Università
Ca'Foscari
Venezia

Master's Degree

in

Business
Administration

Final Thesis

The use of Merton model for the optimal capital structure: a theoretical and empirical analysis

Supervisor
Ch. Prof. Federico Beltrame

Assistant supervisor
Ch. Prof.ssa Gloria Gardenal

Graduand
Federico Fommei
Matricolation number
867435

Academic Year
2018 / 2019

THANKSGIVINGS

Questo lavoro segna la fine del mio percorso universitario, ed in particolar modo degli ultimi due fantastici anni, che hanno visto tanti protagonisti. Prima di tutto vorrei ringraziare la mia famiglia, che mi ha permesso di essere qui e realizzare tutti i miei obiettivi senza mai precludermi nulla: a loro vanno i miei più sentiti ringraziamenti. Vorrei poi ringraziare i miei amici più cari, sia quelli di sempre, che i più recenti che ho conosciuto negli ultimi anni e che mi hanno accompagnato tanto in questi anni, a loro devo tanto. Vorrei poi sinceramente ringraziare il Professor Beltrame che mi ha fornito la massima disponibilità e un notevole supporto per la realizzazione di questa prova finale. Infine, una dedica particolare la vorrei fare ai miei due coinquilini, Giacomo e Stefania, che citando le loro stesse parole, mi hanno accolto due anni fa come un "gatto randagio" e mi hanno dato tantissimo, in primo luogo una nuova felicità.
Grazie

SUMMARY

INTRODUCTION

One of the most debatable topics in finance literature involves the capital structure, which refers to the composition of different financing sources employed by a firm to fund its business, therefore encompassing its investment and financing strategy. Capital structure decisions concern which form of funding should be utilized, the amount of each one to be raised and the right proportions in the overall capitalization mix, as an ideal capital structure should be able to maximize the ownership's worth thus fulfilling the ultimate aim of whatever firm. Managers are so required to make tradeoffs between different financial resources and try to find a proper balance in order to achieve the optimal capital structure, which ultimately results in the maximization of the overall firm value and claimholders returns.

This study is aimed at estimating the theoretical optimal capital structure in a sample of ten industrial firms by following the principles of the Trade-off Theory, by which the overall firm value is given by the sum of the unlevered firm value (as if the entity would be financed only through owners' resources) plus the value of the side effects of debt, consisting of the difference between the expected benefits and costs associated with the use of leverage. Indeed, it is demonstrated that the employment of debt financing brings several advantages but also some risks and costs, since an excessive level of leverage may lead the company in a situation of financial distress and ultimately to the bankruptcy. However, by maximizing the difference between benefits and costs of debt, this theory states the achievement of the optimal capital structure and the consequent maximization of firm value; to do so, it is employed a certain financial model (the Merton model) to estimate such costs and benefits of debt and to derive the relationship that link them to the optimal level of leverage.

So, the *first chapter* explains the nature and peculiarities of the various forms of funding composing a firm's capital structure and explores the several theories about the search for an optimal capital structure which have been developed throughout the years in the finance literature. Following this debate, the *second chapter* shows the features of a particular approach among them – the Trade-off Theory – that has achieved strong empirical confirms, and then are analyzed the characteristics of the financial distress, its

relative costs and the main models used to their estimation. The core of this analysis involves the *third chapter*, where is first introduced the Merton model from the literature and then it is empirically implemented to estimate the optimal capital structure for the firms of the sample, under the principles – and limits – of the Trade-off Theory. Will be shown that the actual level of leverage exhibited in reality by those companies diverges from the optimal ones computed through this model, and the variances are then analyzed for each company and demonstrated that are due to the peculiarities of their businesses and the industries where they operate, to certain events occurred to them and also to the limits of the Trade-off Theory with respect to other factors actually able to affect capital structures but not included in that approach. Lastly, the final conclusions summarize the obtained results and draw some important considerations about the achievements and the limitations of this analysis.

CHAPTER 1: COMPONENTS AND THEORIES OF CAPITAL STRUCTURE

In this chapter will be shown what is intended for capital structure, what are its components and their providers. After the explanation of the main benefits and disadvantages related to the various forms of funding and their effects on the firm value, will be than examined the principal theories and debates that have been developed throughout the years about the capital structure and the search for an optimal set of financing, from the traditional classic theorems to the more advanced propositions.

1.1 Introduction to Capital Structure

The capital structure of a firm refers to the way in which it finances its operations, business activities and growth through a combination of different sources of funds; alongside the capital budgeting, liquidity management, dividend policy and working capital management it represents one of the most important aspects of the financial management for an organization (Myers, 1984).

It is therefore a very popular topic in the financial literature as it concerns fundamental decisions for a firm, not only from the side of the maximization of value produced by the organization, but also because this decision has a considerable impact on its ability to successfully operate in its competitive environment, relating also with the ability to fulfill the needs and interests of all the various categories of the stakeholders involved with the firm's activities (Ajanthan, 2013).

Indeed, the different sources of funds are related to different capital providers: there are basically two principal ways in which a firm can get financial resources, namely through debt and equity. There are also some hybrid combinations showing some features of both of them.

1.1.1 Equity financing

First of all, for equity resources we refer to the **shareholders' funds** that are made available by owners to support the business, through the issuance of new shares or the use of net earnings that are preserved into equity reserves instead of being distributed to the owners. Therefore, we can recognize two main sources of equity funds:

- **Common equity**: the equity shares are issued to the shareholders who become legitimate owners of the company, so they benefit from the distribution of dividends in proportion to the earnings realized by the firm and the amount of shares owned. The ordinary shares of common equity also provide their holders with some rights, especially the voting rights which can be exerted at the general meeting for appointing the managers, but they are also exposed to the entrepreneurial risk of loss associated with the business activities.
- **Retained earnings**: When firms realize positive net earnings, they sometimes decide to maintain the funds as retained earnings cumulated into equity reserves instead of distribute them to the shareholders. In this way the firm is able to finance its operations and growth through internally generated resources, particularly reliable when it is already in a maturity stage of its business cycle (Berk, DeMarzo, 2016).

1.1.2 Debt financing

Apart of the equity, organizations can finance themselves also through capital acquired in the form of loans from external sources: in this case we are talking about **borrowed funds**, which are external liabilities undertaken by the firm to support the business. This is an easier way to get capital but it creates an obligation for the company as it leads to the payments of interest expenses, that are specified at a fixed rate and computed on the amount of principal borrowed. Since this form of capital is provided by investors who do not hold the ownership of the firm, they cannot take the entrepreneurial risk and therefore they are the first claimers of the company's assets in the case of its liquidation.

We can recognize also three different forms of debt:

- **Debentures**: it is a debt instrument typically issued by companies and governments to the general public. It usually takes the form of corporate bond or obligation, and the rate of interest is quite high.
- **Term loans**: it is taken by the firm from the bank at a floating or fixed interest rate. This is an appropriate obligation for healthy companies with a large debt capacity, as the banks are notoriously strong lenders.
- **Public deposits**: the company's management adopts directs advertising strategies to public investors in order to create deposits with a fixed interest rate in the firm to meet the medium-long term financial needs of the company, such as working capital requirements (Priya, 2019).

1.1.3 Combined instruments of funding

These sources illustrated above are examples of pure forms of either debt or equity financing: however, there are also some **hybrid instruments** that combine features of both oh them, thus representing important resources for the companies as they typically allow more flexibility. Among them, the most used by organizations are:

- **Convertible Bonds**: these are fixed-income debt securities yielding interest payments, but with the option to be converted into a predetermined number of common equity shares, that can be usually exerted only during specified periods during the bond's life at the holder's discretion. This type of bond is particularly suitable for those securities with a high potential for growth but still with low capacity of cash-flow production.
- **Option-linked bonds**: this type of security is aimed at linking the cash flows from financing activities to those generated by the operating activities.
- **Preferred equity**: The preferred shareholders enjoy a fixed rate of dividends together with preferential rights of receiving the return on capital in case of the company's liquidation, over the common equity shareholders. So, preferred shares of equity provide important advantages to their owners, but also limited rights of voting and control over the company (Berk, DeMarzo, 2016).

1.2 Different features of different sources

So, there are different ways to finance a business, either by employing debt or equity instruments or applying some mixtures between them. Even nowadays is not clear the reasons beyond the choice of a certain capital structure by a company, or whether there is (and what would be) any optimal combination of debt and equity for maximizing the firm value with full certainty. However, it is known that capital structure choices and changes provide information to investors, as companies' stock prices and enterprise values react when are announced (or anticipated) information contents regarding the financial choices made by organizations (Myers, 1984).

This fact may be due to the several benefits and disadvantages generally associated to the different forms of financing that are known by investors: each resource has its own pros and cons and it is subjected to various degrees of riskiness, and any entrepreneur should be very aware about all of these aspects.

1.2.1 Pros of debt financing

Borrowing funds means that firms usually have to repay them in periodic installments computed over a determined period of time at a specified rate of interest. However, the terms and timing of payment largely vary, depending on which form of debt financing the company has chosen.

So, one of the first advantages of using debt versus equity concerns the matters of control and ownership: by employing traditional instruments of debt financing owners are not giving up any controlling interests in their business, so they still make all the decisions and keep all the profits. Companies never pay more interests than those that are mandatory, and when the debt is fully repaid, the relationship with the lender is ultimately closed (Cremades, 2018).

However, the biggest benefit is given by the tax advantages: unlike dividend payments to shareholders, loan interests are tax deductible. This is known since the first theories of Modigliani and Miller and it can allow considerable savings as firms grow and their earnings turn positive over time, but this fact would be better explained later.

Moreover, should be noticed that the amounts of principal and interest payments are stated at the time the loan is given, so managers can exploit this predictability of cash flows to better prepare and implement company's financial and investment strategies and run the operations with more awareness (Woodruff, 2019).

1.2.2 Cons of debt financing

The most significant disadvantage of getting loans is related to the debt repayment risk, as debt capital requires repayment to the lender on specified dates without fail, regardless how well the business is running or not. These payments might include interest, principal or both of them, and if a company is unable to repay the loan regularly (especially because of the unpredictability of the cash flows generated by the most of businesses), it risks losing the assets pledged as *collateral* and this might lead to bankruptcy. The owners are often required to guarantee the loan personally, so if they have not separated their personal and corporate profits, they may also pledge their personal wealth as collateral. These reasons make debt financing a particularly heavy burden for small businesses and start-ups, often unaffordable for most of them (Cremades, 2018).

Organizations face also the risk of qualification, as companies and owners must have acceptable credit ratings to access to capital and too much debt already taken might limit a firm's capability to raise additional resources, because of the fear that such company may suffer default and not meet its repayment obligations. For this reason both current and potential lenders might decide to stop financing an over-leveraged firm or not allow it from increasing its level of indebtedness, that would rise also the cost of equity for potential future investors thus lowering their willingness to make more equity investments (chron.com).

It is also vital that companies understand the danger resulting from the unpredictability of financing terms over time. Variable interest rates can change during the scheduled repayment plan of a loan and heavily modify repayment terms, adding serious difficulties to organizations. This is typically the case of commercial mortgages or revolving credit lines, in which the lender may decide to not keep financing the business because of the awareness that new borrowing terms will be probably impossible to met (Berk, DeMarzo, 2016).

1.2.3 Pros of equity financing

This kind of financial resource allows the exchange of capital for the ownership rights in the organization, that may occur in various forms: normal partnerships by investors, equity funding from angel investors, financing helps guaranteed by venture capital firms, or even the public raising of capital through an IPO launched to capital markets. With equity financing, the company does not hold the pressure to meet the deadlines of fixed loan payments, rather it gives investors a percentage of the profits realized according the amount and features of the stocks owned (Cremades, 2018).

Therefore, the main advantage of using equity is the lower risk of default associated, as firms do not have to make fixed periodic loan repayments but rather they can decide to retain the earnings realized in order to support the business. This allows more flexibility in running the operations as equity investors do not expect to receive immediately the return on their investment; rather they usually have a long-term view and tolerate the possibility of losing their money if the business fails. Equity financing might be essentially helpful to startup businesses that may not have positive cash flows during the early stage of their business life-cycle.

Linking with that, it is easily understandable that when a company has credit problems, equity financing may be the only choice to finance the survival and the eventual growth. Even if debt financing is offered, the interest rate may be too heavy and the payments too close to each other to be tolerable.

Another important benefit is that equity financing might generate higher cash flows than debt alone and exploit the full potential of the business. Moreover, the cash flows generated through equity are inside the business, while debt loan repayments take funds out of the organization and might reduce the resources needed to finance growth (Woodruff, 2019).

1.2.4 Cons of equity financing

The primary risk associated with the use of equity is the resulting loss of control by owners: equity holders are entitled to vote on organizational matters during the general meetings and the investors who own a large equity stake will probably try to guide the company in ways that may disagree other smaller owners, who might be even replaced if they do not hold enough shares and consequent voting power (chron.com).

This might naturally lead to a serious potential for conflicts within shareholders, as all the partners will not always agree when making decisions. These conflicts might born from different visions for the company or for the strategies undertaken, which might prefer one or more classes of stakeholders over the others. A reduced ownership percentage not only means dividing the overall profits, but in some cases, some investors may be entitled to enjoy positive earnings before others can get anything (Woodruff, 2019).

Furthermore, despite theoretically being only residual claimers for the profits realized, shareholders might benefit from certain agreements with managers, who may be required to periodically distribute dividend payments to them. This can lead to the risk of missing growth opportunities if the firm distributes too much of its profits to the owners, especially in the case of small organizations, where during the first years managers typically prefer reinvesting positive cash flows in the business in order to better support the growth (chron.com).

1.3 Traditional theories of capital structure

So far have been explained the main benefits and risks associated with the different forms of financing. As it can be easily expected, in the real world the financial managers of organizations typically employ some combinations of capital sources in order to try to maximize the firm value and minimize the risks related. Of course, it is not clear how to definitely achieve such goals: equity is often more expensive than debt, especially when interest rates are not so high. On the other hand, equity financing does not need to respect fixed deadlines for payments, as equity holders are residual claimers for company's earnings. So, if there is an optimal capital structure which could be absolutely reliable in each different case, it still has not been discovered; firms can only decide to put in place combinations of financing instruments which might seem more adequate for their situation. However, the search for an optimal capital structure is one of the most intense topic of the corporate finance literature, as several authors have

provided us with a number of considerable theories developed over the last sixty-seventy years. Now will be shown the most important ones.

1.3.1 Modigliani-Miller theorems

The proper milestone of the modern corporate finance theory is still the work made by Franco Modigliani and Merton Miller, who published their article *"The cost of Capital, Corporation Finance and The Theory of Investment"* in 1958, which has pioneered the literature about capital structure inspiring entire decades of research.

The outstanding results achieved by these authors took shape under a set of conditions referred to as **perfect capital markets**, in which:

- Corporate information is free and available to all current and future investors, who behave rationally and have homogeneous expectations about future profits and risks of companies.
- Investors and companies can trade the same set of securities at competitive market prices that are equal to the present value of their future cash flows.
- Firms are financed only by stocks and bonds, without limitations in buying and selling securities.
- There are no taxes, no transaction costs, no costs of financial distress and no issuance costs associated with security trading.
- The companies' debt is not risky, so also the interest rate is considered to be risk-free. The possibility and conditions to access credit is the same for all investors of the same class.
- All companies within the same class face the same business risk.
- Net income (profit and interest) does not change over time and the probability of return is equal for all the investors of the same class.
- Financing choices made by a company does not reveal new information about it (Jaros, Bartosova, 2015).

Under these conditions, Modigliani and Miller developed their two basic theories about capital structure:

MM Proposition I: *In a perfect capital market, the total value of a company is equal to the market value of the total cash flows generated by its assets and it is independent of its financing decisions, namely the choice of its capital structure. Therefore, the total value of the unlevered firm (with no debt) is equal to the value of the levered firm*.

$$V_U = V_L \tag{1.1}$$

The authors stated hence the degree of leverage adopted by a firm would not affect its total value, while it merely changes the allocation of cash flows between debt and equity since the total cash flows generated by the company's assets are still equal to the present value of the future cash flows generated by all the projects undertaken. Indeed, Modigliani and Miller developed this result thanks to the **Law of One Price** (for which equivalent investment opportunities trading simultaneously in different competitive markets must trade at the same price in all the markets): without tax expenses or transaction costs, the total cash flow distributed to the company's security holders (shareholders and debtholders) is equal to the total cash flow produced by its corporate assets and therefore the latter must have the same market value, which is not affected by the level and type of financial resources raised by the firm.

