling capacity will require a reformulation of the models to make them as consistent as possible with the application context.

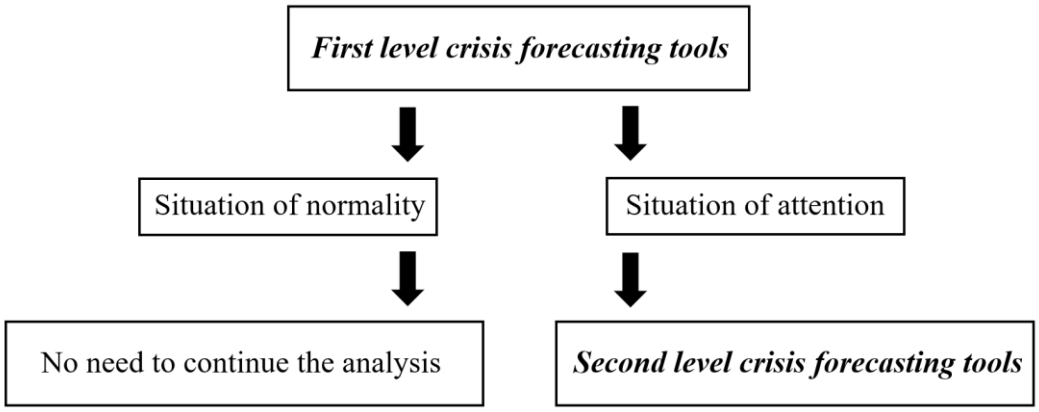
4.2. Choice of the models to be tested

The choice of the models to be tested is based on their diffusion both in literature and in practice. In the current context, where the expensive and complex artificial intelligence is the new frontier of forecasting models, the Financial Statements Analysis and the Z-score Model represent easily applicable tools, both affordable in terms of money spent and time used. The information they need is of accounting nature and, with appropriate adjustments, available from the Financial Statements of the single company: this makes these instruments available also for

subjects outside the company, to understand in advance the possibility of a crisis arising and to take the appropriate precautions accordingly.

In Chapter 5, the Z-score Model will be applied first, then the accounting indicators deriving from the Financial Statements Analysis will be calculated. The order sequence is not random. The Z-score Model represents a *first level crisis forecasting tool*: it has the task of producing a series of alert signals aimed at highlighting a situation of "normality" or "attention" regarding the possibility of the company entering a crisis. The Financial Statements Analysis belongs to the *second level crisis forecasting tools*: they come into play when, following the application of the first level crisis forecasting tools, a situation of "attention" emerges. The use of second level crisis forecasting tools allows for a more in-depth analysis of the company's financial and economic situation, as well as a more precise assessment of the seriousness of the situation and the appropriate methods of intervention.

Figure 8: Combined use of first and second level crisis forecasting tools



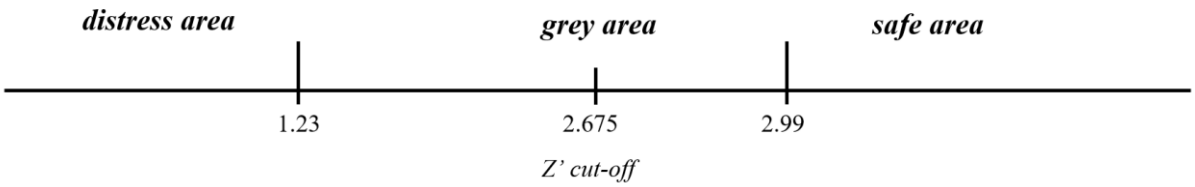
Source: adaptation from E. Giacosa, A. Mazzoleni (2018), *I modelli di previsione dell'insolvenza aziendale*, cit., p. 33.

Since the sample taken as reference consists of small, medium, and large companies, two different configurations of the Z-score Model, depending on the firm's size, will be used. Altman's second version is preferable for big companies, both listed and unlisted, with the following discriminant function:

$$Z' = 0.717\,X_1 + 0.847\,X_2 + 3.107\,X_3 + 0.42\,X_4 + 0.998\,X_5$$

where

- X_1 = *working capital / total assets (WC/TA)*
- X_2 = *retained earnings / total assets (RE/TA)*
- X_3 = *earnings before interest and taxes / total assets (EBIT/TA)*
- X_4 = *Book Value of equity / Book Value of total liabilities* (BV_E/TL)
- X_5 = *sales / total assets (S/TA).*

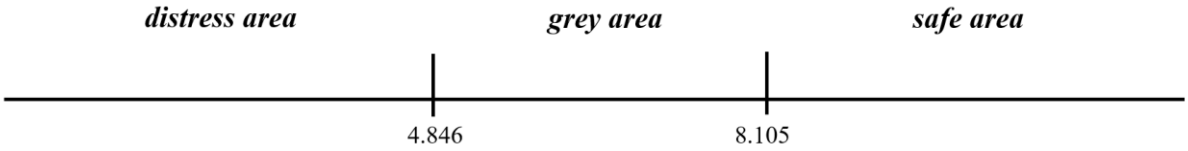


Bottani, Cipriani, and Serao's configuration of the Z-score Model is preferable for small and medium companies. This configuration is not applied to big companies because it could give misleading results since the discriminant function has been developed for a completely Italian context, characterized by a prevalence of small and medium-sized enterprises. The discriminant function is the following one:

$$Z = 1.982\,X_1 + 9.841\,X_2 + 1.951\,X_3 + 3.207\,X_4 + 4.038\,X_5$$

where

- $X_1 = \frac{(current\ assets - current\ liabilities)}{(tangible\ and\ intagible\ assets + ending\ inventory + current\ assets + cash\ \&\ cash\ equivalents)}$
- X_2 = *(legal reserve + extraordinary reserve) / total assets*
- $X_3 = \frac{net\ operating\ income}{(tangible\ and\ intagible\ assets + ending\ inventory + current\ assets)}$
- X_4 = *Book Value of equity / total liabilities*
- $X_5 = \frac{sales}{(tangible\ and\ intagible\ assets + ending\ inventory + current\ assets + cash\ \&\ cash\ equivalents)}$



The sample considered consists of companies officially declared in crisis, therefore it is assumed that the Z-score, in any of its configurations, will place companies in the *distress area* or eventually in the *grey area*. A value of the Z-score greater than 2.99 in Altman's second version, or 8.105 in Bottani, Cipriani, and Serao's version, would lead companies to be considered "healthy" (*safe area*), with a consequent fall of the predictive capacity of the model. Once the Z-score Model is applied, a Financial Statements Analysis will be carried out, calculating some indicators considered as the most representative and preparatory for a timely detection of a possible state of crisis. Table 3 summarizes these indicators: for each of them, the general conditions for assessing the positivity or equilibrium are highlighted. The analysis of the values will be based on a comparison over time, since a comparison in space involves greater problems of data retrieval, data reliability, homogeneity of the statements, and inconsistency deriving from a different application of the accounting principles. The objective is to observe for each company in crisis a condition of disequilibrium that gradually worsens

over the years, starting from the Financial Statements of the fifth (where possible) year preceding the crisis.

Table 3: Indicators for a timely detection of a possible state of crisis

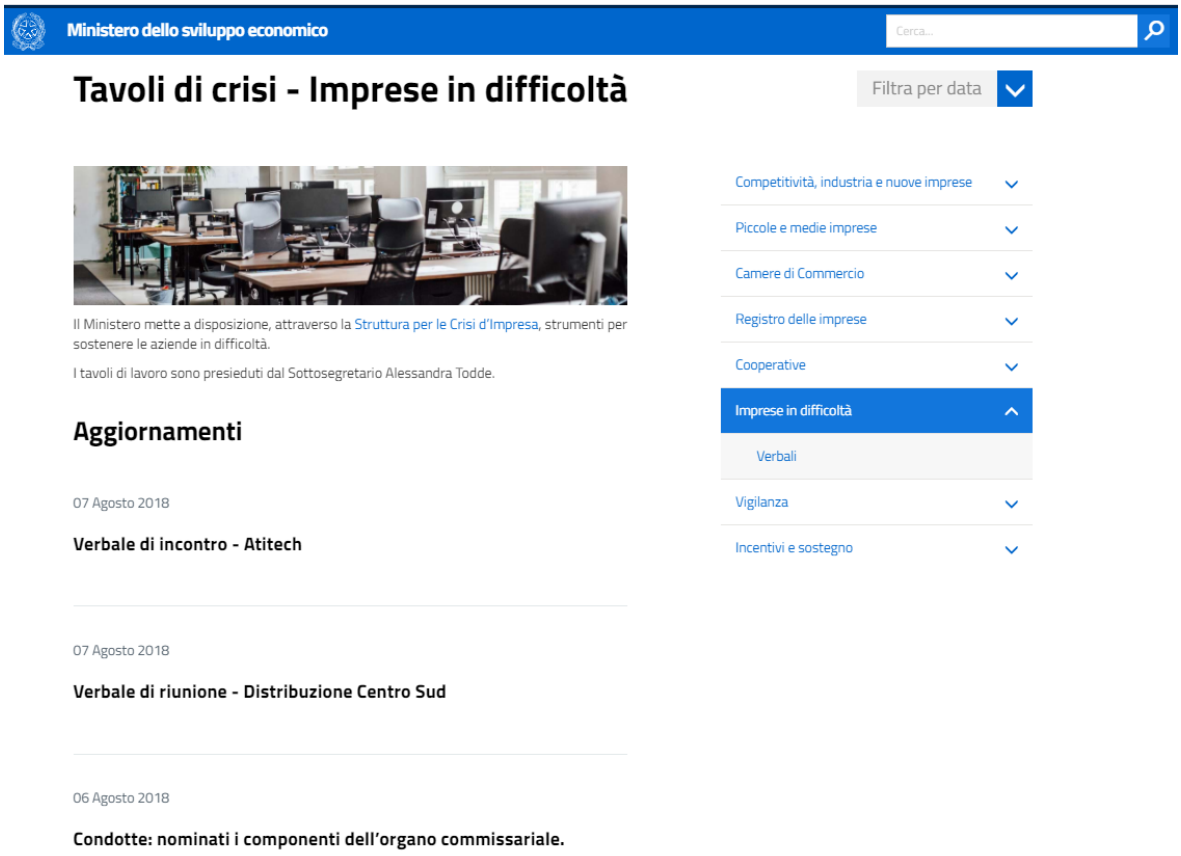
	Indicators	Positivity / equilibrium	Negativity / disequilibrium
Capital Solidity Ratio	***Net Financial Position***	$\Delta \leq 0$	$\Delta \geq 0$
Liquidity Ratios	***Current Ratio***	> 1	< 1
	Acid-test Ratio	≥ 1	< 1
Efficiency Ratios	***Days Receivables Outstanding***	< DPO	> DPO
	Days Payables Outstanding	> DRO	< DRO
Leverage Ratios	***Leverage***	≥ 1 but ≤ 2	> 2
	Debt-to-Equity Ratio	≤ 3	> 3
	Interest Coverage Ratio	≥ 4	< 4
	Financial debts / sales revenues	< 1	≥ 1
Profitability Ratios	***ROE***	> previous years	< previous years
	ROI		

Source: personal elaboration

4.3. Determination of the sample

The sample used for the test consists of unhealthy companies operating on Italian soil. For its determination, reference was made to the official website of the Italian Ministry of Economic Development (MISE), in particular the "enterprises in difficulty" section (https://www.mise.gov.it/index.php/it/impresa/imprese-in-difficolta): this section contains the records of the so-called "tables of crisis", meetings convened by the Italian Ministry of Economic Development in which the representatives of the Ministry in charge of the industrial policy, of the distressed company and of the trade unions take part. These meetings are convened periodically to monitor the state of difficulty or the recovery process of the company, to manage agreements with third parties (possible buyers, suppliers, credit institutions), and to propose solutions to safeguard employees' jobs or to avoid the closure of plants. Records published from year 2008 to year 2020 (for a total of 1388 documents) are analyzed to identify the business names and to build a first list of “officially” unhealthy companies. It is to be specified that the analysis stops at the records of February 2020, to exclude those companies whose economic difficulties are exclusively linked to the Covid-19 pandemic.