This proposition states the value invariance with respect to the financial leverage and is based on the fact that if investors are not satisfied by the firm's choice of capital structure, they can borrow and lend on their own so to adjust the leverage choice made by the company. This is called **homemade leverage** and it represents the substitute for the use of leverage made by the organization, as long as investors and firms can borrow and lend at the same interest rate, as it is stated by the MM's assumptions (Berk, DeMarzo, 2016).

So, the main implication of this first proposition concerns the constant return required on the total capital invested into the firm, regardless the proportions of debt and equity. However, it is well known that the cost of capital differs for different securities: this can be more easily explained by the consequences of employing also debt financing in the company's capital structure, instead of using only equity. Despite borrowing funds may be cheaper than investing only owners' resources in absolute terms, it increases the overall risk of the business (even when the probability of default is low or nothing) and

therefore also the cost of equity capital when the firm is levered. This conclusion leads to the second proposition of Modigliani and Miller.

MM Proposition II: *the return on equity capital is equal to the expected rate of return on the assets employed, plus an additional premium correlated with the financial risk and measured by the debt-to-equity ratio. So, the cost of capital of levered equity increases with the company's debt-to-equity ratio computed at its market value.*

Indeed, the first proposition can be rewritten in terms of homemade leverage: the return on total capital employed in a company can be interpreted as a portfolio of its debt and equity proportions, and since the return of a portfolio is given by the weighted average of the returns on securities included, it can be written as:

$$R_U = \frac{E}{E+D} R_E + \frac{D}{E+D} R_D \tag{1.2}$$

where R_E is the return on levered equity, R_U is the return on the unlevered equity (as if it the firm would be funded with 100 % of equity), R_D is the return on debt, while $E/E+D$ and $D/E+D$ represent respectively the proportions of equity and debt over the total firm value. This formula can be rewritten in the following way:

$$R_E = R_U + \frac{D}{E}(R_U - R_D) \tag{1.3}$$

In this way, the return on levered equity is given by the sum of two factors: the first one (R_U) reflects the corporate risk without leverage and therefore the riskiness of the business operations, while the other one shows the additional risk factor due to the leverage made by the firm and it is represented by the **debt-to-equity ratio (D/E)** which is able to either boost the return on levered equity when the company performs well ($R_U > R_D$) or amplify the drop when the business is going badly ($R_U < R_D$).
So, the equation (1.3) implies that the expected return on equity is directly proportional to the financial leverage, which increases the overall return on capital employed but it also amplifies the cost of capital of the firm. Indeed, the risk of the company's

underlying assets financed through both debt and equity will match the risk of a hypothetical portfolio composed by those proportions of debt and equity chosen by the firm itself: this means that the appropriate cost of capital for the company's assets is actually the cost of capital of that portfolio, whose common name in corporate finance is **Weighted Average Cost of Capital (WACC)** and it represents the average return the company must pay out to all its investors (Modigliani, Miller, 1958).

The second proposition of Modigliani and Miller hence states that in perfect capital markets, the company's WACC is not affected by the choice of capital structure and it is equal to the unlevered equity cost of capital, which in turn equalizes the cost of capital of firm's assets.

$$WACC = R_U = R_A \tag{1.4}$$

1.3.2 Modigliani-Miller theorems with taxation

The scope of the theorems stated by Modigliani and Miller has been wide and revolutionary, but must be remembered the long series of assumptions under which they have been developed. The difficulties of testing these theories in the practice are related to the peculiarities of the real world where those conditions set by the authors cannot hold. Especially the absence of taxes is the most relevant, as firms are typically subjected to the taxation of operating income which has huge consequences for the choice of their capital structure, especially because of the corporate tax benefit they can receive if they employ borrowed funds: since the corporate income taxes are paid after that interest expenses are deducted (unlike dividend payments to equity holders), such interest payments are capable to reduce the actual amount of taxes paid by the firm. This also means that while debt repayments reduce the net income available to shareholders, the use of leverage is going to increase the total amount available to all the firm's investors because are included also the interest payments to debtholders. More precisely, the actual gain from the tax deductibility of interest expenses is known as **interest tax shield** and it corresponds to the additional amount of taxes that should have been paid by the firm if it were not levered.

This peculiarity of corporate taxation give firms an incentive to use more debt instead of equity, because, everything else being equal, the total cash flows to company's security

holders with leverage are higher than those that would be provided to investors without leverage (in that case, such investors would be only the equity holders) by a factor corresponding to the interest tax shield of the debt financing employed (Berk, DeMarzo, 2016).
So, the huge importance of this corporate tax benefit cannot be ignored when disserting about capital structure theories, and for this reason Modigliani and Miller themselves in 1963 removed the first great assumption of their model and reintroduced their theorems with the presence of taxation.

MM Proposition I with taxes: *the total value of the levered firm exceeds the total value of the unlevered firm by a factor equal to the present value of the tax savings from debt:*

$$V_L = V_U + PV\ (Interest\ tax\ shield) \tag{1.5}$$

where V_L is the firm value with leverage and V_U is the value of the unlevered firm, while the present value of interest tax shield can be calculated by multiplying the amount of debt financing (D) by the corporate tax rate (τ_c).

$$V_L = V_U + \tau_c \times D \tag{1.6}$$

Through this fundamental difference, the authors' first proposition clarifies that firms with more debt in their capital structure are more valuable and have a higher market value than those not relying on leverage. Therefore, Modigliani and Miller show that taxation has a direct impact on the firm value and they might suggest to use as more debt financing as possible to exploit the interest tax shield effect, until arriving at a capital structure entirely composed by debt in order to (theoretically) maximize the firm market value.

MM Proposition II with taxes: *there is always a linear relationship between the use of financial leverage and the required return on equity capital:*

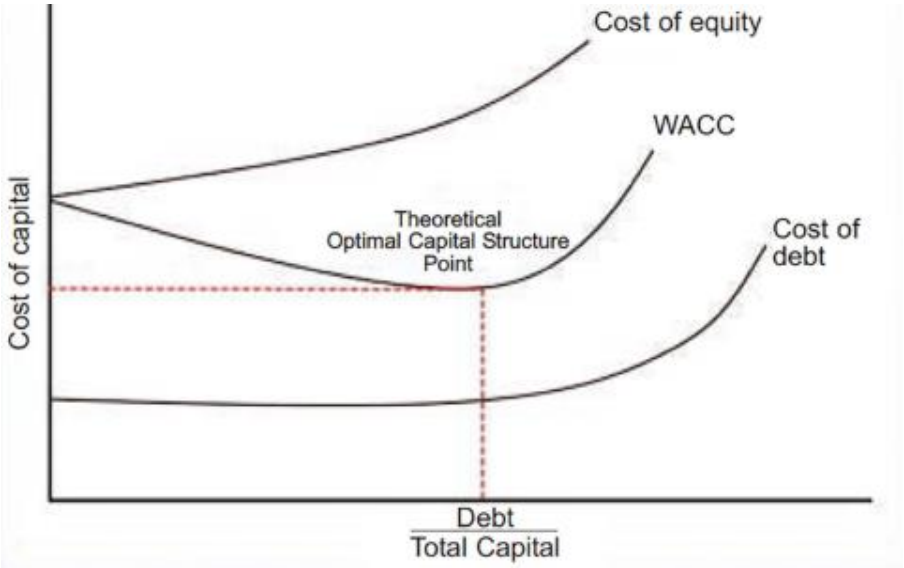
$$R_E = R_U + \frac{D}{E}(1 - \tau_c)(R_U - R_D) \tag{1.7}$$

Indeed, the interest tax shield can be expressed also in terms of cost of capital: the cost of debt is partially offset by the tax savings, so the effective after-tax cost of debt becomes $R_D(1 - \tau_c)$. The after-tax WACC, therefore, represents the effective cost of capital of the company after the inclusion of the corporate tax benefits and differs from the unlevered cost of capital:

$$WACC = \frac{E}{E+D} R_E + \frac{D}{E+D} R_D(1 - \tau_c) \tag{1.8}$$

The equation (1.8) shows that a firm can reduce its WACC by increasing the proportion of debt financing in its capital structure and therefore it can raise the present value of future cash flows: in other words, the higher the leverage ratio, the more the company is able to take advantage of the interest tax shield and the lower is the resulting WACC, thus the company should benefit from employing a consistent percentage of debt until the firm value would result maximized (Ahmeti, Prenaj, 2015).

Image 1.1: Theoretical optimal WACC



(Image source: Balcombe, 2016)

1.3.3 Criticisms to Modigliani-Miller

Since the publication of their first original article in 1958, Modigliani and Miller have deeply influenced the research and teaching in corporate finance literature, like a

proper cornerstone. There are two main reasons for that achievement: the first is substantive, given the nature of "irrelevance propositions" of their original theorems, which claim the firm value's invariance with respect to the financial decisions made by the firm. The first MM proposition explains the set of conditions under which the choice of the proportions of debt and equity to fund a fixed level of investment does not provide any effect on firm value. This theorem belongs to the class of the so called *irrelevance propositions*, which are aimed at showing the irrelevance of a choice that apparently would seem very important, such as the capital structure decision and the dividend policy; indeed, Modigliani and Miller also developed another famous proposition regarding the irrelevance of the firm value with respect to the dividend payout decisions. These particular theorems does not prove that the specified choice is actually irrelevant, but rather they allow to reflect on the assumptions that are necessary to make relevant such choice, thus providing a constant benchmark for assessing the decision undertaken.

The second main reason concerns the methodology adopted, because perhaps the most important aspect in MM's theorems is the approach used to derive them, rather than the propositions themselves: Modigliani and Miller were the first ones to deal with the arbitrage argument and to show that the Law of One Price could have strong implication for security prices and firm market values, thus marking the beginning of the modern theories of corporate finance. Indeed, before their first publication, the study of finance was mostly limited to the description of methods and institutions of the financial system. These works were the first ones to start shaping a coherent theory capable of accounting both for the funding of corporate investment projects and for the allocation of savings by individual investors, and they are based on the assumptions of investors' rational behavior and market equilibrium. Once these basic elements were all introduced, the theory of finance could develop rapidly and lead to the use of the arbitrage argument: first of all, the concept of arbitrage itself is more robust and completed than the simple notion of economic equilibrium. Moreover, since that moment this method has become the standard methodology to price securities in capital markets, as financial derivatives are typically "priced by arbitrage" (the strongest example is given by Black and Scholes who employed the MM propositions to derive their famous option pricing formula in 1973) (Pagano, 2005).

Despite the deep influence provided to the literature, MM theorems have received several criticisms over the years: most of them are directed towards the unrealistic assumptions on which the propositions are based. In fact, the entire development of corporate finance since the publication of the first article (1958) can be basically seen as the progressive relaxation of the assumptions listed before. The first condition about the taxation was removed by Modigliani and Miller themselves, as it is described in the previous paragraph, while other scholars tried to seek for some kind of cost capable to offset the tax benefit of debt, identifying it in the **costs of financial distress**: the higher the degree of leverage adopted by the company, the greater the firm value because of the corporate tax advantages of debt, but also the higher the financial distress and the consequent likelihood of failure. Of course, such risk of bankruptcy is a pretty relevant matter in business life and cannot be ignored, as well as in the real world the market rates at which individuals can borrow are not unlimited, compared to firm's borrowing capacity. This empirical relevance restricts also the reliability of the assumption for which firms and investors can face the same interest rate when choosing among different securities in capital markets (Stiglitz, 1969).

To sum up, the Modigliani and Miller's contribution to financial theory is significant, as their theorems face the most important topics of corporate finance and provided companies with the opportunity to make an insight into the capital structure components and determine which factors are actually most significant in adding value to the firm. However, like the authors themselves were willing to point out, the dissertation cannot be concluded by entirely accepting the irrelevance of financing decisions on firm value, as the characteristics of the real world are strongly different from the utopian assumptions and market conditions on which relies their model, but they offer the opportunity for further researches about the topics treated in those theorems (Ahmeti, Prenaj, 2015).

1.3.4 Debt and taxes

So far discussion has been focused on the benefits of leverage with respect to the corporate taxes firms must pay on their operating income; however, in the real world those are not the only form of tax liability, because the cash flows received from their investments are considered as a form of income and therefore investors are subjected

to the taxation of either the income realized from interest payments or the income earned from dividends or capital gains (that consist of an indirect form of retribution if the firm decides to retain the earnings instead of distributing them as dividends), for which there exists different types of tax rates.

In its famous paper *"Debt and taxes"* (1977), Merton Miller analyzed in depth these issues starting from the consideration that while companies would be interested in issuing as much debt as they can in order to maximize the benefits from the interest tax shield, and consequently, the firm value, it is also reasonable to assume that individual investors will be willing to maximize their **after-personal tax cash flows**, as the price an investor would pay for a security ultimately depends on the amount of cash flows he will receive from that, after the payment of all taxes. Therefore, Miller suggested that the tax advantage of debt at the corporate level should be balanced against the possible tax disadvantage of debt at the personal level, and in his papers he evaluated the combined effects of both corporate and personal taxes and examined the implications of this trade-off for the optimal capital structure (Berk, DeMarzo, 2016).

First of all, it is assumed τ_c as the corporate tax rate, while at personal level are introduced τ_e as the tax rate on equity income and τ_d as the tax rate on interest income. After combing their effects for each dollar of operating income (EBIT) realized by the firm, is obtained:

$$(1 - \tau^*)(1 - \tau_d) = (1 - \tau_c)(1 - \tau_e) \tag{1.9}$$

where $\boldsymbol{\tau}^*$ represents the effective tax advantage of debt: if the firm paid $(1 - \tau^*)$ in interests, debtholders will get the same amount of money after the payment of taxes as equity holders would receive if the company paid 1$ in profits to them. By solving the equation for it:

$$\tau^* = 1 - \frac{(1 - \tau_c)(1 - \tau_e)}{(1 - \tau_d)} \tag{1.10}$$

Written in this form it is easier to understand that each dollar paid after taxes to debtholders from interests costs equity holders $\$(1 - \tau^*)$ on their after-tax basis (Miller, 1977).

The conclusion at which Miller arrived is that if the personal tax on interest income is higher than the personal tax on equity income, then the investors may demand to firms higher risk adjusted returns for risky debt so to maintain the attractiveness of debt also at the personal level. Therefore, sometimes the net tax disadvantage on debt at the personal level may totally offset the tax benefit at corporate level. Especially, he stated that as long as there is a multitude of investors whose marginal rates of personal taxes vary among each other, the capital structure chosen by companies will be irrelevant, because in equilibrium both debt and equity will imply the same cost for financing a project. In this way, Miller renewed the implications of the first MM proposition even by considering also the effects of taxation.

However, should be clarified some points in this analysis: firstly, when Miller wrote his original paper in 1977, the personal tax rate on interest income in U.S.A. used to be higher than personal tax on equity, since the first one was equal to the tax rate on ordinary income, while the second one was a combination of the tax rates on dividend and on capital gains (the resulting rate was lower than the ordinary tax rate); nowadays in U.S.A. there is a unique tax rate for all the sources of income, but there are still differences in other countries. Moreover, the tax on capital gains is paid only when the gain is realized, so, if an investor does not want to immediately enjoy his profit, he can defer the realization.

Anyway, the research in this field has been pioneered by Miller but it is still an ongoing debate for several scholars. Multiple analysis have been undertaken for trying to capture the effects of taxation on the determinants of capital structure, and it has been observed that when personal tax rates are introduced, the optimal aim of the company should be the minimization of the overall tax burden. Therefore it is very essential to include personal taxes while analyzing the relationship between taxes and debt, in order to achieve a better understanding of the overall picture (Brealey et al., 2012).

1.3.5 The Pecking-Order Theory

The theories developed by Modigliani and Miller (and by Miller alone too) have pioneered the research in the fields of corporate finance, but this was just the beginning: several scholars have followed the way tracked by these great authors and started shaping different currents of thought about the optimal capital structure.

Another significant contribute has been given by Stewart Myers, who published *"The Capital Structure Puzzle"* in 1984, that could be easily considered one of the most important works in this field, as the author tried to understand why the theories already developed in the finance literature (namely, the MM propositions and the consequent theorems) were struggling in explaining the firms' actual financing behavior. Especially, Myers criticized the **static trade-off theory**, in which the optimal capital structure is reached when the tax advantage from borrowing given by the interest tax shield is balanced, at the margin, by the costs of financial distress. Later would be explained in details this important theory, but now the focus is just put on the contrast Myers did with two different ways of thinking about capital structure in his paper:

1. A *static tradeoff* framework, in which the company sets a target debt-to-value ratio determined by the trade-off between the costs and benefits of debt, and it gradually moves towards that, in a similar way of a firm adjusting its dividends towards a target payout ratio.