Figure 9: Screen of the website of the Italian Ministry of Economic Development



Source: https://www.mise.gov.it/index.php/it/impresa/imprese-in-difficolta

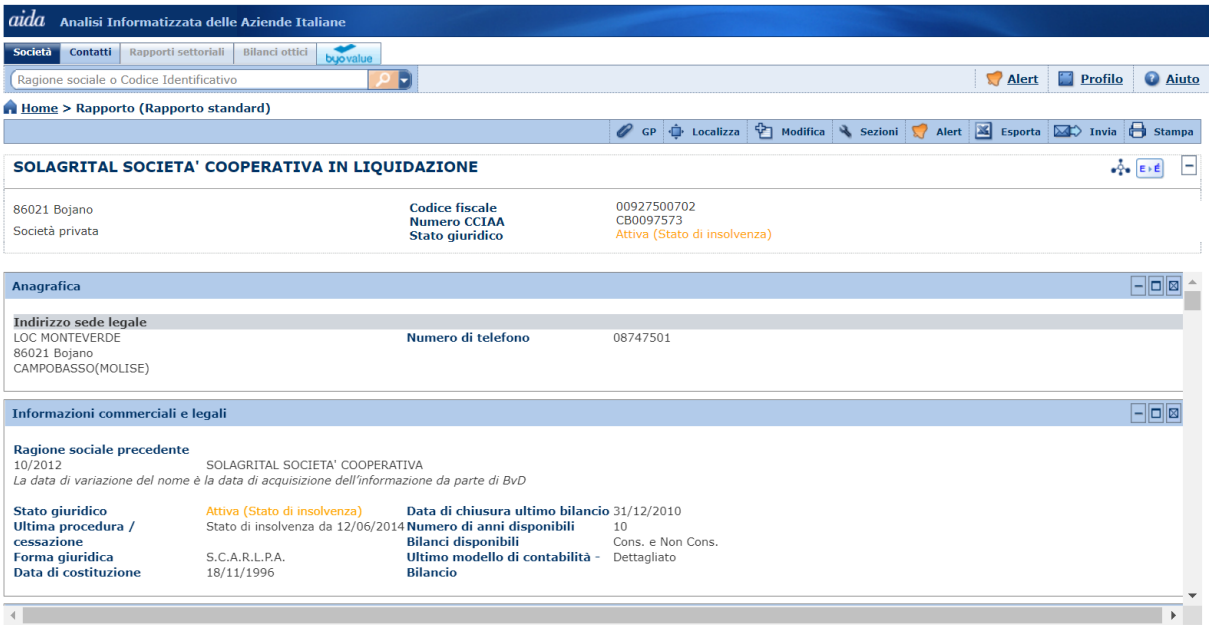
A first screening of the list of unhealthy companies is done using the AIDA Bureau van Dijk Database. AIDA (Analisi Informatizzata delle Aziende Italiane) contains financial, personal, and commercial information on over 1,000,000 companies operating in Italy; data are reported in historical series, up to a maximum of 10 years, and make possible to carry out a complete evaluation of the companies. Each company, for which a table of crisis had been convened at the Ministry, is inserted in the database and selected for the determination of the test sample only if it complies with the following requirements:

- declaration of a state of insolvency, bankruptcy, or liquidation process under "legal status", or declaration of commencement and/or closure of insolvency proceedings (concordato preventivo, controlled administration, extraordinary administration, debt restructuring agreement, deletion from the Commercial Register due to bankruptcy) under "last proceedings / cessation";
- availability of at least three consecutive fiscal years Financial Statements in the five years preceding the crisis.

Compliance with the first requirement is fundamental in order to have an official reference date to which the company's crisis/difficulty situation can be traced; compliance with the second

requirement allows to observe the predictive effectiveness of indicators over time, with the aim of having a trend of values over a period of at least three years and for a maximum of five years. Following this procedure, 92 companies have been isolated from the list initially built up through the ministerial records.

Figure 10: Screen of AIDA Bureau van Dijk Database



Source: AIDA Bureau van Dijk Database

A second screening of the list is carried out based on the company's sector, so that further considerations can be made, where possible, on values within the same sector and between different sectors. Each company has been associated with the respective ATECO 2007 code, an alphanumeric combination that identifies the economic activity and consequently the sector to which it belongs. Only those companies belonging to sectors for which at least four companies are available, are included in the final test sample.

The final test sample used for the analysis is made up of 28 unhealthy companies belonging to the following five sectors:

- *Metallurgy* (6 companies);
- *Manufacture of computers and electronic and optical devices; electromedical equipment, measuring equipment and watches* (8 companies);
- *Construction* (4 companies);
- *Wholesale trade* (5 companies);
- *Computer programming, computer consulting and related activities* (5 companies).

Table 4 reports the business name, the company's size (S = small; M = medium; B = big), and the sector to which companies belong with the respective ATECO code.

Table 4: Final test sample

Business name	***Size***	***Sector***	***ATECO code***
AFV Acciaierie Beltrame S.p.A.	B	24 Metallurgy	241000 Manufacture of basic iron and steel or ferro-alloys
Lucchini S.p.A.	B		241000 Manufacture of basic iron and steel or ferro-alloys
Italcables S.r.l.	S		243400 Manufacturing of strands for reinforced concrete, wire ropes, ties and lifing equipment
Etnall S.r.l.	S		244200 Aluminium production
Carlo Colombo S.p.A.	B		244400 Copper production
EDIM S.p.A.	B		245000 Foundries
Solsonica S.r.l.	S	26 Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches	261109 Manufacture of other electronic elements
Jabil C.M. S.r.l.	S		261109 Manufacture of other electronic elements
OLDCOM S.r.l.	B		261200 Manufacture of loaded electronic boards
Compel Electronics S.p.A.	B		263020 Manufacture of electrical and electronic telecommunications appliances
Italtel S.p.A.	B		263029 Manufacture of other electrical and electronic telecommunications appliances
Linkra S.r.l.	B		263029 Manufacture of other electrical and electronic telecommunications appliances
Selta S.p.A.	B		263029 Manufacture of other electrical and electronic telecommunications appliances
Haemonetics Produzione Italia S.r.l.	S		266002 Manufacture of electromedical equipment (including separate parts and accessories)

Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	B	41 Construction	412000	Construction of residential and non-residential buildings
Condotte immobiliare S.p.A.	B		412000	Construction of residential and non-residential buildings
IMF S.r.l.	B		412000	Construction of residential and non-residential buildings
Tecnis S.p.A.	B		412000	Construction of residential and non-residential buildings
Distribuzione Cambria S.r.l.	B	46 Wholesale trade	463920	Non-specialized wholesale trade of food, beverages and tobacco
DPS Group S.r.l.	M		464910	Wholesale trade of papers, card and stationery
Silda S.r.l.	M		467210	Wholesale trade of metal minerals, ferrous metals and semi-processed goods
Sider All. Sud S.r.l.	M		467220	Wholesale trade of non-ferrous metals and semi-processed products
Dico S.p.A.	B		469000	Non-specialized wholesale trade
Solgenia S.r. l.	S	62 Computer programming, computer consulting and related activities	620100	Computer programming activities
CSP S.p.A.	B		620100	Computer programming activities
Consorzio Gepin	S		620100	Computer programming activities
Opera 21 S.r.l.	S		620100	Computer programming activities
Sofiter System Engineering S.p.A.	B		620100	Computer programming activities

Source: personal elaboration

5. Empirical evidence

5.1. Empirical evidence by the Z-score Model

The application of the Z-score Model to the test sample is limited to the calculation of the scores in the year preceding the crisis declaration or, where not possible, in the second year preceding the crisis declaration. The decision not to go further back in time for those companies for which no Financial Statements are available in the two years before the crisis is dictated by the already proven weak forecasting capacity of the Model (the percentage of correct classifications is less than 50% in the third year and even lower in previous ones). Results obtained are reported as follows:

- Table 5: scores from Altman's second configuration of the Z-score Model for big companies in the first year preceding the crisis declaration;
- Table 6: scores from Altman's second configuration of the Z-score Model for big companies in the second year preceding the crisis declaration;
- Table 7: scores from Bottani, Cipriani, and Serao's configuration of the Z-score Model for small and medium-sized companies in the first year preceding the crisis declaration.

Last column of each table shows the area to which the company belongs based on its Z-score value: D corresponds to the *distress area*, G to the *grey area*, and S to the *safe area*.