2. A *pecking order* framework, where the firm follows a certain order of financial resources to fund its business, preferring internal rather than external financing, and the issuance of debt rather than equity. In this theory, the firm has no well-defined target debt-to-value ratio.

Myers observed multiple cross-sectional analysis of financing patterns, in order to specify whether companies' debt ratios differ each other because they have different optimal ratios or because their actual ratios diverge from the optimal ones: if adjustment costs are small, and companies stay close to their target debt ratios, than the dispersion of debt ratios should be explained by differences in risk or other variables able to influence the optimal capital structure. However, the observed diversity of capital structures across firms that he noticed is hard to be explained by a static tradeoff framework. This evidence let him to argue the framework developed by Miller in his famous "Debt and Taxes", where he described an equilibrium of aggregate supply and demand for corporate debt, where the corporate tax saving is just offset by the personal income taxes paid by the marginal investor in corporate debt obligation; since the resulting equilibrium is achieved at an aggregate level, every taxpaying firm should not

be affected by its debt policy. Anyway, this explication works only with the unrealistic assumption that all companies face approximately the same marginal tax rate (Myers, 1984).

Therefore, after having listed this issues regarding the static tradeoff theory, Myers contrasted it by further developing the already existing theories for which firm fund their businesses through a financing pecking order, including four main steps:

1. Firms prefer internal finance, in the form of retained earnings.

2. Firms adjust their target dividend payout ratios gradually to their investment opportunities, although dividends are quite sticky.

3. Sticky dividend policies, together with unpredictable fluctuations in profitability and investment opportunities, might cause the level of internally-generated cash flow be above or below the level of investment outlays. If it is below, the firm first gets resources from its cash balance or portfolio of marketable securities.

4. If firms need external finance, they issue firstly the safest security, namely debt obligations, then possibly hybrid securities such as convertible bonds, and only as a last resort they issue common equity shares.

So, this model refuses the notion of well-defined target debt-equity ratio because there are two kinds of equity: **internal equity** (in the form of retained earnings reinvested into the business) is at the top of the pecking order, while the **external equity** (raised by issuing new ordinary shares) lies at the bottom as it is considered to be the riskiest way of financing. Hence, each company's observed debt ratio reflects its cumulative requirements for external finance, while firms will finally issue equity shares only when the investment requirements exceed the level of debt capacity that would lead to a too heavy burden of leverage.

Despite initial doubts, especially related to the fact that the costs of issuing equity over debt did not seem so high to offset the tax benefits of leverage, Myers started to convince himself about the reliability of this theory by noticing the considerable relevance on internal finance and debt instruments when looking at aggregate levels, as

well as some works based on asymmetric information provided him with predictions roughly in line with the Pecking Order Theory (Fama, French, 2002).
To sum up, Myers has given us important contributes with his works, summarized in the final conclusions of his paper, for which:

- Firms decide wisely to avoid financing investments by issuing common shares or other risky securities, so to reduce the risk of abandoning positive-NPV projects or issuing underpriced stock.

- Firms set target dividend payout ratios so to meet the normal rates of equity investment through internally generated funds.

- Companies also plan to cover part of normal investment outlays with new borrowed funds, but they try to keep the debt reasonably close to default-risk free rate. This restriction occurs for two reasons: first, to avoid any costs of financial distress, and secondly, to maintain financial slack in the form of reserve borrowing power, which means that the firm can issue safe debt if it needs an external security.

- Since target dividend payout ratios are sticky, and the level of investment outlays is generally different from the amount of internal cash flow, the firm sometimes will end its ability to issue safe debt. In those cases, the company relies on less risky securities first (for example, risky debt or convertibles) before common shares of equity.
  (Myers, 1984)

1.4 Advanced theories of capital structure

So far we have explained the basic theories of capital structure developed in the early stages of corporate finance literature. Especially, Modigliani and Miller have shown the

conditions by which the choice of capital structure can be considered irrelevant: since that moment, many economists have followed the path they tracked. However, throughout the following decades several advanced theories have been articulated, linking the capital structure determinants to many interesting factors. In his article *"The Theory of Capital Structure"* (1991), Milton Harris tries to give a certain order to these innovative fields of research by summarizing the recently developed literature in four categories of capital structure determinants:

- The agency approach, for which the capital structure can be seen as a result of the conflicts of interests between different groups of people claiming the company's resources.
- The asymmetric information approach, by which the capital structure chosen by the firm is able to transmit private information to capital markets or to smooth the adverse selection within the organization.
- The approach by which the capital structure can be seen as a way to influence the nature of products or inputs in the company's marketplace.
- The view of capital structure as the result of corporate control contests.

(Harris, 1991)

1.4.1 The Agency Approach

A significant contribute has been given by models where capital structure choices are determined by **agency costs**, due to conflicts of interest between all the various groups of people involved with the firm's activities. In particular, it is possible to identify two main types of conflicts that are capable to determine the capital structure determinants. The first one is between shareholders and managers, following the classic model of agency theory: conflicts between them arise because managers own less than 100% of the residual claim, therefore, despite their activities foster the company's profits, they do not enjoy the entire gain from their work, but they have to bear the total cost of company's activities. The larger is the stake of the company's equity owned by managers, the more this inefficiency is reduced: hence, holding constant the managers' investment in the firm, if the debt financing increases, also the manager's equity share increases and the conflict between managers and shareholders is then alleviated. This

mitigation of conflicts represents one of the benefits of debt financing (Jensen, Mackling, 1976).

In other papers, managers and shareholders disagree over the operating decisions, as the first ones want always to pursue the firm's engagement in its current operations even if investors would prefer the liquidation. The cost of debt is so represented by the bankruptcy expenses related to the production of information about the firm's prospect that is used in the liquidation decision, while the optimal capital structure trades off improved liquidation decisions and higher investigation costs: a higher level of debt is likely to improve the liquidation decision because it increases the probability of default. Thus, under this model firms with higher liquidation value (with more tangible assets), and those with lower investigation costs will have larger levels of debt and higher likelihood of default but will also have higher market value than similar firms with lower liquidation value and higher investigation costs (Harris, Raviv, 1990).

Lastly, under a similar theory managers are assumed to push investing all available funds even if paying out cash is better for shareholders. Debt obligations enhance the total amount of free cash flows but reduces that part available to shareholders for profitable investments, and also give them the option to force liquidation if the cash flows are poor, so the optimal capital structure is determined by the trade-off between the benefit of debt in preventing investments in value-decreasing projects against the cost of debt in preventing expenditures in projects that are more likely to increase the overall firm value (Stulz, 1990).

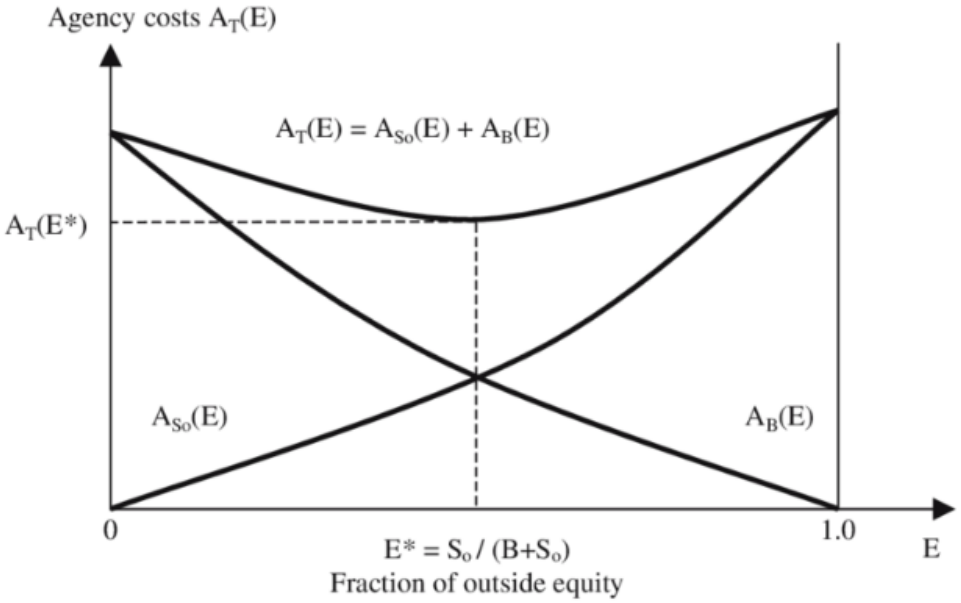
The second main type of conflict concerns the opposition between the equity holders and debtholders, that might rise because debt obligations give equity holders an incentive to make sub-optimal investments: if the return on the investment is large (as usually occurs with riskier projects), equity holders enjoy most of the gain, while if the investment fails, debtholders bear the consequences because of the limited liability of shareholders. Consequently, equity holders may benefit from investing in risky projects, even if this decision might decrease the value of debt and the overall firm value, while debt holders are more risk adverse since they will not be repaid if the company would go into bankruptcy. The loss in equity value from the poor investment can be compensated more than proportionally by the gain in equity value got at the expense of debtholders, so the cost of investing in value-decreasing projects created by debt is tolerated by the equity holders. This issue is an agency cost of debt financing and it is

called the **"asset substitution effect"**, which implies that debt contracts should usually include features aimed at preventing the asset substitution, such as interest coverage requirements, debt covenants and restrictions against which types of new business the company is allowed to invest in. So, again in this case the optimal capital structure can be obtained by comparing the agency cost of debt against its benefits (Jensen, Mackling, 1976).

Following the general thought of equity holders as actors that incentivize the asset substitution effect, Douglas Diamond developed a model focused on the firm's reputation for choosing projects in which debt will be repaid. Here, the company has to choose among two possible investment projects, both requiring the same level of initial outlay financed through debt: a safe, positive-NPV project, whose return is sufficient to repay the debt holders, and a risky, negative-NPV project with two possible payoffs ("success" or "failure") which allows repayment only in the case of success. Given the asset substitution project, the equity holders will require to undertake the risky projects, but managers can also try to convince potential lenders, who can only observe the company's default history to evaluate its likelihood of repaying the debt obligation: the longer the firm's history of assuring debt repayments, the better is its reputation, and the lower is its cost of debt. Therefore, older companies with more stable free cash flows will decide to undertake the safe project, so to not risk the asset substitution effect and not affect their long and valuable reputation, while start-ups and younger firms will have probably to choose the risky project because their little reputation do not allow to access a low cost of debt, so they will end up with a higher level of debt than older companies (Diamond, 1989).

To sum up, models involved with the agency theory show a number of very interesting implications: first of all, they imply that leverage is likely to show a positive correlation with firm value, default probability, the total amount of free cash flows, the liquidation value and the importance of managerial reputation, while it is expected to be negatively correlated with the cost of investigating firm prospects, the extent of growth opportunities, and the likelihood of reorganization after a default. Finally, the positive correlation between firm value and the degree of leverage is likely to state that changes in capital structure due to increase in leverage will be usually accompanied by a rise in the company's stock price (Harris, 1991).

Image 1.2: Capital structure according to agency theory



(Image source: Chen, Strange, 2005)

1.4.2 The role of Asymmetric Information

The introduction of economic models into the corporate finance literature has led to the development of theories in which insiders (like managers) are assumed to hold private information about the stream of firm's returns or the pool of corporate investment opportunities. In some of these models, the choice of capital structure by firms is able to transmit insiders' information to outside investors. Myers' Pecking-Order Theory has been already introduced, but now will be explained its implications for capital markets: if outside investors are less informed than firm's managers and other insiders about the value of the corporate assets, then equity may be mispriced by capital markets: financing new projects by issuing underpriced equity may cause that new investors will capture more than the value of such new projects, resulting in a net loss to existing shareholders and in the abandon of the project even if the NPV is positive. This underinvestment can be avoided if the firm will fund the new project through not undervalued securities, such as internally generated equity, riskless bonds and even risky debt, following the already mentioned pecking order of financing tools. The empirical implications of this theory concern the price's fall of the company's existing shares after the announcement of a new equity issue, because of the conveyance of private information about the managers' choices, that will be avoided if the firm would

finance its new projects through retained earnings or debt financing. As a consequence, the leverage increases with the extent of informational asymmetry (Myers, Majluf, 1984).

These results have been confirmed by several researchers, like William Krasker, who also shows that the larger the equity issue and the informational asymmetry, the worse the signal transmitted to capital markets and the larger the drop in the firm's stock price (Krasker, 1986).

A little different approach shows that when the informational asymmetry concerns only the value of the new project, some negative-NPV projects will be undertaken thus creating overinvestment, because in equilibrium the equity of different companies with projects of various NPV are all priced at an average value, so firms whose projects show a low NPV will take advantage by selling overpriced equity. This process leads to the creation of a negative cut-off NPV so that companies will accept all those projects whose NPV is above that level: because the debt is less overpriced than equity, the issuance of debt is likely to increase that cut-off level and to mitigate the overinvestment problem related to the equity financing. This models also shows that when a company accepts a new project, its stock price will rise because investors understand that the NPV of the new project undertaken by the firm is above the cut-off level. Moreover, when firms can decide whether finance the project through either debt or equity, they prefer issuing debt or even abandoning the project rather than funding it through equity. This conclusion might be consistent with the Pecking-Order Theory, but it departs from its last implication because since a project acceptance is associated only with issuing debt, this will result in a rise in firm’s stock price because debt issues are considered to be good news by capital markets (Narayanan, 1988).

Other scholars, however, have developed models in which companies can decide to issue either debt or equity. Furthermore, in other theorems the level of investment is fixed and the capital structure is used as a signal of private insider information. Here, unlike investors, managers know the true distribution of company’s returns, that are ordered by first order stochastic dominance. So, managers benefit if the firm's securities are more highly valued by the market but are penalized if the company goes into the bankruptcy. At the same time, investors consider more valuable those companies that are more leveraged; since lower quality-firms have higher marginal expected bankruptcy costs for any debt level, their managers do not imitate higher quality-firms

by issuing more debt. The main empirical implications of this model is that firm value, the degree of leverage, and the likelihood of bankruptcy are all positively related (Ross, 1977).

1.4.3 Models based on products and inputs characteristics

The introduction of economics theories in the corporate finance literature does not only concern the role of the informational asymmetry for explaining the capital structure choices, because there have been also introduced certain features of industrial organization: in particular, these models can be classified into two different categories.

The first one explains the capital structure of a certain organization as determined by the strategy adopted for competing in its marketplace. Indeed, while the traditional literature of industrial organization has usually focused on the choice of a certain competitive strategy so to pursue the maximization of the total profits, without considering other implications, this innovative point of view wants to link capital structure choices and product market strategy so that managers are aimed at maximizing equity value instead of either the total firm value or the amount of profits. So, the initial works with this regard readapt the idea developed by Jensen and Mackling by which higher levels of debt would induce equity holders to undertake riskier projects, in the context of a Cournot equilibrium, where companies increase their indebtedness to pursue more aggressive strategies: in this equilibrium model the marginal product from output is large in "good" states, and since leveraged equity holders benefit from limited liability, they receive payoffs only in such good states, ignoring the possibility that the marginal product of output could be low. Therefore, in this model leverage creates an incentive to increase output, also because this will induce the competitors to produce less; so, oligopolistic companies will tend to increase their level of debt financing with respect to monopolists or firms in competitive industries, also in the long run (Brander, Lewis, 1986).

In order to allow the survival of oligopolies over time, the included companies rely on a tacit collusion in which are used punishment strategies when another rival firm deviates from the collusive output level. In this case, the profit formula for the Cournot equilibrium has been rewritten to take into account the fact that managers are now

oriented toward the maximization of the equity value, instead of the overall firm value, so it becomes:

$$b < \pi_m + (\pi_m - \pi_d)r \tag{1.11}$$

where b is the debt issued per period, π_m is the monopoly profit per period, π_d the one-period profit from deviating from the collusive output level, and r is the discount rate. In particular, this condition must be interpreted as the maximum debt capacity that oligopolistic firms can support in those industries without leaving the tacit collusion. By modeling profits in terms of market demand, cost functions and number of oligopolistic companies, it is possible to derive comparative static results on debt capacity as a function of industry and firm characteristics, so to show that debt capacity is induced to increase with the demand elasticity and to decreases with the discount rate (Maksimovic, 1988).

Then, the second industrial organization-based approach to capital structure is to identify the characteristics of the firm's products or inputs that affect its degree of leverage. The liquidation of a company may be reflected into certain costs on its customers (or suppliers), in terms of the inability to obtain the product or service desired; such costs are transferred to the equity holders in the form of lower prices for the firm's goods and services, so they would be willing to liquidate the company only if the net gains from liquidation exceed the costs imposed on customers. With this regard, the capital structure can be used to arrange an optimal liquidation policy for shareholders, so that they never wish to liquidate, while debtholders are always willing to liquidate when the firm gets into bankruptcy, and the latter will ultimately default only when the net gain to liquidation exceeds the cost imposed to customers (Titman, 1984).

Another advantage of leverage is that it strengthens the bargaining position of equity holders in dealing with input suppliers: since debt holders bear the entire costs of bargaining failure without fully exploiting the benefits in case of success, they partially insure equity holders against failure of negotiations with suppliers. Therefore, higher leverage increases the extent of this insurance and hence it enhances the equity holders' bargaining power against suppliers, so that debt can increase firm value also under this point of view (Sarig, 1988).

Hence, it is clear that also capital structure models based on industrial organization features can provide interesting implications.

1.4.4 The influence of corporate contests

The growing importance of takeover activities started during the 80's has led to the development of finance models based on the connection between the market for corporate control and the capital structure, based on the voting rights carried by common equity stocks, unlike borrowed funds.

All the papers in this field of literature focus on the relationship between the equity stake held by managers and the value of outside equity, taking into consideration whether the firm is successfully taken over or not, and the eventual price paid by the bidder; since the capital structure choice determines such equity stake owned by managers, it is able to influence the firm value, the probability of takeover and the consequent price. In particular, since the incumbent company's manager and the potential rival have different abilities to manage the firm, the firm value is affected by the outcome of the takeover contest, which in turn is determined by the incumbent's equity stake and it can result in one of three possible outcomes: the rival takes over for sure, the incumbent manager remains in control for sure, or the final outcome is determined by the votes of passive investors through an election. The optimal equity stake depends on the trade-off made by the incumbent manager between the expected payoffs on his ownership share against the loss of any benefits resulting from his position. Because the manager's equity stake is determined indirectly by the company's capital structure, this trade-off can be seen as a theory of capital structure linked to corporate control matters. Since the incumbent manager can increase his ownership share by repurchasing equity through the issuance of new debt, it means that higher level of debt decreases the value of equity thus allowing the incumbent to purchase a greater equity share (Harris, Raviv, 1988).

A similar model stated that higher leverage increases the gain to target equity holders if the tender offer will be successful, because target and acquiring shareholders can bargain only about that part of the gains not previously committed to debtholders, as well as when new debt is released, target shareholders can capture the benefits accruing to target debtholders, thus receiving all the gain not enjoyed by acquiring

shareholders. If a takeover actually happens, the gains to target equity holders increase with higher degree of leverage and the optimal level of debt is given by balancing this effect against the lower likelihood of takeover that results from the reduced portion of the payoffs accruing to acquiring equity holders. Therefore, companies with greater potential takeover gains will have higher indebtedness (Israel, 1992).

So, the theories of capital structure related to takeover contests and corporate controls show some interesting results: on average, takeover offers cause increases in the level of debt and in the stock price, while higher leverage usually shows a negative correlation to whether the takeover succeeds. Moreover, should be noticed that these theories primarily concern capital structure changes in the short run, as a reaction to imminent tender offers and takeover threats, while they do not explain any movement in the long run, when the other theories seem to be more powerful (Harris, 1991).

CHAPTER 2: THE TRADE-OFF THEORY AND THE COSTS OF FINANCIAL DISTRESS

After the dissertation about the nature of capital structure, its components and effects on firm value under multiple theories and scholars, the focus is now put on the costs of financial distress. The discussion starts with one of the theories of capital structure – the Trade-Off Theory – which has mostly characterized this field of the finance literature: will be shown what are the drivers used by firms to choose the relative percentages of debt and equity that lead to their optimal level of borrowing. Following the consequences of that theorem, will be introduced the costs of financial distress, their relevance in the literature and the main models adopted to their estimation in practice.

2.1 The Trade-off Theory

So far have been explained the main theories regarding the capital structure, beginning the discussion with the fundamental propositions developed by Modigliani and Miller that have pioneered the corporate finance literature, stating the irrelevance of the financing choices for the real decisions and ultimately for the overall firm value. Since then, economists and scholars have gradually adjusted their positions, and the so-called **Trade-Off Theory** can be considered as the most direct evolution of the MM theorem with taxes.

Indeed, the borrowed funds represent an obligation for a company because lenders have the right to be repaid for the amount of capital they decide to not enjoy personally for making it available for a third party. However, if the percentage of indebtedness increases too consistently, the firm may become over-leveraged and might face the impossibility of generate cash flows sufficient to repay the lenders, thus gradually leading to the declaration of bankruptcy and the final liquidation of its assets, which

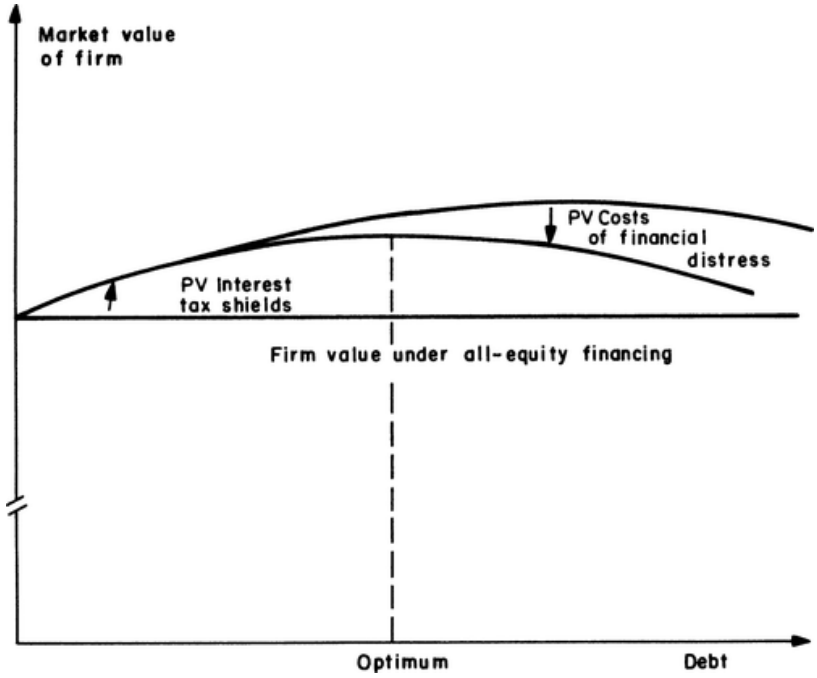
would be transferred to the firm's lenders proportionally to their credits as a form of repayment. This situation of *financial distress* is hence a serious matter of leverage, that warns companies by getting an excessive amount of debt as stated by the traditional theories of Modigliani and Miller, who instead theorized the maximization of the firm value through a capital structure entirely composed by debt financing. Therefore, the Trade-Off Theory aims at balancing the expected benefits from tax savings with the expected costs of financial distress to determine the optimal level of debt that should be achieved in order to maximize the firm value. The discussion can start with the static approach of this theory.

2.1.1 The static Trade-Off Theory

The classic version of this theorem has been developed by Alan Kraus and Robert Litzenberger, who elaborated a state preference model to explain the financial structure choice taken by a firm. Firstly, they started the discussion from the irrelevance theory introduced by Modigliani and Miller, where the assumptions of perfect capital markets allow firms to increase their level of debt financing because of the absence of bankruptcy penalties. Instead, the taxation of corporate earnings and the existence of bankruptcy costs are market imperfections which must be taken into account with a central role when considering the capital structure and its effects on valuation. So, since interest expenses are tax deductible, a fiscal advantage arises from borrowing funds, so that financial leverage is capable to decrease the company's corporate income tax liability and enhance its after-tax operating profits: this is well known from the traditional theories of corporate finance. However, a huge proportion of debt financing in the capital structure brings also some negative consequences, because an highly levered firm might suffer from an excessive burden of debt obligations that complicates its capability to meet regularly the repayment of both principal and interests, until arriving to the already mentioned situation of financial distress, in which the firm is often forced to declare bankruptcy. In these phases, the company faces several types of **costs of financial distress**, which include not only the legal and administrative costs of bankruptcy, but also the related agency costs and moral hazard, the issues due to employees leaving or suppliers demanding detrimental payment terms and the monitoring and contracting costs which can erode the firm value even if managers

achieve to avoid the legal default. So, according to this model, the interest tax shield make it convenient the use of debt as long as the firm does not become insolvent, and therefore, the company will borrow money up to the point in which the fiscal benefit of any additional unit of debt will be exactly offset by the increased probability of financial distress: in that point, the company will achieve its optimal capital structure because the marginal benefits of debt are perfectly balanced by its marginal costs, and the overall firm value is consequently maximized (Kraus, Litzenberger, 1973).

Image 2.1: Capital structure according to the static Trade-Off Theory



(Image source: Myers, 1984)

In this model, the present value of the interest tax shield and the present value of the expected costs of financial distress are two variables both associated with the firm value but inversely correlated, so that:

$$V_U = V_L + PV\ (Interest\ tax\ shield) - PV\ (Bankruptcy\ costs) \qquad (2.1)$$

Therefore, the Trade-off Theory suggest the existence of a firm's *optimal debt ratio* that is determined by balancing the costs and benefits of borrowing, holding the firm's assets and investment plans constant, and substituting equity with debt until the firm value is maximized (Myers, 1984).

An important implication from this model is that the capital structure is not a given choice, like an ”internal” solution, rather it depends on the states of things: if the firm faces a situation of financial health, it can borrow funds, while in states where there is an incoming insolvency problem, the firm will finance through more equity. Hence, companies must identify first the state of things of its business, and only then the capital structure will be developed as a consequence. This point of view is likely to explain better why firms are usually financed through a combination of both debt and equity sources (Swanson, Srinidhi, Seetharaman, 2003).

So, every time there is an optimal capital structure in which the firm value is maximized by balancing the marginal costs and benefits of any additional unit of debt, we are talking about trade-off models. In particular, such models include not only the trade-off connected to the expected bankruptcy costs, but also the agency costs: since debt financing (and the related costs of failure and financial distress) was already common as a financial source before the introduction of the tax deductibility of interest payments, there should also be other important determinants of capital structure decisions, which can be identified in the agency costs between shareholders and managers and shareholders against debtholders, whose dissertation have been already treated in the previous chapter (Jensen, Meckling, 1976).

To sum up, the static Trade-off Theory explains that an optimal capital structure chosen by a firm is determined by the trade-off between the tax advantage of debt and several costs related to the financial leverage, especially the expected costs of financial distress. This theory implies that companies with a greater risk of facing financial distress will tend to borrow less than firms having greater financial health; moreover, the costs of financial distress are not the same for each firm, since they primarily depend on a company’s assets and will be determined by how easily can be transferred the ownership of such assets. Instead, with respect to the tax advantage of debts, it is easy to understand the higher the tax rate, the greater the incentive to borrow for firms. This static trade-off approach has dominated the general thinking about capital structure in the finance literature for a long time, however it suffers from some shortcomings resulting from the empirical evidence: the most important is that many large, financially sophisticated and highly profitable companies do not use a high proportion of debt in their financing. This is in contrast with the static Trade-off Theory which assumes that those firms should use relatively most debt, but it might be explained by thinking that

such companies face a relatively little risk of bankruptcy and so they might enjoy high tax advantages from the interest tax shield (Bowen, Daley, Huber, 1982).
However, it is also because of those shortcomings that Myers developed his Pecking-Order Theory of capital structure in contrast with the static trade-off framework, but however, before that the Trade-off Theory was reworked under a more dynamic view.

2.1.2 The dynamic approach

From the previous chapter is reminded that Myers found inconsistent the existence of a target debt ratio as stated by the static Trade-off Theory, because the several analyzes he performed showed a substantial divergence between the firm's theoretical optimal debt ratio and the actual results tested; in particular, he highlighted the necessity of including into the financial models the *adjustment costs* as important factors shaping the capital structure observed in the companies. Indeed, such costs actually exist as a result of the adjustments made by the firm toward its optimal debt ratio, which are due to all the random events that let the company deviate from its optimum and that cannot be eliminated when considering capital structure models, as it can be observed in any cross-sectional dispersion of current debt ratios within a sample of companies having the same target ratio. Hence, those variations from the results predicted by the static models can be explained by the presence of several adjustments costs forcing the company to operate far from their optimal ratios: the issuance and repurchase of debt is costly in the real world, so the firms whose level of indebtedness is different from their targets will adjust their capital structure only when the benefits of such adjustment actions will exceed the associated costs. Therefore, the dynamic trade-off models state that companies have an optimal debt ratio range where the leverage ratio varies, because the frictions and imperfections of the capital markets make it sub-optimal to continuously adjust the capital structure to the predetermined target, so companies weigh the actual benefits of adjusting their level of leverage with the related adjustment costs and make such changes only when the benefits are higher than the costs (Fischer, Heinkel, Zechner, 1989).
In particular, companies make adjustments to their level of leverage when the proportion of debt financing reaches either one of the two boundaries of the range chosen by managers, which depend on several corporate features such as the

profitability of the assets employed, the cash flows volatility, the level of the interest rates faced and the consistency of the expected bankruptcy costs; beyond the upper and lower bound it is beneficial for firms to adjust the leverage ratio closer to the target. There are different types of adjustments costs, and each one will determine the level of adjustments made by the firm to its capital structure: proportional costs will lead to small adjustments, while fixed costs imply large adjustments around the target set by the firm (Barclay, Smith, 2005).

Several researches embrace this point of view: in particular, some scholars developed models in which the investing and financing decisions are two interrelated aspects of a simultaneous process where companies tend to converge to a given target debt ratio in the long term, by gradually moving towards that through partial adjustments because of the presence of market imperfections. Here, such interdependence between the decisions of investing and the financing choices is represented by the linear relationship between changes in the level of assets and the variation of liabilities, as it is shown by the equation (2.2):

$$\Delta A_t = \Delta LD_t + \Delta SD_t - \Delta LIQA_t + \Delta CP_t + (E_t - DIV_t) \qquad (2.2)$$

So, here can be noticed that changes in company's assets (ΔA_t) correspond to the total amount of financial sources required by the firm and are given by the variation of both long-term debt (ΔLD_t) and short-term debt (ΔSD_t), the decrease of the liquid assets ($\Delta LIQA_t$) the issuance of new shares (ΔCP_t) and the retention of net earnings ($E_t - DIV_t$). This model shows the existence of an endogenous process based on a dynamic behavior through partial adjustments directed towards the target debt ratio, and it has been confirmed by several empirical results (Jalivand, Harris, 1984).

There have been further developments in this field throughout the years, so that it is possible to summarize the main predictions of dynamic trade-off models with respect to five most important factors:

- **Tax rate**: with a higher tax rate, the optimal debt ratio will increase because of the larger tax benefits of debt that make the active debt management more profitable and likely to decrease the restructuring level of assets. However, there

will be also a higher likelihood of bankruptcy, as larger taxes are reflected in higher coupon payments.

- **Volatility**: with a higher volatility the company will increase its optimal leverage range to minimize the transactions costs associated with a frequent rebalancing.
- **Interest rate**: if the interest rate increases, the optimal debt ratio becomes higher as well and the active debt management more advantageous. Indeed, although the tax benefits are not influenced because larger coupons are offset by higher discount rates, the present value of the expected costs of bankruptcy is reduced and the net effect is therefore positive.
- **Adjustment costs**: a higher level of adjustment costs clearly make the active debt management more expensive, so to reduce the target debt ratio and to widen the range of no recapitalization.
- **Bankruptcy costs**: if the costs of financial distress increase, the firm will issue a lower level of debt because of its higher riskiness and therefore the likelihood of default will be reduced. In particular, the lower bound of leverage range will be reduced because the costs of increasing debt will be higher, which in turn enhance the restructure level on assets. Similarly, expected bankruptcy costs are larger for firms whose earnings are more volatile, thus leading smaller and less diversified companies toward lower target ratios.

An interesting property of the dynamic Trade-off Theory concerns the invariance of the optimal leverage to the firm size; however, the tax advantages of debt are the same for all the firms, while the adjustments costs might let companies behave differently depending whether they are fixed or proportional. For small firms, the costs of adjustments are usually higher than the related benefits if such costs are mostly fixed, so that smaller companies should have wider leverage ranges (Dudley, 2007).