Table 5: Altman's Z-score relating to one year before the crisis

Firm	***X_1***	***X_2***	***X_3***	***X_4***	***X_5***	***Z-score***	***Area***
AFV Acciaierie Beltrame S.p.A.	0.038	0.000	-0.016	0.847	0.774	1.107	D
Carlo Colombo S.p.A.	-0.350	-0.375	-0.024	-0.250	5.925	5.166	S
Dico S.p.A.	-1.738	-1.060	-0.318	-0.539	1.267	-2.092	D
EDIM S.p.A.	-0.127	0.000	-0.014	0.054	2.948	2.830	G
Italtel S.p.A.	-0.457	-0.163	-0.200	-0.135	0.757	-0.390	D
OLDCOM S.r.l.	-0.998	-0.866	-0.104	-0.396	1.300	-0.641	D
Selta S.p.A.	-0.173	0.000	-0.102	-0.016	0.758	0.309	D
Sofiter System Engineering S.p.A.	0.193	0.000	0.008	0.014	0.842	1.009	D

Source: personal elaboration

Table 6: Altman's Z-score relating to two years before the crisis

Firm	X_1	X_2	X_3	X_4	X_5	*Z-score*	*Area*
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	0.466	0.000	-0.246	0.043	0.259	-0.154	D
Compel Electronics S.p.A.	-0.297	-0.089	-0.037	0.207	0.643	0.325	D
Condotte immobiliare S.p.A.	0.374	0.000	-0.076	0.374	0.374	0.563	D
Distribuzione Cambria S.r.l.	-0.120	-0.044	-0.700	-0.408	1.118	-1.353	D
IMF S.r.l.	-0.219	-0.136	-0.014	-0.093	0.071	-0.283	D
Linkra S.r.l.	0.228	0.018	-0.012	0.155	1.048	1.252	G
Lucchini S.p.A.	-0.074	-0.536	-0.063	0.065	1.038	0.362	D

Source: personal elaboration

Table 7: Bottani, Cipriani, and Serao's Z-score relating to one year before the crisis

Firm	X_1	X_2	X_3	X_4	X_5	*Z-score*	*Area*
DPS Group S.r.l.	0.006	0.003	0.014	0.087	1.459	6.236	G
Etnall S.r.l.	-0.237	0.001	-0.175	0.027	0.833	2.650	D
Haemonetics Produzione Italia S.r.l.	0.080	0.000	-0.279	0.078	0.000	-0.136	D
Italcables S.r.l.	-0.754	0.014	-0.345	-0.212	1.438	3.093	D
Jabil C.M. S.r.l.	0.244	0.427	-2.704	-0.452	0.920	1.676	D
Opera 21 S.r.l.	0.098	0.003	-0.015	0.126	0.000	0.600	D
Sider All. Sud S.r.l.	-0.008	0.002	0.018	0.038	0.316	1.439	D
Silda S.r.l.	0.393	0.005	0.125	0.303	1.717	8.973	S
Solgenia S.r.l.	0.034	0.000	0.015	0.025	0.158	0.816	D
Solsonica S.r.l.	-0.194	0.000	-0.258	-0.473	0.204	-1.581	D

Source: personal elaboration

Referring to the final test sample, the Z-scores of three companies are not reported: *Consorzio Gepin*, *Tecnis S.p.A.* and *CSP S.p.A.*. Regarding *Consorzio Gepin*, in the second year prior to the crisis, liabilities have null value and consequently it is not possible to calculate X_4 = *Book Value of equity / total liabilities*: the company was deleted from the Commercial Register two years after the one used as reference for the Z-score calculation, but it had been presenting Financial Statements with anomalous data for more than a couple of years, sign that the activity had probably already ceased and that the deletion practice had already been planned but actually completed only a few years later. On the other hand, the Z-scores of *Tecnis S.p.A.* and *CSP S.p.A*. are not reported since Financial Statements of the two years prior to the crisis are not available in the AIDA database. Sometimes the reason for this lack of data availability is to be found in the fact that large groups, which have become insolvent, are unable to approve Financial Statements for the fiscal years immediately before the insolvency, both for the timing and for the presence of contested and therefore never approved Financial Statements (Altman, Danovi & Falini, 2013).

The elaborations of the Z-score for Italian companies show how most of the companies are classified within the *distress area*. The result is in line with expectations, since the final test sample is entirely made up of companies in difficulty. There are few exceptions: three companies (*EDIM S.p.A., Linkra S.r.l., DPS Group S.r.l.*) are classified within the *gray area*, and two companies (*Carlo Colombo S.p.A.* and *Silda S.r.l.*) are classified within the *safe area*. While the former do not give particular problems because, even if not considered unhealthy companies, their placement in the *grey area* labels them as medium-performing companies with high risks to be further investigated, the latter constitute an error, the so-called "false negative": *Carlo Colombo S.p.A.* and *Silda S.r.l.* are painted as healthy companies, even if their situation is far from rosy. This underlines how the Z-score Model is not infallible, and at the same time how the statistical model works on average. It can produce wrong results in two different directions: the "false positive", which labels a healthy company as fallible; and the "false negative", which labels a company with a high probability of failure as healthy. Therefore, the Z-score Model should be used as a starting point for an in-depth examination of the conditions of corporate continuity, and not as a way of issuing a final judgment on its state of health.

An interesting aspect lies in the signs of the Z-scores, which are preceded by the minus in 8 cases. The negative sign underlines a very bad and serious situation where the company has a negative working capital, a negative operating income, and/or a negative equity. If the Z-scores are not negative, in most cases they are close to zero. The almost null value of the Z-score is due firstly to X_2, which often assumes value 0 because companies have no profit from the

previous year carried forward (null retained earnings) or sufficient resources to create extraordinary reserves; and secondly to X_4, corresponding to the ratio between equity and total liabilities. In a recent publication by Altman, Danovi, and Falini (Altman, Danovi & Falini, 2013), it was doubtful whether, given the typical characteristics of Italian companies, indicator X_4 was not excessively penalizing for those subjects whose financial profile is characterized by a low capitalization and a significant recourse to the banking debt.

Although from an internal point of view the Model constitutes a useful tool for predicting the state of crisis that is likely to occur in the short-term, from an external point of view it could determine the end of the company itself. This is the case of the "self-fulfilling prophecies": a company asks the bank for new loans but the analyst, classifying it as insolvent on the basis of the low Z-score, refuses the request. The absence of such new resources could prevent the company from honoring its current debts and others arising in the meantime, thus bringing the company to the state of insolvency that the Model had predicted. The question is: what would have happened if the Model had (erroneously) predicted a rosy future for that company? What would have happened if the Model had classified an unhealthy company as a healthy company? Probably the bank would have provided the required funding, the company would have fulfilled its obligations and perhaps it would have been able to restart on a path of consolidation and development.

Overall, it can be stated that the Z-score Model in Altman's second configuration for large companies and in the "Italian" configuration for small and medium-sized companies, has good predictive effectiveness: it is an excellent *warning tool* for Italian companies, as it correctly classifies 23 companies out of a total of 25. At the same time, its non-infallibility and the dangers associated with its decontextualized and uncritical use which can condemn a company in difficulty forever, are aspects that must always be kept in mind.

Anyway, a single configuration that allows companies of all sizes to be considered simultaneously could be a future useful development of the Model, which must be rearranged to adapt to the current economic situation devastated by the recent Covid-19 pandemic.

5.2. Financial Statements Analysis

The application of the Z-score Model (*first level crisis forecasting tool*) has highlighted a situation of "attention" for 23 enterprises out of 25, which must be further investigated through the application of a *second level crisis forecasting tool*, such as the Financial Statements Analysis. For *Carlo Colombo S.p.A.* and *Silda S.r.l.*, wrongly classified as healthy companies by the Z-score Model, the application of an additional tool of analysis is fundamental to "unmask" a situation that only apparently seems positive.

In the following paragraphs, there are the values of the most useful financial indicators used for a timely detection of a possible state of crisis. Financial indicators are applied to all 28 companies of the final test sample: their values are broken down by sector and reported in chronological order to facilitate a comparison *over time*, from the furthest year from crisis declaration (5Y = 5 years before the crisis) to the year preceding crisis declaration (1Y = one year before the crisis). Where there is no value, Financial Statements for that year are not available. The acronym *n.s.* - *not significant* is reported if items of the numerator and/or items of the denominator have opposite sign to the usual one, thus making the ratio lose its meaning, while the acronym *n.a.* - *not available* is reported if in the Balance Sheet or Income Statement the exact value for an item or sub-item is not available and therefore it is not possible to calculate the ratio. Lastly, for each financial indicator, its average by sector has been calculated and reported in the last table of each paragraph.

Since the final test sample is made up of companies in difficulty, selected financial indicators are expected to show a worsening trend over time, with values that deviate from those considered as “acceptable" thresholds in a situation of normal administration.

5.2.1. Net Financial Position

Table 8: Net Financial Position by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		126,672,385 €	167,397,477 €	149,889,223 €	132,467,317 €
Lucchini S.p.A.	392,420,000 €	473,366,302 €	620,111,359 €	403,679,514 €	
Italcables S.r.l.			16,171,979 €	13,134,174 €	5,601,821 €
Etnall S.r.l.		18,149,185 €	21,643,323 €	25,665,175 €	24,237,937 €

Carlo Colombo S.p.A.	155,698,086 €	148,404,154 €	159,579,075 €	164,681,173 €	146,061,935 €
EDIM S.p.A.	873,149 €	700,440 €	565,918 €	1,697,716 €	6,785,807 €

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	-1,372,171 €	-245,361 €	-598,722 €	-210,177 €	-735,533 €
Jabil C.M. S.r.l.			6,325,933 €	-7,836,348 €	-22,109 €
OLDCOM S.r.l.	32,442,000 €	37,050,000 €	34,519,000 €	35,803,000 €	24,836,000 €
Compel Electronics S.p.A.	6,879,000 €	6,157,000 €	5,930,000 €	4,474,000 €	
Italtel S.p.A.	276,518,000 €	183,339,000 €	192,667,000 €	204,004,000 €	240,306,000 €
Linkra S.r.l.	7,535,000 €	3,672,000 €	7,906,000 €	9,946,000 €	
Selta S.p.A.	31,841,546 €	26,464,000 €	15,017,000 €	14,393,000 €	20,136,000 €
Haemonetics Produzione Italia S.r.l.	-513,373 €	-302,884 €	-133,789 €	-708,830 €	-1,023,196 €

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	5,678,164 €	5,713,827 €	3,693,396 €	4,537,422 €	
Condotte immobiliare S.p.A.	89,388,262 €	85,633,970 €	80,953,510 €	67,885,276 €	
IMF S.r.l.	26,938,322 €	26,333,545 €	27,029,127 €	27,017,546 €	
Tecnis S.p.A.	54,994,411 €	55,854,943 €	38,170,726 €		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	4,440,386 €	7,740,077 €	3,385,786 €	711,818 €	

DPS Group S.r.l.	n.a.	26,190 €	-5,467 €	-5,039 €	-32,867 €
Silda S.r.l.		n.a.	n.a.	161,294 €	108,769 €
Sider All. Sud S.r.l.	-17,261 €	-19,444 €	-21,495 €	-67,328 €	n.a.
Dico S.p.A.	84,551,000 €	132,749,043 €	188,328,822 €	220,120,523 €	247,793,687 €

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	1,262,902 €	659,239 €	674,574 €	696,974 €	789,013 €
CSP S.p.A.	6,578,343 €	5,650,546 €	2,330,246 €		
Consorzio Gepin	2,370,083 €	n.a.	-7,435 €	n.a.	
Opera 21 S.r.l.			-27,961 €	-2,125 €	-583 €
Sofiter System Engineering S.p.A.	2,343,258 €	426,583 €	1,711,015 €	868,411 €	1,085,188 €

Source: personal elaboration

Table 9: Average Net Financial Position by sector

Metallurgy	***Manufacture of computers and (…)***	***Construction***	***Wholesale Trade***	***Computer programming (…)***
134,595,047 €	35,664,026 €	40,593,488 €	35,775,497 €	1,625,515 €

Source: personal elaboration

The Net Financial Position corresponds to the difference between the sum of short-term and long-term financial liabilities, and cash & cash equivalents. It summarizes the company's tendency to increase or decrease its financial indebtedness through the generation of liquidity. From the analysis carried out, the Net Financial Position does not seem to be one of the most representative and useful indicators of a forthcoming state of crisis: for 10 companies out of 27 (*Consorzio Gepin* does not allow a judgement given the lack of data) this indicator decreases over time, sign that the company is able to produce more liquidity over the years and to repay its financial debt. In addition, for 5 companies the Net Financial Position is negative: the

dominance of cash & cash equivalents over financial liabilities makes an imminent crisis almost unimaginable if the judgement on the company's state of health were based only on this indicator.