2.1.3 Empirical evidence

The Trade-off Theory has remained the dominant capital structure theory for a very long time in finance literature, because it shows a certain degree of flexibility and compelling statements, especially the dynamic version. However, the empirical evidence of this theorem has often been questioned: in particular, Myers did not find any

evidence of the static trade-off framework when he analyzed samples of firms, in which he noticed that the actual debt ratios used to diverge from the optimal leverage theorized, thus concluding that other capital structure determinants were not included in the model. As a consequence, he built his Pecking Order theory on the assumption that the issues related to the informational asymmetry, the agency costs and other financing expenses overwhelm the forces that determine the optimal debt ratio in the static Trade-off Theory, so that the results predicted by the latter should be inconsistent (Myers, 1984).

However, if financing costs do not overcome other factors, the Trade-off Theory survives because companies weigh carefully all costs and benefits when setting leverage targets. In particular, companies prefer setting leverage and dividend payout targets below their no-adjustment-cost optimal values in order to reduce the need to issue risky securities or to avoid losing profitable investment opportunities. This is the starting point of the analysis conducted by Eugene Fama and Kenneth French in their paper *"Testing Trade Off and Pecking Order predictions about Dividends and Debt"* (2002), perhaps one of the most important in this field of research that was aimed at testing the validity of the implications of both Trade-off and the Pecking Order models, as both make similar predictions about the company's profitability. By applying a cross-sectional regression approach on the exogenous drivers of the target leverage level, namely the profitability of the assets employed, the amount of investment opportunities, the level of the interest tax shields and the volatility of earnings, they tried to address the conclusions of the Trade-off Theory, for which agency costs, tax expenses and bankruptcy costs drive more profitable companies towards higher levels of book values of debt, as well as larger investment opportunities lead to lower level of leverage (both at market and book values) because firms have stronger incentives to avoid underinvestment and asset substitution inefficiencies arising from the conflict between shareholders and debt holders. The results obtained contrast the static trade-off framework with respect to the first point of analysis, because they found that more profitable companies are usually less leveraged, hence aligning with the Pecking Order Theory that associates firms with larger earnings to lower debt ratios. However, the authors also found a strong evidence that a higher level of investments is positively related to the market value of leverage: this result supports both Pecking Order and Trade-off models about how the agency conflict between equity holders and

debtholders affect target leverage when the debt capacity depends on the market value of the assets in place. To sum up, Fama and French identify weaknesses for both the Trade-off Theory (the negative relation between leverage and profitability) and the Pecking Order Theory (the large equity issues by small companies with low proportions of debt). Instead, the several shared predictions of the two models tend to perform well in their tests, but at the same time it is not clear whether such results can be attributed to either one theory or the other one, or both of them (Fama, French, 2002).

Anyway, despite some criticisms, the Trade-off Theory is widely accepted in the finance literature, as dynamic trade-off models show a certain robustness hard to reject and often empirically proven. Among the several researchers, the result obtained by Evan Dudley are particularly important for the relevance of dynamic trade-off frameworks: he adopted a non-linear econometric model with thresholds varying with respect to the company's level of profitability, the risk free rate, the amount of investment opportunities, the volatility of the stock price and the firm size. The aim was testing the determinants of the optimal leverage range chosen by firms and evaluating what occurs when the level of indebtedness reaches one of the boundaries of such range, and the obtained results support the predictions of the dynamic Trade-off Theory, as the optimal debt ratio is either increased by higher volatility or reduced by the rise of the risk free interest rate and the level of profitability, while the contradictory results for bankruptcy costs can be explained by including also the agency costs in the model. Moreover, companies seem to under-adjust their level of debt when reaching the extremities of their range, while firms with higher level of profitability tend to enlarge their indebtedness more when the debt ratio achieves the lower boundary of the range: this is consistent with the dynamic trade-off models in which the fiscal benefits of debt are balanced against the expected costs of financial distress when considering capital structure decisions (Dudley, 2007).

2.2 The costs of financial distress

So, the situation of financial distress occurs when a company faces increasing difficulties in repaying its debt obligations according to the credit terms set up by the lenders; indeed, when the level of leverage starts to be particularly high, the cost of debt increases because of the greater risk faced by banks and investors for investing in such company, and therefore the debt burden becomes quite heavy for the firm. Moreover, as it has been already discussed in the previous chapter, the company might struggle in finding new external financing as potential lenders may decide to not invest in an over-leveraged firm, as well as also the cost of equity rises. If the company is not able to solve or at least mitigate its financial distress, it will probably go into bankruptcy and got its assets liquidated among its creditors; especially, the point of financial distress is usually achieved when the EBITDA generated by the firm is lower than its financial expenses. This situation happens quite often in the real world, especially to smaller companies or firms at the initial stage of their business life-cycle or those with higher potential to growth: in all these situations the cash flows are strongly volatile and so investors must apply a higher cost of debt (Pindado, Rodrigues, 2005).

There are several costs associated with this situation, that are commonly known as **costs of financial distress**: they have been already introduced, firstly when talking about Myers' Pecking Order Theory and later during the explanation of the Trade-off Theory, but in this section will be provided a detailed insight into their nature, their features and the different kinds of costs involved.

2.2.1 Direct costs of bankruptcy

Since not all the costs of financial distress are directly observable and measurable, the literature has traditionally divided them in two different categories, depending on whether the event of bankruptcy has already incurred or not: direct (ex-post event) and indirect (ex-ante event) expenses. This distinction is particularly important because direct costs emerge every time there are transaction costs related to conflicts between different classes of claimholders, while the presence of indirect costs depends on the market setting and upon the circumstances that characterize the distress of a certain company, before the final bankruptcy and liquidation, so they are actually hard to track and measure as they are considered to be opportunity costs due to the consequences of running a firm's operations.

First of all, the **direct costs of bankruptcy** usually vary across the different kinds of firms, but they typically include the legal fees for lawyers, accountants and other professional figures, and all of the other expenses and cash outflows arisen at the moment of the declaration of bankruptcy, including the amount of interest not already paid. Therefore, unlike the indirect expenses of financial distress, for direct costs is always available a certain degree of quantitative information to calculate their actual value.

The bankruptcy proceedings are characterized by the extensive use of economic agents by each of the parties involved with the company's activities, who are aimed at maximizing their own wealth and benefits resulting from the process, including accountants, lawyers, several professional consultants and other witnesses related to closing out the business; each of them must be paid for the services performed for their clients (the different groups of security holders). In particular, the Law states that each agent who provides professional services during the bankruptcy process must receive the approval of the court for his compensation; this might increase the difficulties related to their estimation in cases in which there are decades of parties involved in the process. Also for this reason, the court of justice is required to list all the fees paid in order to make it possible the analysis of the direct costs of financial distress, even if those data sometimes cannot be accessed because of the incompleteness or unavailability of the court records (Warner, 1977).

Despite these limitations, direct evidence for the examination can be found quite easily, and the first one to attempt a measurement of the direct costs of financial distress was Jerold Warner in his article *"Bankruptcy Costs: some evidence"* in 1977, who made a research aimed at evaluating if such expenses were actually able to affect the financing choices made by the companies. So, in his model the author wanted to examine that evidence by employing bankruptcy cost data collected from the Interstate Commerce Commission regarding 11 failed firms of the railroad industry: such cost data include the payments to all the parties involved for legal and trustees' fees, professional services and filing fees, but not any compensation to the employees for the time spent in managing the procedure.

Below are summarized the obtained results: the average length of time taken by the bankruptcy process is about 13 years, while the average direct costs of distress equals $1.88 million.

Image 2.2: Evidence from Warner's sample of firms

FIRMS IN THE SAMPLE

Name	Number of Years in bankruptcy	Bankruptcy cost, millions of dollars
Chicago and Northwestern	11	2.14
Chicago, Indianapolis, and Louisville	14	0.82
Chicago, Milwaukee, St. Paul and Pacific	11	2.89
Chicago, Rock Island and Pacific	16	2.00
Denver and Rio Grande Western	13	1.37
Erie Railroad	4	2.22
Minneapolis, St. Paul & Slt. Ste Marie	7	0.95
Missouri Pacific	23	2.54
New York, New Haven and Hartford	13	2.15
St. Louis San Francisco Railway	15	2.34
Western Pacific Railroad	10	1.24
High	23	2.89
Low	4	0.82
Mean	12.5	1.88
Median	13	2.00

(Image source: Warner, 1977)

However, Warner argued that the bankruptcy costs should not be measured at the time of failure, rather as a fraction of the firm market value when the company originally made its financing choice, in order to properly represent the trade-off between those relevant expected costs of distress with the interest tax shields. To do so, Warner considered the firm market value as the sum of the market values of both debt and equity securities traded 84 months before the bankruptcy filing, against which were compared those direct costs previously found: despite the observed direct costs tend to be higher in absolute terms for those companies with higher market value, the empirical evidence stated that such expenses do not seem to be directly proportional to the firm market value and there should be some substantial fixed costs associated with the failure process of the railroad industry, and so also some economies of scale with respect to the costs of bankruptcy. Moreover, by comparing the *expected* costs of distress with the firm market value during the 7 years period, Warner did not notice a significant rise in their percentages (ranging from 1% around 84 months before the filing to 5,3% at the moment of failure), thus leading to the conclusion that the direct costs of bankruptcy cannot be completely ignored but they do not significantly affect the firm value, especially in comparison with the benefit given by the interest tax shield (Warner, 1977).

Image 2.3: Warner's evidence about the size of bankruptcy costs

I.C.C. Reported Bankruptcy Cost as a Percentage of Market Value

Name	Month 0	−12	−36	−60	−84	Cost as % of change in value
Chicago and Northwestern	2.7	1.4	2.4	0.6	0.6	0.7
Chicago, Indianapolis & Louisville	6.6	9.4	1.9	1.6	1.6	2.2
Chicago, Milwaukee, St. Paul & Pacific	3.8	2.1	3.7	0.8	0.4	0.4
Chicago, Rock Island and Pacific	1.7	1.9	0.4	0.4	0.6	0.8
Denver and Rio Grande Western	8.9	5.5	5.1	1.6	1.5	1.7
Erie Railroad	3.9	1.1	1.3	2.5	1.0	1.4
Minneapolis, St. Paul & SSM.	9.1	2.9	3.7	3.2	1.0	1.2
Missouri Pacific	3.3	1.7	0.6	0.8	1.3	2.1
New York, New Haven and Hartford	3.9	2.2	1.5	1.1	0.6	0.8
St. Louis San Francisco Railway	6.0	9.8	0.8	0.6	0.9	1.0
Western Pacific	8.8	6.5	5.9	2.3	1.5	1.8
High	9.1	9.8	5.9	3.2	1.6	2.1
Low	1.7	1.1	0.4	0.4	0.6	0.4
Mean	5.3	4.0	2.5	1.4	1.0	1.3

(Image source: Warner, 1977)

So, Warner was the first one to suggest that such direct expenses have a relatively insignificant impact on the pricing of claims and on the capital structure prior to bankruptcy: after him, further scholars have strengthened those findings and especially Lawrence Weiss has conducted several analyzes in this field throughout the years. In his work *"Corporate Bankruptcy: Economic and Legal Perspective"* in 1990 he used three different measures to assess the magnitude of direct costs of bankruptcy:

- The market value of equity.
- The book value of debt plus the market value of equity.
- The book value of total assets, measured at their value at the fiscal year prior to the bankruptcy filing.

Of course, only the largest companies in the sample used by the author had publicly traded debt (which represents in any case only a part of the total amount of borrowed funds), so it was adopted the book value of debt as a proxy for its market value; moreover, the use of the book value of total assets guarantees that results are not overstated by the significant decline in the market value of equity before the bankruptcy filing. In the end, Weiss discovered that, on average, the direct costs of financial distress sum up to the 20,6% of the market value of equity, the 3,% of the book value of debt

plus the market value of equity and the 2,8% of the book value of total assets (Weiss, 1996).

Those results confirmed the general thinking that direct costs of bankruptcy should be quite low compared to the firm value, so that trying to cut them would substantially be a waste of resources. The same author had already reached such conclusion in a previous work, where he examined the process of bankruptcy for 37 companies listed in the NYSE and AMEX, that filed petitions under the 1979 Bankruptcy Code between 1979 and 1986. So, by covering a wide range of industrial firms, his research was the first one to analyze such bankruptcy expenses under the new Code and it showed that the average of direct costs is 3,1% of the book value of debt plus the market value of equity at the end of the fiscal year previous the bankruptcy. These findings denied the previous literature stating that direct costs should range from 4% to 15% and demonstrated the validity of the results achieved by Jerold Warner (Weiss, 1990).

2.2.2 The indirect costs of financial distress

Apart of the direct costs of bankruptcy, the financial distress of a company is characterized by several types of indirect costs arising ex-ante the event, as a consequence of the increasing awareness that the firm will be going into bankruptcy. Indeed, when a company is facing financial distress, conservative managers may decide to restrict the amount of expenditures on research and development, marketing campaigns and other types of long-term investments in order to save as more cash as possible; the firm might also incur opportunity costs if managers decide to forgo risky projects, so that the level of potential profits will be inevitably reduced. Also, a company in financial distress may suffer reputational damages, in the forms of loss of customers, larger cost of capital to pay, less favorable trade credit terms received from suppliers, or higher vulnerability with respect to the competitors' moves in the marketplace (Wilkinson, 2013).

To explain more in details, the **indirect costs of financial distress** consist of various forms of opportunity costs which can be summarized in four main classes:

1. Loss of sales and lower value of the inventory: the customers might become worried about the likelihood the company will cease its business, so they will

start to stop buying its goods or services and become concerned about assured supply or warranties.

2. Loss of credits and stagnating financing: both equity holders and debtholders will be less willing to take the risk of investing in an already highly leveraged firm, so they will decide to reduce their capital provided. In such conditions, the company will be probably forced to abandon valuable investment opportunities.
3. Higher operating costs: the firm may lose valuable employees or decide to pay them higher compensations to remain involved with the business. Moreover, suppliers may shift to unfavorable credit terms to protect themselves from the company's risk of insolvency, leading to an increase in the net working capital and in the overall cost of capital.
4. Decline in the corporate competitiveness: in a situation of financial distress managers are focused only on the actions necessary to avoid the bankruptcy, thus paying lower attention to the competitive strategies. This increased weakness in the marketplace will be probably going to be exploited by competitors.

In certain industries a rise in the indirect costs of financial distress may bring in catastrophic consequences and completely erode the firm value, especially for companies specialized in long-term goods and services, whose most important attributes concern the quality perception, the interaction with complementary goods or services, or the provision of customized long-term services (Weiss, 1996).

The literature on financial distress has primarily focused on the direct costs of bankruptcy, but since the 90's scholars have begun to include the ex-ante indirect costs as a pretty important source of financial distress, leading to the development of models no longer limited to the study of bankrupt firms. This enlargement of the point of view finds his roots in the growing awareness that bankruptcy is just one of the possible outcomes of a situation of financial distress because it shows only the legal nature of the process, without providing with any significant economic or financial consequence. Instead, companies usually start to suffer the effects of the financial distress some years before the declaration of bankruptcy by getting into a negative cycle characterized by increasing operational difficulties and lack of financial flexibility (Ward, Foster, 1997).

These are the reasons by which is probably better to define more widely the financial distress as the *"non-sporadic situation where firms can no longer meet their liabilities when they become due, and either break their commitments with creditors or face them with severe difficulties"*. In this way it is clearly included the role of the indirect costs of financial distress, which have been considered as opportunity costs quite difficult to observe and measure in nature since the first attempts made by Jerold Warner in 1977. Despite the measurement struggles, Edward Altman in 1984 tried to find an estimation by comparing companies with the sales performance of their industries, because he noticed that sales variables are less affected by the specific institutional features than either net earnings or market values. That work has been relabeled by Tim Opler and Sheridan Titman, who developed a model in which the financial distress of a firm is being measured by comparing the growth rate of its corporate sales with the growth rate of its specific industry, basing their research on the tendency adopted by highly leveraged companies to reduce their market share because of sales' decline even if they do not get actually into the bankruptcy process. More specifically, their model shows that firms in the top leverage decile in industries facing contractions in the final output suffer a decline by 26% in their level of sales more than do companies in the bottom leverage decile; they also face a similar reduction in the market value of equity. So, by analyzing a sample of 105.074 firms in distressed industries (and the choice of distressed industries rather than single distressed companies can minimize the causality problem that makes it complicated the interpretation of the previous researches), the authors found out a significantly positive relationship between the financial condition and the corporate performance in downturns, during which companies with higher indebtedness tend to reduce their market share and operative earnings than their competitors; this relationship tends to increase with larger expenditures in R&D and with a greater industry concentration.

Image 2.4: First evidence about indirect costs of distress

	Mean Bankruptcy Rate (%)	Mean Merger Rate (%)	Mean Rate of Exit for Other Reasons (%)
Poor industry			
Leverage deciles 8–10	6.5	12.1	3.4
Leverage deciles 1–7	2.7	11.4	5.6
Normal industry			
Leverage deciles 8–10	3.9	10.0	2.4
Leverage deciles 1–7	2.0	13.9	1.7

(Image source: Opler, Titman, 1994)

These findings seem consistent to the theories by which sales losses might be partially driven by customers or competitors rather than other factors, as well as companies with specialized and more customized products or services are more vulnerable to the consequences of financial distress, thus leading to the conclusion that indirect costs do exist and they significantly affect the performance of levered firms. Although the authors do not believe that the ex ante financial decisions are the only determinants of the distress, as it might be due to either bad luck or poor management choices, their work has achieved outstanding results in the finance literature by demonstrating the existence and the importance of the indirect costs of financial distress (Opler, Titman, 1994).

2.3 The insolvency risk

In the previous section was examined the nature and characteristics of the different types of the costs of financial distress, but in the Trade-off Theory the tax benefits of the use of debt are balanced against the *expected* costs of bankruptcy, that are basically calculated by multiplying the amount of both direct and indirect costs of financial distress by the company's risk of insolvency. So, while the bankruptcy concerns the legal outcome of the financial distress in which the insolvent firm or person is required by the court to close out the business and pay off his creditors in some way, the **insolvency** is a slightly different concept, meaning that situation due to financial

distress in which an individual or entity is no longer able to pay his debt obligations. In particular, there are two distinct concepts of insolvency: the first one refers to the inability to pay debt obligations when they are due, while the other one is defined as the situation in which the entity's liabilities exceed its assets, referring more on the case when the present value of the future cash inflows is smaller than the present value of the amount of principal and interest that are due. Of course, it is pretty important trying to measure the likelihood of failure for a firm because such assessment would be likely to determine the payout distribution associated with the claimholder's investment and the amount of expected distress costs (Beaver, Correia, McNichols, 2010).

Obviously, if a firm fails to make a single repayment, it does not mean the failure of the business or the beginning of the bankruptcy process, but it is likely to increase the probability of insolvency that will be enhanced every time the firm will raise more debt financing. Therefore, the **risk of insolvency** (or risk of default) can be defined as the likelihood that the firm's cash flows will not be sufficient to cover debt obligations when they will become due, so it is positively correlated with the amount and volatility of the firm's operating cash flows. Throughout the years have been developed several methods for estimating the risk of insolvency, that will be briefly shown in this section.

2.3.1 The use of financial ratios

The earlier researches aimed at predicting and evaluating the risk of insolvency were focused on the application of financial ratios as useful tools for the estimation of an individual company's failure through univariate analysis. It is particularly important the works developed by William Beaver, who reshaped the analysis made by other scholars (especially Paul Fitzpatrick, who discovered persistent differences in financial ratios between financially healthy and financially distressed industries) about the role of financial ratios and developed a kind of "liquid-asset-flow model" to better explain the ratios being tested, in which the company is considered as a reservoir of liquid assets, so that insolvency is defined in terms of the probability that such reserve might be gradually exhausted until arriving at the point in which the firm is not able anymore to meet its obligations when due. In that model, the author concluded that the probability of default is negatively correlated with the size of the reservoir (the amount of liquid assets) and the level of the net liquid-asset flow from operations, which measures the

net level of liquid assets supplied to (or taken from) the reserve by the ongoing operations; instead, it is positively associated with the proportion of debt borrowed and the level of fund expenditures for operations. So, these multiple implications have been used by Beaver in his first work in 1966, *"Financial ratios as predictors of failure"*, to make predictions with respect to the mean values of the six financial ratios included in the model:

1. Cash Flow / Total Debt
2. Net Income / Total Assets
3. Total debt / Total Assets
4. Working Capital / Total Assets
5. Current ratios
6. No-Credit Interval

By employing a sample of both failed and non-failed firms and the information disclosed in their financial statements (in a period for five years before the failure for the companies of the first category), Beaver discovered that failed firms have a lower level of cash flows and a smaller reserve of liquid assets than non-failed companies, and they also tend to take more debt even if their ability to meet obligations is lower (Beaver, 1966).

This analysis of financial ratios as predictors of financial distress primarily depends on the nature of likelihood ratios, as predicting financial distress can be considered similar to the assessment of the probability of financial distress (FD) conditional upon the value of a ratio (or set of ratios) — P(FD|R). In estimating conditional probability of financial distress, the possible events become dichotomous because the company will either experience financial distress (FD) or it will not (NFD). After the observation of financial ratios, the likelihood of both financial distress and not distress is then assessed: in particular, the **likelihood ratio** is the probability that the observed numerical value of the financial ratio would appear if the firm were financially distressed — P(R|FD) divided by the probability that the specific value of the ratio would be observed if the firm were not distressed — P(R|NFD). The joint probabilities are given by the product of the prior probabilities multiplied by the likelihood estimations, while their sum gives

the marginal probability, P(R), which means the probability that a ratio of such observed numerical value could happen.

So, Beaver found a remarkable level of consistence for the data whit his theory and the previous researches, and he demonstrated the validity of the ratio analysis for predicting the financial distress, at least for five years before the failure (the period covered by the analysis), although he found out that some ratios work better than others: for example, the liquid asset ratios show a much weaker predictive power than the cash flow-to-total debt ratio throughout the whole period of analysis. Furthermore, the ratios cannot estimate the failure and the non-failure of companies with the same degree of success, thus implying that investors will not be able to completely remove the possibility to invest in a firm that might go into bankruptcy over the years (Beaver, Correia, McNichols, 2010).

Later, the use of simple financial ratios was criticized because managers can manipulate quite easily their results in order to distort decisions; this is one of the reasons why Beaver carried out the classification test using the dichotomous prediction previously explained. Through such method, is it possible to identify several financial indicators endowed with the highest predictive power that can be used as a predictor with multiple degrees of freedom. Univariate analysis was then gradually replaced by the multivariate analysis conducted by further scholars, as will be explained in the next paragraph (Horváthová, Mokrišová, 2018).

2.3.2 MDA and Altman-Z Score Model

Although the importance of profitability, solvency and liquidity ratios as predictors for bankruptcy has been confirmed by the mentioned studies, the validity of their results for evaluating the likelihood of financial distress for companies is quite questionable, especially because of the univariate nature of the methodology applied that makes the financial ratios analysis susceptible to misleading interpretation for the assessment of default risk. For example, a firm with a poor level of profitability and solvency record may be likely to get into a potential bankrupt, but the situation might not be considered so serious because perhaps its liquidity is above the average level. The potential ambiguity of this methodology is clearly evident, because it depends on which ratios

have to be considered more important for the assessment of bankruptcy risk, thus leading to the necessity of more developed models.

For these reasons, the **multiple discriminant analysis (MDA)** has started to be utilized as more appropriate technique for the evaluation of the potential for the bankruptcy, as it is a statistical tool used to classify an observation into one of several groupings (a priori defined) depending on the observation's individual characteristics, so it primarily concerns the classifications and predictions in problem where the dependent variable appears in qualitative form, like also being bankrupt or non-bankrupt. So, first of all must be selected the different group classifications, than data are collected for the objects (in this case, corporations) in the groups and is than derived a linear combination of these characteristics, like financial ratios for instance, which "best" discriminates between the groups. The MDA technique has the advantage of considering simultaneously an entire set of characteristics that are common to all the companies, and also the interaction between them, while a univariate model is only able to examine sequentially the groups' individual features (Altman, 1968).

So, by choosing the MDA as the most appropriate technique, in 1968 Edward Altman elaborated a model for the assessment of the financial distress known as the **Altman Z-Score model**, which has been further modified throughout the years but it has been the dominant model all over the world, and even now is the main method for the estimate of companies' default risk. So, this technique measures an entity's probability of default within two years through the simultaneous use of multiple financial ratios to get a complete assessment of the firm as a whole, instead of looking at them independently. The ratios applied measure the liquidity, profitability, leverage and operational activity of the company: each of them is likely to convey important information and points of risk on its own, but the most appealing feature of the Z-Score model is the measurement of the overall risk of the company. The original version was developed for public companies, than Altman elaborated two additional Z-Score models: one for private manufacturing companies and another one for private non-manufacturing firms (Jude, 2016).

In the first model derivation, Altman employed a sample of 66 firms divided in two groups of 33 companies each one: the first group was composed by manufacturers that filed a bankruptcy petition during the period from 1946 to 1965, while the second one consisted of a paired group of manufacturing companies chosen on a stratified random

basis. So, for the assessment of default risk, the model adopted a discriminant function (Z) with five weighted factors:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5 \quad (2.3)$$

- $\boldsymbol{X_1}$ **- Working Capital / Total Assets** = measures the liquidity of the firm's assets relative to its total capitalization. The working capital is commonly defined as the difference between current assets and current liabilities; generally, a firm facing consistent operating losses will have reduced current assets with respect to the total assets.
- $\boldsymbol{X_2}$ **- Retained Earnings / Total Assets** = this is a measure of the cumulative profitability over time, which also includes the age of a firm. For instance, a relatively young firm will probably show a low measure because it has not had enough time to cumulate profits. This is precisely the situation in the real world, as the incidence of failure is much higher for companies at the earliest stages of their business life.
- $\boldsymbol{X_3}$ **- EBIT / Total Assets** = this is a measure of the productivity of the corporate assets, without considering any tax or leverage factors. The survival of a firm is usually based on the earning capacity of its assets, hence this ratio should be particularly appropriate for dealing with the corporate failure. Furthermore, the insolvency occurs when the company's total liabilities exceed its total assets with the value determined by the latter's earning power.
- $\boldsymbol{X_4}$ **- Market Value of Equity / Book Value of Total Debt** = here, equity is measured by the combined market value of both preferred and common shares of stock, while debt includes both current and long-term obligations. This ratio measures how much the firm's assets can decrease in value before getting exceeded by liabilities and so the company becomes insolvent. Moreover, this factor includes a market value dimension not considered by the previous studies, so it is likely to enhance the effectiveness of bankruptcy's predictions.
- $\boldsymbol{X_5}$ **- Sales / Total Assets** = this measure shows the ability of the corporate assets to produce sales, so it deals with the competitive dimension of the firm. This final ratio is quite important because, despite it might be the least significant measure on an individual basis, it shows a unique relationship with

the other variables in the model, hence it ranks second in the contribution to the discriminating ability of the overall model.

So, the Z-Score gives different interpretations about the company's default risk according to three scoring ranges: if Z is above 2.99, the bankruptcy is than not likely to occur. A score between 2.99 and 1.81 is known as the *grey zone* (because of the susceptibility to error classification) where default may happen but is not imminent, so that managers are still able to take corrective actions. Lastly, if the score lies below 1.81 the firm actually finds itself in a situations of financial distress and it is likely to file for bankruptcy within two years.

This model demonstrated an extreme accuracy in predicting bankruptcy for 94% of the initial sample; also, the robustness of discriminant function had been tested in several secondary samples aimed at proving the reliability of the model, which can be used for several practical and theoretical applications, including business credit evaluation, internal control procedures, and the setting of investment guidelines. Indeed, if used correctly and periodically, the discriminant function has the ability to assess the company's present condition and to predict corporate problems early enough so to let management be aware about the gravity of the situation in time to avoid failure, or at least to warn the firm's creditors and shareholders if the default results unavoidable. Moreover, given its nature as an efficient predictor of financial issues, the Z-Score model could also be used as a valuable tool for screening out undesirable investments (Altman, 1968).

This model has been modified and improved many times over the years, especially under the aim of making it more suitable to different specifications and corporate situations. For instance, for private non-manufacturing companies the Altman model is slightly different as factor 5 (Sales / Total Assets) is omitted and there are also different weighting and scoring ranges: there, a score above 2.6 indicates strong likelihood of bankruptcy, which is instead considered to be unlikely for any score under 1.1, while the grey zone ranges between 2.6 and 1.1. Furthermore, in 1995 was developed the **Z-Double Prime Model** in order to analyze the solvency and assess the rating level to corporations located in BRICS countries; also because of that, nowadays one of the most widespread application of the Z-Score is to analyze the variances between the level of rating disclosed by international agencies (when available) and that one assessed by

the Altman's model. The author himself performed multiple tests from 1968 to 1999 in order to demonstrate the robustness of the Z-Score model on samples of distressed firms, collecting a validity of around 80-90% in all tests.

To sum up, it is easy to recognize that the Z-Score Model can provide several advantages. Firstly, all the inputs are easily available on financial statements, so that they can be collected and interpreted quite easily, without any particular assumptions or the need to rely on market data; this makes the model easy to understand, as the final score necessarily falls into one of those three categories. Hence, this model is perfectly suitable for investors, credit analysts, auditors and all the categories of agents interested in the assessment of a firm's risk of bankruptcy (Jude, 2016).

2.3.3 The non-linear regression approach: Logit and Probit models

Despite the evident benefits of the Z-Score Model and the whole MDA, it is necessary to point out that discriminant analysis is valid only under certain restrictive assumptions, thus showing some important statistical shortcomings: firstly, the model requires that all the explanatory variables must follow a multivariate normal distribution, but this assumption has been proved to be regularly violated by data from real world. After that, several scholars have questioned the indication of the preceding likelihood of distress and misclassification costs, as well as the main tendency of equal variance-covariance matrices across groups. Therefore, because of such various limitations of the discriminant analysis, researchers have gradually started to focus on other techniques for predicting the default risk and particularly on statistical models based on conditional probability. Among them, the **logistic regression** is a suitable technique for the prediction of financial distress, as it is a non-linear regression in which the explaining, dependent variable is not continuous but dichotomous, meaning that it can take only one out of two possible values; adapting to this context, if the firm faced financial health, the variable takes value 0, while if the company went bankruptcy during the period, the value taken is than 1. Because of these characteristics, the logistic regression is considered to be more suitable for the prediction of default risk, providing also the benefit that the likelihood of distress can be calculated also for companies without significant proportions of debt financing, and it has led to the development of the so-called Logit model and Probit model (Ohlson, 1980).

The **Logit model** is based on cumulative logistic function and it focuses on the prediction of the probability the event either occurs or not, which is therefore equal to either 1 or 0; so, Logit models assume that for any company there is a definable probability it will default, given a set of attributes upon which such probability of bankruptcy depends conditionally. This relationship can be expressed by the following function:

$$Y_i^* = \beta' x_i + \varepsilon_i \tag{2.4}$$

where:

$Y_i = 1$ if $Y_i^* \geq 0$

$Y_i = 0$ otherwise

In the equation (2.4) β is a set of regressors, x_i is a set of attributes that determine a potential bankruptcy ($Y_i = 1$) and ε_i represents the statistical error term. Given that, the probability of default for firm *i* can be calculated in the following way:

$$P_i(Y_i = 1|x_i) = F(\beta' x_i) = \frac{1}{1 + e^{-\beta' x_i}} \tag{2.5}$$

So, the logit model is able to eliminate the disadvantages of the MDA because it does not assume either the normal distribution of the independent variables or the homogeneity of the variance-covariance matrix; it is an advantageous technique when the prediction is based on which values will take some independent variables, and the result of this regression determines the probability of occurrence of two responses (yes or no, or 1 and 0) depending upon the definition of the two values of the explanatory variable. Hence, the logistic regression is capable to predict a precise outcome from variables which can be dichotomous, continuous, or even discrete, and the final response is generally categorical, stating the absence or presence of a default or survival (Jones, Hensher, 2008).

Then, an alternative method is the **Probit model**, which is substantially similar to the previous one with respect to the specification and the robustness of the obtained results, but with the main difference that is assumed a normal distribution of random

(independent) variables. In the practice there are no significant differences, if the sample of companies contains a huge amount of observations with extreme values, leading to the presence of less "fat tails" and a steeper slope in the distribution.
Despite their strong similarity, the parameter estimation of these two methods is quite different, and Logit model also shows two main advantages: a simpler distribution function (while the normal distribution function of the Probit model is much more complex) and a better interpretability of the inverse linear transformation (Klieštik, Mišanková, 2015).