Looking at sector averages, the *Metallurgy* sector is heavily indebted despite the cash generated. While the *Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches* sector, the *Construction* sector, and the *Wholesale trade* sector have very similar averages (which oscillate between 35,664,026 € and 40,593,488 €), the *Metallurgy* and *Computer programming, computer consulting and related activities* sectors are at two opposite poles, the first with a Net Financial Position of 134,595,047 € and the second with a Net Financial Position of 1,625,515 €. The *Metallurgy* sector, therefore, appears to be in great difficulty in the period examined, since large demands for financial debt are not matched by an adequate and conspicuous generation of cash & cash equivalents.

Returning to the indicator at the individual company's level, since 10 companies do not show a degenerative trend of the Net Financial Position over time and for about one fifth of the sample cash & cash equivalents are higher than short and long-term financial liabilities, the Net Financial Position, singularly considered, does not represent a premonitory sign of an imminent state of crisis.

5.2.2. Current Ratio

Table 10: Current Ratio by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		1.23	1.27	1.15	1.13
Lucchini S.p.A.	4.03	3.01	0.69	0.92	
Italcables S.r.l.			0.78	0.7	0.37
Etnall S.r.l.		1.25	1.28	1.2	0.7
Carlo Colombo S.p.A.	0.83	0.83	0.81	0.68	0.65
EDIM S.p.A.	1.21	1.23	0.99	0.85	0.86

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	1.58	0.9	0.79	0.29	0.84
Jabil C.M. S.r.l.			1.13	1.69	1.32
OLDCOM S.r.l.	0.76	0.8	0.74	0.39	0.35
Compel Electronics S.p.A.	1.05	0.99	0.63	0.47	
Italtel S.p.A.	0.84	1.09	0.98	0.87	0.54
Linkra S.r.l.	1.29	1.28	1.52	1.36	
Selta S.p.A.	1.27	1.12	1.24	0.99	0.79
Haemonetics Produzione Italia S.r.l.	0.25	0.35	0.43	0.47	1.09

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	2.58	2.99	2.88	1.98	
Condotte immobiliare S.p.A.	1.37	1.17	1.66	1.69	
IMF S.r.l.	2.33	1.72	1.6	0.8	
Tecnis S.p.A.	1.3	0.95	0.96		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	1.14	0.91	1.17	0.74	
DPS Group S.r.l.	1.16	1.13	1.07	1.03	1.01
Silda S.r.l.		1.58	1.3	2.32	1.82
Sider All. Sud S.r.l.	1.02	0.96	n.a.	0.93	0.99

Dico S.p.A.	0.56	0.49	0.38	0.29	0.13

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	0.44	1.06	1.14	0.95	1.09
CSP S.p.A.	1.33	1	0.95		
Consorzio Gepin	1	1.82	5.53	n.a.	
Opera 21 S.r.l.			1.07	1.12	1.11
Sofiter System Engineering S.p.A.	1.49	1.11	1.99	1.13	1.34

Source: personal elaboration

Table 11: Average Current Ratio by sector

Metallurgy	***Manufacture of computers and (…)***	***Construction***	***Wholesale Trade***	***Computer programming (…)***
1.14	0.95	1.69	1.03	1.46

Source: personal elaboration

The Current Ratio expresses the ratio between current assets and short-term liabilities: when it assumes a value greater than 1, it means that the company can meet short-term financial commitments with short-term resources, without resorting to the divestment of fixed assets.
In the present analysis, contrary to expectations, 10 companies (*AFV Acciaierie Beltrame S.p.A.*, *Jabil C.M. S.r.l.*, *Linkra S.r.l., Alte Tecnologie Ingegneristiche Group S.r.l.*, *Condotte immobiliare S.p.A.*, *DPS Group S.r.l.*, *Silda S.r.l.*, *Solgenia S.r.l.*, *Opera 21 S.r.l.*, and *Sofiter System Engineering S.p.A.*) report Current Ratios higher than the unit in the years preceding the crisis declaration, a rather positive sign from a liquidity point of view and in contradiction with the real and not very promising situation of the companies in question. In addition, for 7 of these 10 companies, the index not only exceeds the unit, but also the values usually assumed as benchmark (1.1 for large companies and 1.2 for small companies), thus declaring an even "optimal" monetary and financial equilibrium.

For *Consorzio Gepin*, the unavailability of data in the two years preceding the crisis does not allow a judgement on the monetary equilibrium, while *Haemonetics Produzione Italia S.r.l.* reports a Current Ratio higher than the unit, but only in the year preceding the crisis declaration: however, the ratio, equal to 1.09, is low if compared to the optimal value taken as benchmark for small companies.

By an accurate observation of the values reported, it can be seen that the Current Ratio shows for almost all companies a worsening trend starting from the year farthest away to the closest one; 4 companies are an exception, which are the same ones characterized by Current Ratios higher than the unit.

It would seem that, for just over a third of companies, the Current Ratio is not a "reliable" parameter on which basing a judgement about the company's state of health. Sectorial averages themselves, reported in Table 11, are higher than the unit for 4 sectors out of 5: only the *Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches* sector has an average Current Ratio of 0.95, representative of the critical situation that all companies in the sample are going through. On the contrary, the *Construction* sector has the highest average value, equal to 1.69: it would seem that this sector does not suffer from particular problems with regard to the coverage of short-term debts with current resources. However, this is only an apparent equilibrium, since the Acid-test Ratio for the *Construction* sector shows a situation diametrically opposite to the one just described.

If a Current Ratio higher than the unit excludes a financial disequilibrium, it does not necessarily indicate a financial equilibrium: it is necessary to calculate a second Liquidity Ratio, the Acid-test Ratio, for those 10 companies for which the Current Ratio is higher than 1. The Acid-test Ratio does not consider the inventory at the numerator (which could be converted into liquidity in more than 12 months), and, therefore, a value lower than 1 makes possible to state with absolute certainty that the company is not liquid.

5.2.3. Acid-test Ratio

Table 12: Acid-test Ratio by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		0.82	0.71	0.73	0.71
Lucchini S.p.A.	2.72	2.03	0.41	0.66	
Italcables S.r.l.			0.61	0.59	0.35

Etnall S.r.l.		0.94	0.8	0.71	0.62
Carlo Colombo S.p.A.	0.56	0.57	0.59	0.54	0.54
EDIM S.p.A.	0.86	0.88	0.94	0.54	0.46

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	1.26	0.68	0.58	0.24	0.52
Jabil C.M. S.r.l.			0.71	1.42	1.02
OLDCOM S.r.l.	0.55	0.61	0.6	0.29	0.25
Compel Electronics S.p.A.	0.82	0.76	0.62	0.46	
Italtel S.p.A.	0.79	1.02	0.89	0.76	0.46
Linkra S.r.l.	0.64	0.73	0.84	0.9	
Selta S.p.A.	0.96	0.84	0.8	0.63	0.53
Haemonetics Produzione Italia S.r.l.	0.25	0.35	0.43	0.47	1.09

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	1.04	1.23	0.88	0.55	
Condotte immobiliare S.p.A.	0.25	0.08	0.13	0.17	
IMF S.r.l.	0.1	0.08	0.05	0.03	
Tecnis S.p.A.	1.11	0.83	0.94		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	1.07	0.59	0.72	0.55	
DPS Group S.r.l.	0.74	0.73	0.93	0.93	0.91
Silda S.r.l.		1.34	1.11	0.97	1.17
Sider All. Sud S.r.l.	0.22	0.39	n.a.	0.37	0.17
Dico S.p.A.	0.38	0.34	0.27	0.22	0.09

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	0.44	1.06	1.14	0.95	1.09
CSP S.p.A.	1.33	1	0.94		
Consorzio Gepin	1	1.82	5.53	n.a.	
Opera 21 S.r.l.			1.07	1.12	1.11
Sofiter System Engineering S.p.A.	1.49	1.11	1.99	1.13	1.34

Source: personal elaboration

Table 13: Average Acid-test Ratio by sector

Metallurgy	***Manufacture of computers and (…)***	***Construction***	***Wholesale Trade***	***Computer programming (…)***
0.80	0.71	0.53	0.66	1.46

Source: personal elaboration

The analysis of the Acid-test Ratio is limited to the values assumed by this indicator for the 10 companies with a Current Ratio higher than 1. The Acid-test Ratio is lower than 1 only for half of the sub-sample considered: *Jabil C.M. S.r.l.*, *Silda S.r.l.*, *Solgenia S.r.l.*, *Opera 21 S.r.l.*, and *Sofiter System Engineering S.p.A.* continue to have a ratio higher than the unit. However, while for *Jabil C.M. S.r.l.* and *Silda S.r.l.* the Acid-test Ratio and the Current Ratio have different

values, and the former is obviously lower than the latter, for *Solgenia S.r.l.*, *Opera 21 S.r.l.*, *Sofiter System Engineering S.p.A.*, and in general all the companies belonging to the *Computer programming, computer consulting and related activities* sector, the Current Ratio and the Acid-test Ratio have the same value (consequently also respective averages are the same), sign that companies belonging to this sector do not have inventory in their Balance Sheet.

Overall, it can be said that while the Current Ratio does not immediately identify an imminent situation of difficulty, the Acid-test Ratio highlights better the low liquidity of companies considered, which we can finally say are illiquid. A striking example in this sense is provided by the comparison between sectorial averages: if average Current Ratios show a situation in which the *Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches* sector is the only one suffering from a monetary imbalance and in which for the *Construction* sector this problem is far from being the case, average Acid-test Ratios show a very different situation, in which the *Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches* sector is characterized by a certain illiquidity but similar to the one faced by the *Metallurgy* and the *Wholesale Trade* sectors, and in which the *Construction* sector has the lowest Acid-test Ratio (0.53).

The Acid-test Ratio is not better as indicator only for companies belonging to the *Computer programming, computer consulting and related activities* sector, for which there is no inventory and which appear to be liquid in the present analysis.

For the remaining companies, that already have a Current Ratio lower than the unit, the critical situation remains and is further confirmed by the Acid-test Ratio: as was logical to expect, the latter shows a worsening trend over time for almost all companies and, with the exception of *Linkra S.r.l.*, *Tecnis S.p.A.*, and *DPS Group S.r.l.*, reports values not only lower than the unit but also lower than those assumed as benchmark (0.89 for large companies and 0.79 for small companies).

5.2.4. Days Receivables Outstanding and Days Payables Outstanding

Table 14: Days Receivables Outstanding and Days Payables Outstanding by sector

Metallurgy		5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.	***DRO***		100.63	74.17	71.23	76.8
	DPO		91.43	93.13	106.9	107.42

Lucchini S.p.A.	***DRO***	n.a.	76.91	80.28	79.09	
	DPO	46.55	98.24	80.05	76.3	
Italcables S.r.l.	***DRO***			103.84	116.94	83.77
	DPO			93.47	146.2	236.14
Etnall S.r.l.	***DRO***		214.72	238.46	177.64	179.73
	DPO		153.92	83.59	68.34	84.44
Carlo Colombo S.p.A.	***DRO***	19.11	22.94	25.65	25.45	26
	DPO	16.22	19.23	17.63	18.96	23.44
EDIM S.p.A.	***DRO***	73.13	79.75	191.33	38.35	40.2
	DPO	74.86	101.17	198.23	58.17	72.09

Manufacture of computers and (…)		5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	***DRO***	86.07	47.77	52.19	48.64	580.15
	DPO	55.55	60.67	67.4	79.51	n.s.
Jabil C.M. S.r.l.	***DRO***			42.2	72.45	13.53
	DPO			78.3	95.94	75.95
OLDCOM S.r.l.	***DRO***	68.2	55.25	55.93	69.8	23.37
	DPO	149.86	128.21	145.59	159.76	193.99
Compel Electronics S.p.A.	***DRO***	47.13	60.78	100.74	68.54	
	DPO	147.27	94.78	24.89	30.73	
Italtel S.p.A.	***DRO***	65.59	104.65	60.04	50.98	99.55
	DPO	258.51	177.16	176.22	167.04	210.95

Linkra S.r.l.	***DRO***	78.9	107.81	88.7	95.05	
	DPO	125.74	137.23	151.58	157.73	
Selta S.p.A.	***DRO***	266.29	226.38	1052.82	192.97	175.71
	DPO	230.72	222.06	n.s.	333.74	234.25
Haemonetics Produzione Italia S.r.l.	***DRO***	1.03	0	13.55	14.1	n.a.
	DPO	100.78	43.4	38.86	31.24	129.55

Construction		5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	***DRO***	258.52	539.91	290.07	379.59	
	DPO	n.s.	n.s.	n.s.	n.s.	
Condotte immobiliare S.p.A.	***DRO***	278.53	222.73	186.11	177.62	
	DPO	n.s.	n.s.	496.56	326.93	
IMF S.r.l.	***DRO***	71.66	39.02	63.65	41.86	
	DPO	477.03	252.14	491.97	n.s.	
Tecnis S.p.A.	***DRO***	58.15	56.23	67.53		
	DPO	86.98	126.85	79.39		

Wholesale Trade		5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	***DRO***	118.53	27.12	33.87	37.6	
	DPO	22.66	32.6	291.52	n.s.	
DPS Group S.r.l.	***DRO***	106.25	120.21	139.29	168.11	136.58
	DPO	n.d.	201.32	232.69	216.52	212.15

Silda S.r.l.	***DRO***		n.a.	134.73	n.a.	109.91
	DPO		n.a.	n.a.	79.58	36.93
Sider All. Sud S.r.l.	***DRO***	50.86	0	0	0	n.a.
	DPO	271.85	0	0	0	n.a.
Dico S.p.A.	***DRO***	9.93	8.71	9.4	8.21	3.89
	DPO	129.84	122.05	119.33	125.19	245.85

Computer programming (…)		5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	***DRO***	205.41	158.98	263.81	106.66	61.37
	DPO	343.6	n.s.	n.s.	n.s.	493.42
CSP S.p.A.	***DRO***	141.17	194.98	230.16		
	DPO	61.02	107.52	164.43		
Consorzio Gepin	***DRO***	338.98	n.a.	n.a.	n.s.	
	DPO	341.15	n.a.	442.7	n.a.	
Opera 21 S.r.l.	***DRO***			68.01	0	n.a.
	DPO			13.19	0	0
Sofiter System Engineering S.p.A.	***DRO***	197.64	119.42	166.32	196.85	146.52
	DPO	407.05	85.9	82.37	70.41	60.15

Source: personal elaboration

Table 15: Average Days Receivables Outstanding and Average Days Payables Outstanding by sector

	Metallurgy	***Manufacture of computers and (…)***	***Construction***	***Wholesale Trade***	***Computer programming (…)***

DRO	95.33	523.36	174.49	66.29	177.27
DPO	91.86	564.40	305.51	121.19	213.40

Source: personal elaboration

The judgement of the monetary equilibrium passes also through the Efficiency Ratios, in particular the Days Receivables Outstanding, the Days Payables Outstanding, and their comparison over time. The calculation of these two ratios caused many difficulties for companies such as *Alte Tecnologie Ingegneristiche Group S.r.l.*, *Silda S.r.l.*, *Sider All. Sud S.r.l.*, *Solgenia S.r.l.*, *Consorzio Gepin*, and *Opera 21 S.r.l.*, which, in several years, report values not available (*n.a.*), meaningless (*n.s.*) or equal to zero. From the remaining sample of 22 companies, only 4 companies (*Etnall S.r.l.*, *Compel Electronics S.p.A.*, *CSP S.p.A.*, *Sofiter System Engineering S.p.A.*) show DROs higher than DPOs and, therefore, a concrete difficulty in collecting and having the necessary money to repay debts (probably these companies suffer from a treasury gap). For two companies, *Lucchini S.p.A.* and *Carlo Colombo S.p.A.*, DROs and DPOs present similar values as the time needed to repay the suppliers is the same as the time needed to collect the credits.

Looking at the sectorial averages, the comparison between the two ratios does not appear to be a point of reference for the preventive identification of the crisis in the present work. However, from the analysis carried out, an interesting aspect lies in the average times necessary to collect credit and to repay debt, very different from sector to sector, with cycles that last just over two months (it is the case of the *Wholesale trade* sector) and cycles that even exceed the calendar year (as in the *Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches* sector).

5.2.5. Leverage

Table 16: Leverage by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		2	2.11	2.18	2.18
Lucchini S.p.A.	2.38	2.41	9.52	16.31	
Italcables S.r.l.			6.37	18.26	-3.71

Etnall S.r.l.		5.71	6.51	6.78	38.24
Carlo Colombo S.p.A.	12.54	11.95	15.15	-3.8	-3
EDIM S.p.A.	4.77	5.31	15.3	17.84	19.38

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	2.09	24.97	-20.08	-0.39	-1.11
Jabil C.M. S.r.l.			-7.21	24.41	-1.21
OLDCOM S.r.l.	7.2	5.99	5.96	-2.29	-1.53
Compel Electronics S.p.A.	11.42	4.81	4.72	5.83	
Italtel S.p.A.	-9.37	7.76	9.92	19.71	-6.41
Linkra S.r.l.	62.3	8.46	6.91	7.47	
Selta S.p.A.	4.22	5.6	4.71	7.83	-61.21
Haemonetics Produzione Italia S.r.l.	-0.73	-0.9	-5.92	-1.61	13.88

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	38.52	64.88	90.66	24.19	
Condotte immobiliare S.p.A.	4.6	5.52	4.97	6.57	
IMF S.r.l.	34.32	-52.82	-18.36	-9.8	
Tecnis S.p.A.	4.38	9.12	8.71		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	15.88	45.88	52.96	-1.45	
DPS Group S.r.l.	13.15	12.57	15.5	15.11	12.49
Silda S.r.l.		6.9	8.95	4.91	4.3
Sider All. Sud S.r.l.	11.23	42.34	33.51	40.23	26.98
Dico S.p.A.	11.1	10.98	10.68	-1.78	-0.86

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	-17.97	259.4	72.12	41.43	40.36
CSP S.p.A.	8.63	9.36	9.93		
Consorzio Gepin	808.67	2.22	1.22	1	
Opera 21 S.r.l.			12.34	8.02	8.93
Sofiter System Engineering S.p.A.	4.35	43.64	151.88	123.63	74.04

Source: personal elaboration

Table 17: Average Leverage by sector

Metallurgy	***Manufacture of computers and (…)***	***Construction***	***Wholesale Trade***	***Computer programming (…)***
8.36	4.37	13.93	17.05	76.18

Source: personal elaboration

The Leverage, equal to the ratio between total assets and shareholders' equity, shows a catastrophic situation for all companies: if a value higher than 2 is a symptom of undercapitalisation, there are companies that not only have very high values (even double-digit), but also companies for which the ratio is preceded by a minus sign, due to a negative and therefore insufficient shareholders' equity. A rather misleading situation, to which we are

accustomed, can be seen for *Consorzio Gepin*, that in the second year before the cancellation from the Commercial Register has a Leverage equal to 1. The company, as emerged during the analysis conducted through the Z-score Model, does not present any debt in the second year before the crisis: probably the "real" year of crisis is the one that refers to “5Y”, where the Leverage assumes a very worrying value equal to 808.67.

Looking at sector averages (Table 17), values obtained are representative of a situation of difficulty in all five sectors, but with a different degree of "severity": the *Metallurgy* sector and the *Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches* sector have high but contained average values, while for the *Construction* sector, the *Wholesale trade* sector, and the *Computer programming, computer consulting and related activities* sector, the ratio between total assets and shareholders' equity increases, but only in the last case it reaches an almost irrecoverable level due to a percentage amount of debt difficult to reduce.