2.3.4 The bond rating approach

Lastly, another significant approach more recently developed to estimate the probability of financial distress is the application of **rating models**: in particular, the risk rating consists of the categorization of individual credit facilities based on credit analysis and market conditions, into a series of categories based on a graduating level of risk, from AAA class (corresponding to an absolute capacity to repay debt) to D class (meaning the firm is insolvent). Although its use is primarily oriented to the loan pricing, the underwriting of new loans and the management of corporate and individual portfolios, it can also be adjusted to the assessment of the corporate default risk as some models use the bond rating of a certain firm and the default rate empirically observed for the companies of the same rating class to get an estimate of the likelihood of default. Indeed, many firms issue bonds which are rated for insolvency risk by rating agencies, and such bond rating is not only capable to provide valuable information about the default risk perceived by the agency, but, since bonds have been rated for several decades, the default probabilities of these securities in each rating class can be used as inputs into discounted cash flow valuation models (Damodaran, 2016).
In particular, Edward Altman and Vellore Kishore have estimated the cumulative probabilities of insolvency for bonds of different rating classes (specifically, only for AAA, AA, A, BBB, BB, B and CCC bonds) over periods of both 5 years and 10 years: as a result, the cumulative default probability for a BB bond over 10 years is equal to 16,89%.
Despite the evident advantages, the models aimed at evaluating the likelihood of financial distress through bond ratings suffer from some important limitations: first of

all, the responsibility to evaluate the default risk is being delegated to the rating agencies, but the assumption their estimates are correct is probably too optimistic. Moreover, we cannot be totally sure about the further assumption that rating criteria do not change over time, and lastly, is estimated the likelihood of default of an obligation, but it is not also indicated if the (financially distressed) company will fail at the same time (Altman, Kishore, 2001).

2.4 Models for estimating the costs of distress

So far have been introduced the different categories of the costs of financial distress and the main theories for estimating the risk of insolvency: in this way, it is possible to actually calculate the expected costs of bankruptcy in the Trade-off Theory in order to theoretically achieve the optimal level of debt in every firm. The financial literature has traditionally been full of scholars and studies aimed at estimating with as much accuracy as possible the empirical evidence of the costs and consequences of bankruptcy, so that in this section will be shown the main models used in the real world to estimate the costs of distress.

2.4.1 The Altman's analysis

As mentioned in the previous section, the financial literature has traditionally focused more on the direct costs of financial distress, which consist of the administrative and legal expenses associated with the bankruptcy process involving all the parties related to the business activity and claiming some kind of residual benefits. So, over the years several studies have agreed about the relative size and impact of such direct costs in proportion to the firm market value before the petition for bankruptcy, and the works made by Warner and Weiss have been particularly relevant in this field. However, those studies have lately received several criticisms, especially because of the total absence of any involvement and measurement of the indirect costs of financial distress, whose relevance would have been further demonstrated in the literature. Moreover, Warner

did not consider in detail the costs-benefits analysis for the companies' capital structure, as well he did not consider that the long time to fail taken on average by the firms in his sample is a peculiarity of the railroad industry, but this is not absolutely valid for all the companies (Castanias, 1983)

So, several scholars have tried to improve those first attempts in order to better measure all the different categories of distress costs, and with this regard the first significant contribute was given by **Edward Altman** in 1984 with his work "*A Further Empirical Investigation of the Bankruptcy Cost Question"*, which assesses the empirical evidence about both direct and indirect costs of bankruptcy. In particular, this paper should be considered pretty important for several reasons: first of all, it met the need to give further evidence about the size of the costs of financial distress, providing for the first time an actual proxy methodology for the measurement of the indirect costs. Furthermore, there is a comparison of a simple format for measuring the present value of expected cost of distress against the present value of the expected tax advantages from the interest tax shields, allowing important implications for the long debate about the existence of an optimum capital structure for companies.

So, this study assumes firstly the existence of the expected bankruptcy costs as an important matter when firms consider about their capital structure and make their financing decisions, so are investigated three items that will be than combined in order to estimate the expected present value of the bankruptcy costs, against which will be then compared the expected present value of the interest tax shield: the *direct costs of bankruptcy*, consisting of the legal, accounting, filing and other administrative fees; the *indirect costs of financial distress* in the form of the amount of lost profits expected by the firm because of the potential bankruptcy, and the *probability of failure* for the companies analyzed. Indeed, Altman moved from the narrow definition of distress costs given by Warner in his previous research by including also the opportunity costs of the managerial lost time spent in administering the process as a form of indirect cost of bankruptcy (not a direct one, as stated Warner) that was not previously measured, thus underestimating the relevance of the indirect costs and hence the overall amount of expenses related to the distress. So, in this model Altman employs a first sample of seven industrial firms and another one comprised of twelve retailers. While the direct costs are indentified in the explicit fees paid by the debtor in the liquidation process that are documented in the failure records of the individual companies, the indirect

costs refer to the foregone sales and profits, calculated as the difference between the expected profits for the period up to three years before the failure and the amount of actual profits earned. The expected profits are estimated in two different ways in the model: a regression technique and a security analyst forecast.

In the first method, there are three steps to be followed: first of all, the sales of the bankrupt company are regressed against the sales of the aggregate industry (computed by summing the amount of sales of the 10 biggest companies of the industry) for the 10 years-period before the forecasted year: so, by indicating with $S_{i,t}$ the amount of sales of the firm i during the period t and with $S_{I,t}$ the overall level of sales of the industry I in the period t, is obtained:

$$S_{i,t} = a + bS_{I,t} \tag{2.6}$$

Then, the industry sales are inserted for the considered period in order to determine the estimated firm sales, $\hat{S}_{i,t}$ (so that: $\hat{S}_{i,t} = a + bS_{I,t}$), which can be used to calculate the expected profits $\hat{P}_{i,t}$ trough the relationship:

$$\hat{P}_{i,t} = \hat{S}_{i,t} \times \overline{PM} \tag{2.7}$$

where $\overline{PM}$ represents the average historical profit margin on industry sales over that 10-years period. Lastly, the expected profits are compared with the actual profits, $P_{i,t}$, to estimate the amount of indirect costs of distress of that year that usually consist of unexpected losses. So, by indicating with $\Delta P_{i,t}$ the amount of unexpected profits (or losses).

$$\Delta P_{i,t} = P_{i,t} - \hat{P}_{i,t} \tag{2.8}$$

The indirect costs are compared with the firm market value for up to three years before the bankruptcy, and such market value is determined by adding the market value of equity (preferred and common stocks) and the market value of debt (where available) with the book value of other debt plus the capitalized value of financial leases; so, this measure is potentially larger than the one applied by Warner, who considered only the

market value of the securities issued by the firm. This simple linear regression between the sales of the company and those of the industry over time shows a good robustness, as the R^2 of the model is equal to 0,784 for the first sample of companies and 0,465 for the second one. With respect to the results, the overall average of the percentage of direct costs over the firm value is equal to 6% both just prior to the failure and also five years before: such costs are considerably higher than those measured by Warner, and when are added also the indirect costs, the average percentages relative to the firm value become equal to 12,1% at *t*-3 and 16,7% at *t* (despite such indirect costs were not available for some firms for some periods prior the bankruptcy, as were not expected losses). So, it seems clear that these costs cannot be dismissed as trivial, and the main results for the combined corporate sample of 18 firms are summarized by the image 2.5.

Image 2.5: Average bankruptcy costs relative to firm value in the first Altman's method

	Years Prior to Bankruptcy			
	3	2	1	0
Direct Bankruptcy Costs/Value	4.3%	4.6%	4.6%	6.2%
Indirect Bankruptcy Costs/Value	8.1%	7.1%	6.6%	10.5%
Total Bankruptcy Costs/Value	12.4%	11.7%	11.2%	16.7%

(Image source: Altman, 1984)

The second method for measuring the indirect costs of distress in this model consist of the use of security analysts earnings estimates made by some experts of the firm of Lynch, Jones and Ryan on a sample of seven recent large bankrupt companies: again, the proxy for indirect costs is indentified in the amount of unexpected or abnormal losses computed as the difference between the analyst earnings estimates for any given year (consisting of the consensus median earnings per share expectations based on the previous year's estimates) and the actual earnings realized in that year. The data base included estimates made by analysts since 1976 only for those firms followed by Wall Street professionals; since some of the failed companies were still involved in the reorganization procedure at that moment, this method did not assess the direct costs but only the indirect costs, whose percentage relative on the firm market value was on average close to 20% (and quite high for five out of seven firms in the sample) for three years prior the declaration of bankruptcy, as it is shown in the image 2.6. If are used the

average direct costs found through the previous method, the total distress costs-to-value ratio would be over 26% at three years before the petition and around 24% just prior the bankruptcy: in this sample of recent failed companies, the costs of financial distress appear to be even more significant than in the previous group of retailers and industrial firms.

Image 2.6: Indirect costs of bankrupt firms as a percentage of total value in Altman's second method

Firm	Indirect Costs (BCI) ($ millions)	Firm Total Value (V)[a] t-2	t-1 ($ millions)	t^b	BCI/V (%) t-2	t-1	t^b
Braniff Int'l	297.3	917.7	1095.6	1065.8	0.271	0.271	0.279
Itel Corp.	513.8	1279.3	1880.9	1761.3	0.408	0.291	0.319
Lionel Corp.	2.0	133.2	163.4	309.1	0.015	0.012	0.006
McLouth Steel	73.3	328.3	356.2	357.4	0.223	0.206	0.205
Sambo's Restaurants	112.6	485.1	502.2	489.0	0.232	0.224	0.230
White Motor Co.	12.2	475.9	418.2	714.0	0.026	0.027	0.017
Wickes Cos.	277.4	762.8	1489.3	1507.0	0.364	0.186	0.184
		Average (1)—Average of 7 firm ratios			= 0.220	0.175	0.177
		Average (2)—Summation of IC/V			= 0.301	0.218	0.208

[a] Total Value = Market Value Equity + Market Value Debt (when available) + Book Value Other Debt + Capitalized Leases.
[b] Period t = one month prior to petition date for Total Value.

(Image source: Altman, 1984)

So, this work made by Altman is particularly important for several reasons: first of all, it has provided the ultimate evidence about the relevance of the costs of financial distress and for the first time the indirect costs were actually measured through compelling proxies. Moreover, he specified a simple format for measuring the present value of the expected bankruptcy costs and comparing it with the present value of the expected tax benefits from interest payments under the static Trade-off Theory, suggesting important implications for the optimal capital structure debate. Such format can be written as:

$$\frac{P_{B,t}(BCD_t + BCI_t) \times (PV_t)}{\mathrm{MV_t}} \; vs \; \frac{\tau_c(iD)_t(PV_t) \times (1 - P_{B.t})}{\mathrm{MV_t}} \tag{2.9}$$

where $P_{B,t}$ is the probability of bankruptcy estimated in the period t, BCD_t and BCI_t are respectively the direct and indirect costs of distress in the period t, $\mathrm{MV_t}$ is the firm market value in the period t, τ_c is the corporate tax bracket in the period t, iD is the amount of interest expenses from period t to infinity and PV_t is the present value adjustment back to the period t. By applying this format, Altman found out that the present value of expected bankruptcy costs for the most of the failed companies exceeded the present value of the interest tax shields from the use of leverage, thus leading to the conclusion that such firms were overleveraged and so the costs of financial distress should play an important role in the considerations for an optimal capital structure (Altman, 1984).

2.4.2 The contribute of Pindado and Rodrigues

A more recently interesting model has been developed by **Julio Pindado** and **Louis Rodrigues** in 2005 in their work *"Determinants of financial distress costs"*, that was aimed at providing international evidence on the determinants of the costs of financial distress by integrating two traditionally separated lines of research: the (mainly theoretical) studies on financial distress costs and those (mostly empirical) on financial distress prediction. Such integration is based on the idea that distress costs are determined both by the likelihood of financial distress and by the costs the company incurs in case of bankruptcy; therefore, this model aims at estimating the financial distress costs, on one hand, by using a more accurate indicator of the probability of financial distress instead of the traditional measures of leverage, which leads to a deeper examination of the real effect of increasing debt financing (thus assuming that such probability can influence the corporate performance, as also Altman claimed through his linear relationship between firm's and industry's sales) and, on the other one, by a set of explanatory variables determining the magnitude of the expenses suffered by a company when occurs a situation of financial distress. Also, by taking into account the likelihood of bankruptcy, this model allows testing the trade-off between benefits and costs of debt in order to verify whether the advantages of leverage outweigh its costs.

Following the main tendencies in the literature over the last decades, in this paper the definition of financial distress wisely takes into account the initial period of

development of the whole process, when it is still possible to avoid the final state of bankruptcy and the liquidation of the assets despite bearing most of the indirect financial distress costs: since this definition focuses on the financial concept of distress, without considering its legal aspects, the indicator of the probability of financial distress here proposed is consequently not country-specific and it can be applied to different contexts. In particular, unlike prior studies, such measure of probability is based on logistic models and it is able to capture most of the impact of financial distress on performance. Indeed, since the literature has largely agreed upon the relative size of the direct costs of bankruptcy, this paper focuses on the indirect costs, which are measured by an indicator of performance. Then, the positive relationship between leverage and the probability of financial distress, and consequently also with the related costs of financial distress, has been generally accepted; however, Pindado and Rodrigues reject the too simplistic relations and therefore they assume that the positive and negative effect of leverage on financial distress costs are not mutually exclusive, rather they may offset each other, making leverage insignificant in explaining the costs of distress, so that both opposing effects of leverage should be considered in the estimation.

So, in this model the financial distress costs are explained by the rising probability of financial distress and by the consequent determinants of these costs that control for the effects of investment opportunities, sector, and firm size through a logistic regression like:

$$IC_{it} = \beta_0 + \beta_1 IPROB_{it} + \beta_2 LEV_{it} + \beta_3 LA_{it} + \beta_4 \Delta INV_{it} + (\beta_5 + \gamma_1 DEMP_{it})\Delta EMP_{it} + \beta_6 Q_{it} + \beta_7 SECTOR_{it} + \beta_8 SIZE_{it} + \varepsilon_{it} \quad (2.10)$$

where IC_{it} refers to the costs of financial distress that are measured as the difference between the sector's growth rate of sales and the company's growth rate of sales, $IPROB_{it}$ is the probability of financial distress, LEV_{it} consists of the company's leverage adjusted to its referred sector, LA_{it} refers to the level of liquid assets held by the firm, ΔINV_{it} and ΔEMP_{it} stand respectively for changes in the level of investment and employment, $DEMP_{it}$ is a dummy variable which takes value 1 if the firm's likelihood of financial distress is larger than the average probability in its country, and 0 otherwise, than Q_{it} is the company's Tobin's q value adjusted to its referred sector, $SECTOR_{it}$ is the average level of profitability of the firm's industry and $SIZE_{it}$ is the logarithm of the

company's level of sales, and ε_{it} is the random disturbance error. Hence, apart of the probability of financial distress and the ex-post costs of bankruptcy that are proxied by the level of leverage, the holding of liquid assets and the changes in investment and employment policies (all of them are linked through positive signs, confirming the expected positive relationships between the probability of financial distress and the indicators of distress costs), the econometric specification of the model also controls for the effect of three additional variables on company's sales performance. So, given the strong positive relationship between Tobin's q and all proxies for the corporate growth, a firm's investment opportunities (Q_{it}) is able to influence its expected sales growth; at the same time, are also included in the model the differences in industrial performance ($SECTOR_{it}$), because a company's performance can be only evaluated by considering the profitability trend of its sector that is measured by the industry's average EBIT. The basic idea is that if a company has valuable investment opportunities with respect to its sector, this could mitigate its financial distress costs, while the sector variable is aimed at capturing the effect of the industry's economic trend on a firm's individual performance. Moreover, following the traditional assumption based on the negative correlation between the corporate size and the volatility of cash flows, the firm's size can be used as a proxy for the inverse of the likelihood of financial distress.

Given the cross-sectional and cross-institutional scope of this analysis, was used an international database (the Compustat Global Vantage) requiring data for at least six years in a row, while the country selected are UK, USA and Germany, as they are highly representative for the global economic world thus allowing to take into account a satisfactory variety of institutional environments, especially because those three countries cover a broad spectrum of financial distress procedures, hence it is possible to examine various ways in which distress costs are influenced by different legal systems: indeed, one of the most important contributions of this research concerns the possibility to analyze how the differences in institutional contexts across various countries influence financial distress costs. Then, for each country is realized an unbalanced panel consisting of firms with six to ten year data between 1990 and 1999, while all companies are organized in nine broad economic industry groups in accordance with SIC (Economic Sector Code); the estimation results of the model by country are shown in the image 2.7.