5.2.6. Debt-to-Equity Ratio

Table 18: Debt-to-Equity Ratio by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		1.00	1.11	1.18	1.18
Lucchini S.p.A.	1.38	1.41	8.52	15.31	
Italcables S.r.l.			5.37	17.26	-4.71
Etnall S.r.l.		4.71	5.51	5.78	37.24
Carlo Colombo S.p.A.	11.54	10.95	14.15	-4.80	-4.00
EDIM S.p.A.	3,77	4,31	14,30	16,84	18,38

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	1.09	23.97	-21.08	-1.39	-2.11
Jabil C.M. S.r.l.			-8.21	23.41	-2.21

OLDCOM S.r.l.	6.20	4.99	4.96	-3.29	-2.53
Compel Electronics S.p.A.	10.42	3.81	3.72	4.83	
Italtel S.p.A.	-10.37	6.76	8.92	18.71	-7.41
Linkra S.r.l.	61.30	7.46	5.91	6.47	
Selta S.p.A.	3.22	4.60	3.71	6.83	-62.21
Haemonetics Produzione Italia S.r.l.	-1.73	-1.90	-6.92	-2.61	12.88

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	37.52	63.88	89.66	23.19	
Condotte immobiliare S.p.A.	3.60	4.52	3.97	5.57	
IMF S.r.l.	33.32	-53.82	-19.36	-10.80	
Tecnis S.p.A.	3.38	8.12	7.71		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	14.88	44.88	51.96	-2.45	
DPS Group S.r.l.	12.15	11.57	14.50	14.11	11.49
Silda S.r.l.		5.90	7.95	3.91	3.30
Sider All. Sud S.r.l.	10.23	41.34	32.51	39.23	25.98
Dico S.p.A.	10.10	9.98	9.68	-2.78	-1.86

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	-18.97	258.40	71.12	40.43	39.36
CSP S.p.A.	7.63	8.36	8.93		
Consorzio Gepin	807.67	1.22	0.22	0	
Opera 21 S.r.l.			11.34	7.02	7.93
Sofiter System Engineering S.p.A.	3.35	42.64	150.88	122.63	73.04

Source: personal elaboration

Table 19: Average Debt-to-Equity Ratio by sector

Metallurgy	***Manufacture of computers and (…)***	***Construction***	***Wholesale Trade***	***Computer programming (…)***
7.36	3.37	12.93	16.05	75.18

Source: personal elaboration

The same considerations made for the Leverage can also be made for the Debt-to-Equity Ratio: high or even negative values for the Leverage correspond to high or even negative values for the Debt-to-Equity Ratio.

Rarely the Debt-to-Equity Ratio assumes values lower than 1: in general, a value no higher than 3 is considered acceptable. In the analysis carried out, two companies are an exception: *Consorzio Gepin* and *AFV Acciaierie Beltrame S.p.A.*. As for the previous indicator, *Consorzio Gepin*'s Debt-to-Equity Ratio, equal to 0, should not be considered as it is not indicative of the real crisis situation (the "real" crisis dates back to the fifth year before the crisis declaration). *AFV Acciaierie Beltrame S.p.A.* is the only company with an acceptable Debt-to-Equity Ratio (Debt-to-Equity Ratio equal to 1.18): for this company the Leverage is just above the value taken as benchmark (Leverage equal to 2.18 versus its threshold value equal to 2), so it would be logical to expect a rather low value for the Debt-to-Equity Ratio. Anyway, the company is the only exception within the final test sample.

5.2.7. Interest Coverage Ratio

Table 20: Interest Coverage Ratio by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		8.51	3.71	3.77	1.01
Lucchini S.p.A.	3.42	n.s.	n.s.	n.s.	
Italcables S.r.l.			n.s.	n.s.	n.s.
Etnall S.r.l.		0.38	3.02	2.14	n.s.
Carlo Colombo S.p.A.	0.3	2.21	1.65	0.79	0.21
EDIM S.p.A.	n.s.	n.s.	5.77	7	0.53

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	n.s.	n.s.	n.s.	n.s.	n.s.
Jabil C.M. S.r.l.			n.s.	n.s.	n.s.
OLDCOM S.r.l.	3.61	6.16	3.49	0.97	0.39
Compel Electronics S.p.A.	n.s.	n.s.	n.s.	0.47	
Italtel S.p.A.	1.03	n.s.	n.s.	1.19	n.s.
Linkra S.r.l.	n.s.	n.s.	0.5	0.5	
Selta S.p.A.	1.34	3.02	n.s.	n.s.	n.s.
Haemonetics Produzione Italia S.r.l.	n.s.	n.s.	n.s.	n.s.	n.a.

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	n.s.	0.24	0.17	n.s.	
Condotte immobiliare S.p.A.	0.07	n.s.	n.s.	n.s.	
IMF S.r.l.	n.s.	n.s.	n.s.	n.s.	
Tecnis S.p.A.	1.13	5.48	4.03		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	n.s.	3.3	n.s.	n.s.	
DPS Group S.r.l.	3.4	3.04	2.69	6.96	10.66
Silda S.r.l.		56.76	3.63	3.13	35.78
Sider All. Sud S.r.l.	1.2	2.02	1.69	1.47	1.95
Dico S.p.A.	n.s.	0.77	n.s.	n.s.	n.s.

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	3.24	1.15	2.32	3.27	3.98
CSP S.p.A.	5.7	3.58	2.76		
Consorzio Gepin	1.06	n.s.	n.a.	n.a.	
Opera 21 S.r.l.			62.85	0.16	n.s.
Sofiter System Engineering S.p.A.	4.55	n.s.	1.85	4.06	8.17

Source: personal elaboration

Table 21: Average Interest Coverage Ratio by sector

Metallurgy	*Manufacture of computers and (…)*	*Construction*	*Wholesale Trade*	*Computer programming (…)*
3.00	39.43	1.27	7.18	8.81

Source: personal elaboration

Also the Interest Coverage Ratio underlines the seriousness of the situation in which companies find themselves. In the configuration adopted, which provides for the ratio between the gross operating margin and the interest expenses, the ratio is considered acceptable if its value is higher than 4: only in this way the gross operating margin can repay financial charges, other types of extra-operating costs, and leave an appropriate remuneration to the capital investors. The analysis reveals a situation so serious that, several times, the Interest Coverage Ratio is not significant (*n.s.*) because the operating income, integral part of the numerator, is negative (aspect already highlighted by the Z-score Model).

For those companies for which it is possible to calculate a meaningful value of the ratio, the indicator never assumes, except in four cases, a value higher than 4.

Sectorial averages for the Interest Coverage Ratio are shown in Table 21, but are not indicative of the real condition of the sample since the lack of data or their insignificance, which affects all the sectors, does not allow to calculate reliable averages.

5.2.8. Financial debts / sales revenues

Table 22: Financial debts / sales revenues by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		24.45	24.87	24.68	28.39
Lucchini S.p.A.	51.44	94.67	62.09	59.99	
Italcables S.r.l.			26.02	23.28	14.96
Etnall S.r.l.		72.73	71.55	62.34	69.15
Carlo Colombo S.p.A.	10.68	11.01	12.12	13.12	14.64
EDIM S.p.A.	21.6	15.76	3.01	0.76	7.5

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	0.44	0.74	0	0	0
Jabil C.M. S.r.l.			0	0	0
OLDCOM S.r.l.	30.69	36.96	39.78	50.86	40.3
Compel Electronics S.p.A.	31.01	40.65	39.81	39.82	
Italtel S.p.A.	85.76	81.9	77.22	73.64	84.75
Linkra S.r.l.	14.45	10.68	13.38	28.07	
Selta S.p.A.	54.53	41.63	n.s.	39.07	44.79
Haemonetics Produzione Italia S.r.l.	0	0	0	0	n.a.

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	55.97	n.s.	62.06	79.71	
Condotte immobiliare S.p.A.	n.s.	n.s.	n.s.	n.s.	
IMF S.r.l.	n.s.	n.s.	n.s.	n.s.	
Tecnis S.p.A.	29.19	18.89	11.22		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	2.38	4.59	2.9	2.26	
DPS Group S.r.l.	n.a.	16.57	13.47	8.3	5.78
Silda S.r.l.		n.a.	n.a.	45.92	18.53
Sider All. Sud S.r.l.	0	0	0	0	n.a.

Dico S.p.A.	22.11	21.89	26.25	32.46	69.58

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	46.94	46.09	n.s.	82.06	94.15
CSP S.p.A.	20.31	14.48	8.2		
Consorzio Gepin	21.62	n.a.	n.a.	n.a.	
Opera 21 S.r.l.			0	0	n.a.
Sofiter System Engineering S.p.A.	23.15	8.35	0	0	0

Source: personal elaboration

Table 23: Average financial debts / sales revenues by sector

Metallurgy	***Manufacture of computers and (…)***	***Construction***	***Wholesale Trade***	***Computer programming (…)***
34.17	27.51	42.84	16.15	21.91

Source: personal elaboration

The ratio between financial debts and sales revenues, together with the Interest Coverage Ratio, is an indicator of debt sustainability. Generally, if the amount of financial debts exceeds the volume of sales, the company has difficulty in sustaining the debt incurred. With the exception of 6 companies, which do not have short-term and long-term financial debts in their Balance Sheet and for which the ratio in question is therefore zero, the remaining companies report very high values for this indicator, due to an excessive amount of financial debts and/or an insufficient amount of revenues. The preponderance of financial debts on sales revenues is visible also from the sector averages, which report very high values, from the less worrying (16.15) of the *Wholesale trade* sector to the most demanding (42.84) of the *Construction* sector.

5.2.9. ROE

Table 24: ROE by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		2.74	4.28	-13.83	-16.72
Lucchini S.p.A.	5.26	-15.69	n.s.	-80.08	
Italcables S.r.l.			-34.21	n.s.	n.s.
Etnall S.r.l.		-26.15	-12.04	-0.28	n.s.
Carlo Colombo S.p.A.	-84.09	0.44	-28.08	n.s.	n.s.
EDIM S.p.A.	-29.64	-29.69	14.46	22.99	0.12

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	-36.5	n.s.	n.s.	n.s.	n.s.
Jabil C.M. S.r.l.			n.s.	n.s.	n.s.
OLDCOM S.r.l.	0.8	-5.15	0.32	n.s.	n.s.
Compel Electronics S.p.A.	n.s.	-56.5	-28.71	-58.46	
Italtel S.p.A.	n.s.	-50.47	-37.56	-103.91	n.s.
Linkra S.r.l.	n.s.	31.06	-10.91	-34.09	
Selta S.p.A.	-7.89	0.09	-13.95	-95.4	n.s.
Haemonetics Produzione Italia S.r.l.	n.s.	-13.77	n.s.	n.s.	n.s.

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	-100.55	-52.49	-47.17	72.61	
Condotte immobiliare S.p.A.	1.11	-20.18	-21.15	-57.46	
IMF S.r.l.	n.s.	n.s.	n.s.	n.s.	
Tecnis S.p.A.	0.5	9.53	4.98		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	-78.37	-139.18	-82.51	n.s.	
DPS Group S.r.l.	4.01	3.33	3.42	22.03	1.66
Silda S.r.l.		39.17	28.37	12.6	34.61
Sider All. Sud S.r.l.	0.04	48.76	20.68	2.92	3.5
Dico S.p.A.	-84	-99.37	-76.16	n.s.	n.s.

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	n.s.	n.s.	70.33	38.24	-7.96
CSP S.p.A.	15.67	9.2	2.99		
Consorzio Gepin	0	0	-26.98	-34.15	
Opera 21 S.r.l.			40.13	14.07	-13.89
Sofiter System Engineering S.p.A.	28.46	n.s.	n.s.	23.78	32.06

Source: personal elaboration

Table 25: Average ROE by sector

Metallurgy	*Manufacture of computers and (…)*	*Construction*	*Wholesale Trade*	*Computer programming (…)*
-20.78	-28.20	-17.11	-27.15	13.82

Source: personal elaboration

ROE expresses the return on equity and corresponds to the ratio between net income and shareholders' equity. As previously stated in Chapter 3, it is not possible to define *ex ante* thresholds or acceptable values for this indicator, since it is influenced both by the sector to which the company belongs and by the company's size. Table 25, which summarizes ROE averages, shows how the situation can be very different from sector to sector: from a negative ROE of -28.20 for the *Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches* sector, to a positive ROE of +13.82 for the *Computer programming, computer consulting and related activities* sector. Therefore, *Computer programming, computer consulting and related activities* has the highest return on equity since it is the only sector with a positive ROE. But this average value seems to be misleading since 3 out of 5 companies of the sector in question have a negative ROE in the last available year: a positive average is only due to rather high positive ROEs in the third, fourth, and fifth year before the crisis declaration.

ROE analysis at single company's level highlights three outputs:

- 8 companies in the year preceding the year of crisis declaration have negative ROE (alternatively the net income or the shareholders' equity is preceded by a minus sign);
- 12 companies in the year preceding the year of crisis declaration have both negative numerator and negative denominator: for these companies the calculation of the ROE is meaningless (*n.s.*);
- 8 companies in the year preceding the year of crisis declaration have positive ROE.

For the first 20 companies, there is no doubt that they are experiencing serious difficulties, given their negative net income and/or equity. The indicator has often been negative for several years and over time shows a deterioration. Regarding the 8 companies with positive ROE, it is not sufficient that this indicator is positive: ROE must be compared with its values in the previous years. Even in this case, ROE reveals a rather delicate and worsening situation, since only 3 companies out of 8 (*Alte Tecnologie Ingegneristiche Group S.r.l.*, *Silda S.r.l.*, *Sofiter System Engineering S.p.A.*) show a clear improvement from the penultimate year to the last year.

5.2.10. ROI

Table 26: ROI by sector

Metallurgy	5Y	4Y	3Y	2Y	1Y
AFV Acciaierie Beltrame S.p.A.		4.37	-0.36	1.88	-2.2
Lucchini S.p.A.	4.55	-11.7	n.s.	-9.44	
Italcables S.r.l.			-10.6	-29.57	n.s.
Etnall S.r.l.		-3.76	2.31	3	-27.6
Carlo Colombo S.p.A.	-2.73	0.48	-1.26	n.s.	-4.46
EDIM S.p.A.	-18.15	-18.87	6.26	n.s.	-4.7

Manufacture of computers and (…)	5Y	4Y	3Y	2Y	1Y
Solsonica S.r.l.	n.s.	n.s.	n.s.	n.s.	28.49
Jabil C.M. S.r.l.			n.s.	n.s.	n.s.
OLDCOM S.r.l.	4.81	7.69	5.38	n.s.	n.s.
Compel Electronics S.p.A.	n.s.	n.s.	-25.69	-8.75	
Italtel S.p.A.	-4.81	-11.06	-9.07	-2.73	n.s.
Linkra S.r.l.	n.s.	n.s.	-2.9	-2.85	
Selta S.p.A.	1.48	8.24	-3.12	-19.3	-23.99
Haemonetics Produzione Italia S.r.l.	n.s.	1.39	n.s.	n.s.	n.s.

Construction	5Y	4Y	3Y	2Y	1Y
Alte Tecnologie Ingegneristiche (A.T.I.) Group S.r.l.	-8.92	-5.43	-3.39	n.s.	

Condotte immobiliare S.p.A.	0.08	-0.95	-0.86	-9.49	
IMF S.r.l.	-9.58	-3.59	-1.34	-1.86	
Tecnis S.p.A.	1.68	19.09	17.07		

Wholesale Trade	5Y	4Y	3Y	2Y	1Y
Distribuzione Cambria S.r.l.	n.s.	-12.67	n.s.	n.s.	
DPS Group S.r.l.	n.d.	11.65	11.89	17.43	8.3
Silda S.r.l.		n.a.	n.a.	6.16	14.88
Sider All. Sud S.r.l.	n.a.	n.a.	n.a.	n.a.	n.a.
Dico S.p.A.	-18.83	-5.29	-15.38	n.s.	n.s.

Computer programming (…)	5Y	4Y	3Y	2Y	1Y
Solgenia S.r.l.	n.s.	-13.76	11.94	n.s.	7.37
CSP S.p.A.	15.08	17.77	3.89		
Consorzio Gepin	n.a.	n.a.	-25.92	n.a.	
Opera 21 S.r.l.			n.s.	-2.38	-13.49
Sofiter System Engineering S.p.A.	15.71	n.s.	n.s.	0.67	5.75

Source: personal elaboration

Table 27: Average ROI by sector

Metallurgy	***Manufacture of computers and (…)***	***Construction***	***Wholesale Trade***	***Computer programming (…)***
-7.01	0.21	-0.05	-0.75	-2.48

Source: personal elaboration

For ROI, the most widely used indicator of profitability in the Financial Statements Analysis, the same considerations apply as for ROE: since it is not possible to define parameters or threshold values *ex ante*, the comparison is made from year to year. ROI analysis for the sample of Italian companies shows a "structure" similar to that of ROE:

- for 11 companies the last available ROI before the crisis declaration is negative;
- for 8 companies it is not significant (*n.s.*);
- for 2 companies it is not available due to lack of data (*n.a.*);
- for 7 companies the last available ROI is positive, but only for 2 there has been an improvement from the penultimate year to the last available year.

Looking at ROI averages, very different values for this indicator emerge from sector to sector. Anyway, these averages are always negative (the lowest return on investments is recorded for the *Metallurgy* sector, equal to -7.01), if not close to zero (+0.21 for the *Manufacture of computers and of electronic and optical devices; electromedical equipment, measuring equipment and watches* sector), making it difficult to say which sector is better than the other: rather, it would be more appropriate to say which sector is "less worse" than the other.

5.2.11. Considerations about the Financial Statements Analysis

The application of the Financial Statements Analysis to the final test sample has confirmed the difficult situation for some companies and has allowed it to emerge for others. Considering values obtained, it is possible to state that the analysis of the Financial Statements has produced the desired results, in line with the effective condition that companies of the sample are facing. Of 10 indicators considered, only 2, namely the Net Financial Position and the comparison between Days Receivables Outstanding and Days Payables Outstanding, do not report the seriousness of the situation, with values and trends over time that seem to dispel the concern of an imminent crisis. In these cases, it would be appropriate to investigate the underlying motivations of these trends or the measures implemented to obtain the improvements that indicators show; however, an analysis of the "history" and the policies adopted by the individual company goes beyond the purpose of the present work. Another indicator (the Current Ratio) initially has presented a heartening condition for a consistent part of the sample, but it is the literature itself that tells us to place this indicator alongside the Acid-test Ratio before expressing a judgement on the corporate liquidity. The latter has allowed to better investigate those situations that did not arouse any suspicion on the part of the Current Ratio, confirming the validity of the two indices whenever they are placed side by side.

The remaining indicators, with the exception of those few companies for which there has been an apparent improvement over time, show a worrying declining trend from both an economic and financial point of view, which leaves no doubt about the highly probable declaration of crisis in the near future. This confirms the validity of the Financial Statements Analysis as a *warning tool* endowed with good predictive effectiveness.

Although the analysis conducted has confirmed the signaling ability of the Financial Statements Analysis, the *second level crisis forecasting tool*, as any other instrument, is not infallible. Numerous criticisms have been levelled at it over time, first the reliability of the data. Precisely this aspect could be the cause of the poor validity of the two indicators Net Financial Position and comparison between DROs and DPOs: there is a natural tendency on the part of any company to "inflate" the data in the Financial Statements when the situation becomes critical or the first signs of a crisis are observed. No company would ever want to declare the state of crisis to the market, so data are falsified to postpone the declaration of the state of crisis as much as possible. The distortion of accounting prospectuses to make a situation appear different and better than the real one makes consequently some indicators inflated and representative of an unreliable condition.

A second limit of the Financial Statements Analysis is related to the subjectivity in the choice of the type and number of indicators to use. This choice is purely subjective and may lead to different results depending on the subject conducting the analysis. The list of indicators used in the present work constitutes a "basic pool" from which to draw and start, but which can and must be supplemented by further indicators based on the business reality, in order to highlight other areas of intervention and further investigate those previously discovered.

Finally, the Financial Statements Analysis has often been criticized for its “late” predictive ability, which highlights the signs of a crisis when it has already been going on for a long time and causes are in their degenerative phase. The empirical evidence in the present work does not seem to support this limit, given the general degenerative trend of the ratios observed from the most distant year to the closest one. However, for some indicators, a clear and substantial deterioration in the values is seen only from the penultimate year to the last year available, when the room for manoeuvre is quite narrow.

6. Conclusions

The present work has demonstrated the good signalling capacity of the Z-score Model and the Financial Statement Analysis when applied to the Italian business environment. Both models are not infallible as pointed out several times, but overall they are representative of the severe situation in which companies find themselves: the Z-score Model correctly classifies 23 companies out of 25, while, of the 10 indicators used in the Financial Statements Analysis, 8 present values and trends typical of companies in difficulty.

The fact that results obtained confirm the validity of the Z-score Model and the Financial Statements Analysis as *warning tools*, makes possible to facilitate and to encourage the control and the monitoring of the company's state of health, thanks to the low costs and the ease of use. Tools here considered are not so expensive, both in terms of money and time. The starting point for their application are the accounting prospectuses, which are easily available (at least in Italy) for listed and unlisted companies; besides the Income Statement, the Balance Sheet, and the Cash Flow Statement (in the case of indicators relating to the company's ability to generate cash), no additional documents or reports internally prepared are necessary. Also skills required for the analysis are not particularly sophisticated: the comprehension of the accounting documents and the calculation of the indicators can be carried out by people endowed with a minimal business culture. Moreover, the fact that these tools are available to both internal and external parties allows monitoring the company's state of health and highlighting any anomalies from two different points of view, characterized by different interests, different objectives, and different incentives to bring out as soon as possible the signals of the crisis.

Obviously, the two models do not work in 100% of cases, but, on the other hand, an infallible tool has not yet been invented, not even with the latest and most refined artificial intelligence. On the contrary, the Z-score Model and the Financial Statements Analysis complement one another, as the second one (*second level crisis forecasting tool*) finalizes the work of the first one (*first level crisis forecasting tool*), and they constitute an excellent compromise between the quality of the analysis and the cost to conduct it, especially for those companies for which state-of-the-art tools are prohibitive.

This empirical evidence does not deny further developments and rethinking of the instruments in question: business insolvency forecasting models must always evolve to adapt to the changing economic contexts, especially after this historical period during which the Covid-19 pandemic has disrupted the global economic scenario.

Unfortunately, especially in small and medium-sized Italian enterprises, still today there is a relatively modest number of companies with a systematic system for monitoring the onset of

decay and imbalances. Given the recurrence of the crisis phenomena, this monitoring and control system should be encouraged: as the Economist L. Guatri writes in *Turnaround: declino, crisi e ritorno al valore* (1995) “the disease [cannot] be avoided by not measuring the fever”, therefore, where the sophisticated artificial intelligence is not affordable, the Z-score Model and the Financial Statements Analysis constitute valid evaluation tools that should be used on a daily basis.

7. Bibliography

1. Altman, E. (1993). *Corporate financial distress and bankruptcy: a complete guide to predicting & avoiding distress and profiting from bankruptcy*. New York: John Wiley & Sons.
2. Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The journal of finance*, 23(4), 589-609.
3. Altman, E. I., Danovi, A., & Falini, A. (2013). Z-score models' application to Italian companies subject to extraordinary administration. *Journal of Applied Finance (Formerly Financial Practice and Education)*, 23(1).
4. Barbera, A. (2019). Aziende in crisi: le 149 vertenze sul tavolo del Ministero. *LaStampa* [online]. Available on https://www.lastampa.it/economia/2019/12/21/news/aziende-in-crisi-le-149-vertenze-sul-tavolo-del-ministero-1.38241422 [access date 06/10/2020].
5. Bazzerla, M. (2018). Crisi aziendali e controllo di gestione: l'importanza degli strumenti di controllo nella prevenzione della crisi. *Controllo di gestione*, 15(4), 23-31. Milano: IPSOA.
6. Bibeault, D. B. (1982). *Corporate Turnaround: how managers turn losers into winners*. New York: Mc Graw-Hill.
7. Bibeault, D. B. (1999). *Corporate Turnaround: how managers turn losers into winners*. Washington: Beard Books.
8. Biella, M., & Mosca, A. (2019). Crisi di impresa e di insolvenza. *Italia Oggi Sette* [online]. Available on www.italiaoggi.it [access date 01/09/2020].
9. Booth, S. A. (1993). *Crisis Management Strategy*. London and New York: Routledge.
10. Bottani, P., Cipriani, L., & Serao, F. (2004). Analisi del rischio di insolvenza di una PMI tramite l'utilizzo del Modello dello Z-Score. *Amministrazione e Finanza*, 1.
11. Bottani, P., Cipriani, L., & Serao, F. (2004). Il modello di analisi Z-Score applicato alle PMI. *Amministrazione e finanza*, 19(1), 50-53.
12. Brodi, E. (2018). *Tempestiva emersione e gestione della crisi d'impresa. Riflessioni sul disegno di un efficiente «sistema di allerta e composizione»*. Bank of Italy Occasional Paper, (440).

13. Buongiorno, M. (2019). Gli indici del CNDCEC per la verifica della crisi d'impresa. *Euroconference news* [online]. Available on www.ecnews.it [access date 10/09/2020].

14. Bureau van Dijk - A Moody's Analytics Company (2013). Database AIDA - Analisi Informatizzata delle Aziende Italiane.

15. Buttignon, F. (2008). Il governo delle crisi d'impresa in Italia alla luce del nuovo quadro normativo: una riflessione introduttiva. *Rivista dei dottori commercialisti*, 59(2), 243-268.

16. Cerved Group S.p.A. (2018). *Riforma legge fallimentare: quali soglie per il regime di allerta?* [online]. Available on https://know.cerved.com [access date 10/09/2020].

17. Ciabattoni, M. (2017). *Study notes from Corso di metodologie e determinazioni quantitative d'azienda*. Padova: Università degli Studi di Padova, Dipartimento di Scienze Economiche ed Aziendali.

18. CNDCEC (2019). *Crisi d'impresa: gli indici d'allerta* [online]. Available on www.commercialisti.it [access date 10/09/2020].

19. Comitato Pari Opportunità ODCEC Torino (*S.d.*). *La gestione dell'impresa in crisi. L'analisi di Dottori Commercialisti, Managers e Imprenditori*.

20. Commissione di Studio "Procedure concorsuali e giudiziarie" (2019). *Gli indicatori di allerta: osservazioni e criticità.*

21. Coronella, S. (2009). I modelli di previsione delle crisi aziendali: alcune riflessioni. *Rivista italiana di Ragioneria e di Economia aziendale*, 109(9-10), 503-516.

22. Danovi, A., & D'Amico, A. (2020). *La previsione dell'insolvenza ex art. 13 co. 3 C.c.i.: efficacia del test di classificazione binario e dell'analisi discriminante lineare*. Impresa Progetto - Electronic journal of management, n°1/2020.

23. Danovi, A., & Quagli, A. (2015). *Gestire la crisi d'impresa: processi e strumenti di risanamento*. Milano: IPSOA.

24. Di Nardo, T., *et al*. (2018). *Osservatorio sui bilanci delle srl. Trend 2015-2017*. Fondazione Nazionale Commercialisti.

25. Dlgs. 12 gennaio 2019, n. 14.

26. Fazzini, M. (2011). *Analisi di bilancio*. Milano: IPSOA.

27. Fotina, C. (2019). Crisi aziendali, ecco le imprese che il Conte bis dovrà salvare. *IlSole24Ore* [online]. Available on https://www.ilsole24ore.com/art/crisi-aziendali-il-nuovo-governo-universo-imprese-salvare-AC5RrTg?refresh_ce=1 [access date 06/10/2020].

28. Giacosa, E., & Mazzoleni, A. (2012). *Il progetto di risanamento dell'impresa in crisi*. Torino: Giappichelli.

29. Giacosa, E., & Mazzoleni, A. (2016). *La previsione della crisi d'impresa: strumenti e segnali di allerta*. Milano: Giuffrè.

30. Giacosa, E., & Mazzoleni, A. (2018). *I modelli di previsione dell'insolvenza aziendale. Efficacia predittiva, limiti e prospettive di utilizzo*. Torino: Giappichelli.

31. Guatri, L. (1986). *Crisi e risanamento delle imprese*. Milano: Giuffrè.

32. Guatri, L. (1995). *Turnaround: declino, crisi e ritorno al valore*. Milano: Egea.

33. Lizza, P. (1998). La cultura della crisi. *Rivista dei dottori commercialisti*, (5), 835-859.

34. Mazzei, B. L. (2020). Allerta sulla crisi d'impresa: a rischio otto società su 100. *IlSole24Ore* [online]. Available on https://www.ilsole24ore.com/art/allerta-crisi-d-impresa-rischio-otto-societa-100-ACy32LGB [access date 06/10/2020].

35. Mazzoleni, A., & Giacosa, E. (2011). *Il progetto di risanamento dell'impresa in crisi: la recente esperienza italiana.* Paper n°. 116. Brescia: Università degli studi di Brescia.

36. Ministero dello Sviluppo Economico – Imprese in difficoltà [online]. Available on https://www.mise.gov.it/index.php/it/impresa/imprese-in-difficolta [access date 06/10/2020].

37. Napodano, G., *et al*. (2010). *La crisi d'impresa. L'attestazione di ragionevolezza dei piani di ristrutturazione ex art. 67, 3° comma, lettera d) L.F.*. Quaderno n°. 27. Osnago: 3LB S.r.l.. Milano: Scuola di Alta Formazione dei Dottori Commercialisti e degli Esperti Contabili.

38. Pasqui, M. (2020). Crisi d'impresa: come si applicano gli indici di allerta del CNDCEC. *IPSOA quotidiano* [online]. Available on www.ipsoa.it [access date 10/09/2020].

39. Quagli, A., & Davoni, A. (2008). *Gestione della crisi aziendale e dei processi di risanamento. Prevenzione e diagnosi, terapie, casi aziendali.* Milano: IPSOA.

40. Quagli, A., *et al*. (2012). *Il piano industriale e strumenti di risanamento. Guida metodologica e operativa*. Milano: IPSOA.

41. Raccomandazione della Commissione Europea del 6 maggio 2003 relativa alla definizione delle microimprese, piccole e medie imprese (2003). L., n. 124(36), 20.

42. Sacco, B. (2019). Il nuovo Codice della crisi d'impresa e dell'insolvenza e gli alert di bilancio: un'opportunità per le PMI?. *Quaderni di ricerca sull'artigianato, Rivista di Economia, Cultura e Ricerca Sociale*, 7(2), 181-202.

43. Sacco, B. (2019). Il nuovo Codice della crisi d'impresa e dell'insolvenza e gli alert di bilancio: un'opportunità per le PMI?. *Quaderni di ricerca sull'artigianato*, 7(2), 181-202.

44. Sanguigni, V. (2018). *Conferenza sull'Analisi e descrizione delle cause della crisi e degli squilibri aziendali: condizioni per il loro superamento.* Roma, 26/03/2018. Roma: Scuola di Alta Formazione dell'Ordine dei Dottori Commercialisti e degli Esperti Contabili.

45. Santoni, V. (2014). *La Previsione dell'insolvenza aziendale: confronto della performance dei modelli Zscore, Logit e Random Forest su un campione di aziende manifatturiere italiane*. Tesi di dottorato in Diritto ed economia dei sistemi produttivi. Università degli studi di Sassari.

46. Sirleo, G. (2009). *La crisi d'impresa e i piani di ristrutturazione. Profili economico-aziendali*. 1° ed. Roma: ARACNE editrice S.r.l.

47. Varetto, F. (1999). Metodi di previsione delle insolvenze: un'analisi comparata. *Il Rischio Creditizio. Misura e Controllo*, 178-301.

48. Vicari, P., Ferillo, A., & Valeri, A. (2009). *Classificazione delle attività economiche-Ateco 2007*. Roma: Istituto Nazionale di Statistica (ISTAT).

49. Zotti, A. (2020). *Study notes from Mergers & Acquisitions and Corporate Restructuring*. *Business Administration Course*. Padova: Università degli Studi di Padova, Dipartimento di Scienze Economiche ed Aziendali.