Image 2.7: Estimated results in Pindado and Rodriguez's model

Country	*US*	*UK*	*Germany*	*TOTAL*
Explanatory variables	1704 firms.	491 firms.	186 firms.	2381 firms.
$IPROB_{it}$	0.80417*(0.1434)	0.20661*(0.04119)	0.14593*(0.02558)	0.51531*(0.1416)
LEV_{it}	−0.832149*(0.1761)	−0.330297*(0.05523)	−0.439209*(0.05347)	−0.983263*(0.183)
LA_{it}	−1.06477*(0.1294)	−1.62107*(0.03583)	−1.56152*(0.05297)	−1.02550*(0.1478)
ΔINV_{it}	−1.72876*(0.3123)	−1.71194*(0.07951)	−2.44524*(0.07831)	−2.05796*(0.3379)
ΔEMP_{it}	−19.6724(17.36)	−69.0092*(3.328)	−150.008*(5.658)	−44.0876*(12.75)
$DEMP_{it}$* ΔEMP_{it}	57.2335**(26.92)	−115.514*(6.880)	141.965*(6.805)	39.9293*(26.34)
Q_{it}	−0.020958(0.01865)	−0.071216*(0.009134)	−0.073227*(0.006894)	−0.04511**(0.02052)
$SECTOR_{it}$	−0.007426*(0.002722)	0.00692*(0.002359)	0.00037(0.001529)	−0.006927**(0.003348)
$SIZE_{it}$	0.14878**(0.05781)	−0.29941*(0.01735)	0.451465*(0.01616)	−0.14337**(0.05782)
χ^2 (1)	–	281.919*	435.164*	2.29861**
z_1	202.8 (9)	4846 (8)	3703 (9)	181.1 (9)
z_2	48.99 (8)	332.4 (8)	6859 (8)	50.92 (8)
z_3	–	–	–	57.81 (10)
m_1	−1.116	−2.972*	−1.253	−1.130
m_2	1.125	−1.032	1.260	0.7505
Sargan	230.6 (315) 1.0	339.4 (315)0.165	169.6 (315) 1.0	237.4 (315) 1.0

(Image source: Pindado, Rodrigues, 2005)

To sum up the main conclusions from this analysis, firstly, as expected, the measure for the likelihood of distress has worked better than traditional leverage-based indicators: its coefficient is highly significant and shows the correct sign for all the countries analyzed, thus providing more solid information about the consequences of the probability of distress for the related financial distress costs. Furthermore, the separation between the effect of this probability and the impact of leverage permits analyzing deeper considerations about the potential advantages of leverage in all the different cases exhibited in the model. The coefficients of Tobin's q, sector and size variables are generally significant, confirming the need to control for these effects when analyzing financial distress costs, which in turn show two main negative relationships observed in all the countries: the first one is with the holding of liquid assets, thus confirming that the benefits of keeping larger amounts of liquid assets are overcome by their opportunity cost, while the second one concerns the investment policy, so that the underinvestment is demonstrated to bring more struggles than overinvestment, as well as the labor legislation makes employment reductions an unfeasible option in a situation of financial distress. Finally, financial distress costs are also affected by institutional differences, especially with regard to their sensitivity to leverage across different countries (Pindado, Rodrigues, 2005).

2.4.3 Models based on valuation

So far have been explained the main models that have been focused on some kind of estimation of the costs of financial distress: the studies proposed firstly by Warner and Weiss and than by Altman, Pindado and Rodrigues are only some of the most important researches in this field. For the purposes of this thesis, it is important to end this section with a brief dissertation about a more recent trend aimed at linking the search for the optimal capital structure with the models of corporate valuation. Especially, in this paragraph will be illustrated the findings of an interesting paper realized by **Pablo Fernandez** in 2007, *"Valuing companies by cash flow discounting: ten methods and nine theories"*, which provides significant implications with respect to the trade-off between the costs and benefits of debt and the role played by leverage in the valuation of companies.

So, this article consists of a summarized dissertation about all the methods and theories regarding the corporate valuation using discounted cash flows: firstly are shown the ten most commonly adopted methods for the company valuation by discounted cash flows, of which the first four are the most basic and important ones:

1. Free cash flows (*FCF*) discounted at the weighted average cost of capital (*WACC*):

$$E_0 + D_0 = PV_0[WACC_t;\ FCF_t] \tag{2.11}$$

2. Equity cash flows (*ECF*) discounted at the required return on equity (*Ke*):

$$E_0 = PV_0[Ke_t; ECF_t] \tag{2.12}$$

3. Capital cash flows (*CCF*) discounted at the weighted average cost of capital before tax (*WACCbt*): the *CCF* represent the total cash flows available to all the security holders of the company, both debt and equity, and are equal to the *ECF* plus the cash flow corresponding to debtholders (*CFd*).

$$E_0 + D_0 = PV_0[WACCbt_t;\ CCF_t] \tag{2.13}$$

4. Adjusted Present Value (APV): this method indicates that the sum of the values of debt and equity is equal to the value of the unlevered company's equity (*Vu*), plus the present value of the value of tax shield (*VTS*):

$$E_0 + D_0 = Vu_0 + VTS_0 \tag{2.14}$$

If *Ku* is the required return to assets, *Vu* is given by:

$$Vu_0 = PV_0[Ku_t;\ FCF_t] \tag{2.15}$$

5. The business's risk-adjusted free cash flows (*FCF \\ Ku*) discounted at the required return to assets (*Ku*)

6. The business's risk-adjusted equity cash flows (*ECF \\ Ku*) discounted at the required return to assets (*Ku*)

7. Economic profit (*EP*) discounted at the required return to equity (*Ke*)

8. Economic value added (*EVA*) discounted at the *WACC*

9. The risk-free rate-adjusted free cash flows (*FCF \\ Rf*)discounted at the risk-free rate (*Rf*)

10. The risk-free rate-adjusted equity cash flows (*ECF \\ Rf*) discounted at the risk-free rate (*Rf*)

It is important to underline that all these methods always provide the same final value, as all of them analyze the same reality under a common set of hypotheses, while the only difference consists of the type of cash flows taken as the starting point for the valuation.

Moreover, are then analyzed nine different theories about the calculation of the value of tax shields (VTS), which in turn is reflected into nine different theories on the relationship between the levered and the unlevered beta and also about the relationship between the required return to equity and the required return to assets. Such theories are:

1. No-cost-of-leverage
2. Modigliani and Miller (1963)
3. Myers (1974)
4. Miller (1977)

5. Miles and Ezzell (1980)
6. Harris and Pringle (1985)
7. Damodaran (1994)
8. With-cost-of-leverage
9. Practitioners method

These theories differ especially with regard to the method for calculating VTS for the company valuation. Fernandez thus provided a brief overview of these models and their most significant implications for the role of leverage in the discounted cash flow valuation of firms, starting the discussion by suggesting that one of the biggest problems with most of their colleagues' works was that they considered VTS as the present value of the tax savings from interest payments, while he argued and proved that it should be the difference between the present value of taxes paid by the unlevered firm and the present value of tax payments made by the levered firm. In particular, it is already known that Modigliani and Miller stated the irrelevance of capital structure choices on the firm value in the absence of taxes, while under the effects of taxation, they calculated VTS by discounting the present value of tax savings from interest payments on a risk-free debt at the risk-free rate; Fernandez stated the inconsistency of this theorem for growing companies. Then, Myers (1974) introduced the Adjusted Present Value method, by which the value of the levered company is equal to the value of the company without debt (Vu) plus the present value of the tax saving from interest payments, so that VTS is calculated by discounting the tax savings ($DTKd$) at the cost of debt (Kd); however, it could be argued that the risk of the tax saving arising from the use of debt is coincident with the risk of the debt, and Fernandez showed that this theory leads to consistent results only if the firm will not boost its proportion of debt financing.

Anyway, for the purposes of this thesis, the most important models are the so called "Practitioners' method" and the With-costs-of-leverage method. So, the **Practitioners' method** is widely used by consultants and investment banks because of its robustness, as it introduces larger leverage costs in the corporate valuation: for a given risk of the underlying assets (β_u) are then realized a still higher β_L and consequently a higher cost of equity and a lower equity value with respect to the equations estimated by the previous methods, so that VTS can be calculated through the following equation:

$$VTS = \frac{DT(Ku - Kd) + D(Kd - Rf)}{Ku} \tag{2.16}$$

This method is considered quite important because it is the first one to introduce the so called **credit spread**, which consists of the difference between the cost of debt and the risk-free rate of interest $(Kd - R_f)$, and since it represents the higher interest rate on debt applied by debtholders, it is assumed to incorporate in some way the expected costs of financial distress. Therefore, under this point of view are now needed two different models: on one hand, there should be an approach able to relate the credit spread to the company's actual level of leverage (in the next chapter will be introduced the Merton model to satisfy this purpose, otherwise can also be used the credit spreads developed by rating agencies), while on the other is needed a further model to estimate the present value of the financial distress costs, by assuming that those depend on the firm's operations. This model can be identified in the **With-costs-of leverage method**, by which:

$$PV\ (Costs\ of\ financial\ distress) = D\frac{Kd - R_f}{Ku} \tag{2.17}$$

So, given a certain level of leverage D, it is possible to compute the present value of the costs of financial distress, which are considered to be proportional to the level of debt financing D and the credit spread associated to that leverage: this implication will be exploited in the next chapter when will be implemented the Merton model. Under this method the value of tax shields becomes:

$$VTS = PV[Ku; DKuT - D(Kd - R_f)] \tag{2.18}$$

Lastly, in his paper Fernandez considers a further theory for the estimation of VTS: the No-costs-of-leverage method, which is the only one that provides robust results when there is absence of leverage costs, so that the VTS is the present value of $DTKu$ discounted at the unlevered cost of equity (Ku):

$$VTS = PV[Ku; DTKu] \tag{2.19}$$

Therefore, the value of tax shields here consists of the difference between the present value of taxes paid by the unlevered firm and the present value of taxes paid by the levered firm, as stated at the beginning of the discussion. The equation (2.19) provides a VTS that is lower than (2.18) by a factor corresponding to $PV[Ku; D(Kd - R_f)]$, which consist the leverage costs introduced in the previous model. However, Fernandez proved that if the company expects to increase its debt, the VTS is the present value of $DTKu$ discounted at the required return to unlevered equity (Ku), while if the company will not enlarge its leverage, the VTS is equal to $PV[DTKd; Kd]$ (Fernandez, 2007).
A summary of the different calculation methods of the VTS by the nine theories is given by the table below:

Image 2.8: Different values of interest tax shields in Fernandez's paper

	Theories	Equation	VTS
1	No-costs-of-leverage	(34)	DT
2	Damodaran	(31)	$\frac{DT - [D(\mathrm{Kd} - R_F)(1-T)]}{\mathrm{Ku}}$
3	Practitioners	(33)	$\frac{D[R_F - \mathrm{Kd}(1-T)]}{\mathrm{Ku}}$
4	Harris and Pringle	(29)	$\frac{TD\mathrm{Kd}}{\mathrm{Ku}}$
5	Myers	(25)	DT
6	Miles and Ezzell	(28)	$\frac{TD\mathrm{Kd}(1+\mathrm{Ku})}{[(1+\mathrm{Kd})\mathrm{Ku}]}$
7	Miller (1977)	(26)	0
8	With-costs-of-leverage	(35)	$\frac{D(\mathrm{Ku}T + R_F - \mathrm{Kd})}{\mathrm{Ku}}$
9	Modigliani and Miller	(24)	DT

(Image source: Fernandez, 2007)

This paragraph has just illustrated that also valuation models provide valuable contributions for the analysis of leverage costs and, consequently, for the estimation of the costs of financial distress and the search for an optimal capital structure. So, in the next chapter will be declined the With-costs-of-leverage model in the approach developed by Merton in order to estimate the optimal level of leverage for corporations.

CHAPTER 3: THE MERTON MODEL AND ITS EMPIRICAL APPLICATION

The last chapter ended with the introduction of the With-costs-of-leverage method for the corporate valuation: this approach developed by Fernandez will be now incorporated in the broader Merton model for pricing the cost of debt and than for assessing its effects when the level of leverage chosen by the firm vary. Indeed, this chapter represents the core of the analysis as will be used the features of the Merton-Fernandez approach for the purposes of this thesis: so, by employing a sample of ten firms from the ten biggest Italian industries (according to the FTSE-MIB index), first of all will be used the implications of the Merton model to derive a relationship that links the cost of debt to the varying debt-to-equity ratio, than for each level of leverage will be calculated the side effects of debt in order to find out which specific ratio is able to maximize the difference between the value of the interest tax shield and the value of the costs of financial distress, and therefore the overall firm value for each company included in the sample. Lastly, the validity of this analysis will be tested by replacing the optimal level of leverage computed through the Merton model with the actual debt-to-equity ratio chosen by the firms in the real world; the resulting variances will be then analyzed by keeping in mind the peculiarities of each firm.

3.1 The Merton model

In this analysis will be utilized the **Merton model** in order to derive the relationship between the cost of debt and the level of leverage, which is an approach aimed at assessing the credit risk of a firm's debt and it is widely adopted by investors and financial analysts to evaluate a company's ability in meeting its financial obligations, repaying its debt and weighing the likelihood of its default. Indeed, this model is developed to provide an easier valuation of the firm and a probabilistic assessment of

its solvency risk by analyzing maturity dates and debt totals so to price the cost of debt that should be applied by banks and financial intermediaries, in a similar way of how Fischer Black and Myron Scholes derived their famous formulas to price European put and call options. So, after the introduction of this framework in 1974, further structural models of credit risk mostly took origin from the theoretical basis introduced by Merton's works, which was especially extended and practically implemented by the KMV Corporation so to achieve the development of the so called **KMV-Merton model**.

3.1.1 Merton's original framework

After the collapse of several big companies because of their failure to repay their debt obligations (such as Lehman Brothers, General Motors, Enron Corporation), it has been gradually clear that credit risk is perhaps the main source of bankruptcy, leading to an increasing awareness that such risk needs to be well managed so to not incur in corporate failure, and one of the ways to do that is through the credit risk modeling. One of the pioneers has been Robert Merton, who introduced in 1974 an approach to price the simplest form of corporate liabilities: since it measures the probability of default through data related to the firm's peculiarities (assets and liabilities) it is considered to be a *structural model*, as the likelihood of default increases when the market value of the company's liabilities approaches the market value of its underlying assets, and therefore, the probability of default (credit risk) can be derived from the capital structure of the company (Yusof, Jaffar, 2012).

In particular, this model adopts the traditional tools of the option pricing and it is based on the following set of assumptions:

- The capital markets are perfect, hence market movements are unpredictable, investors can borrow and lend at the risk-free rate of interest, equity shares are perfectly divisible, and there are no informational asymmetries, no transaction costs or commissions, no taxes.
- All options are only European and can be exercised only at the expiry date.
- No dividends are paid out and returns on underlying stocks are regularly distributed.
- The stocks' volatility and the risk-free rate of interest are constant.

The firm's equity (E) gathers significant information about the firm's probability of default as it is assumed to be a function of the asset value (V) that follows the lognormal random walk process typical of the Brownian motion, while the return on the company's assets are normally distributed; in particular, the equity behaves like a European call option with V as the underlying asset, the strike price equal to the debt (D) and the expiry date corresponding to the debt's maturity date (T), so its payoff is given by:

$$E_T = \max(V_T - D, 0) \tag{3.1}$$

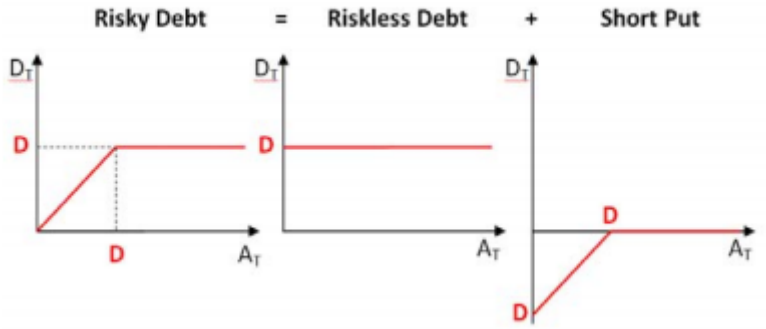
Indeed, the debt consists of one zero-coupon bond with maturity date T and face value (plus interests) equal to D, while the equity follows the liquidation process, in which the equity holders are supposed to be paid only after all the repayments to debtholders, so if the company fails to repay all of its obligations, the ownership's equity would then become equal to zero. So, the company's ability to make regularly debt repayments depends on the asset value V at the expiry date T: if it is larger than the corporate debt at that moment ($V_T > D$), the firm will than repay its debt, otherwise, if it is smaller ($V_T < D$), the company will not make any repayment as the value of the equity would become worthless, so the equity holders will exercise the option of claiming default, with debtholders gaining the value of the company's total assets (V_T) as a consequence of the liquidation process. For such reasons, the payoff of this option could never become negative: if the asset value is lower than the promised payment, the firm incurs into default, the lenders receive a payment corresponding to the asset value and the equity holders get nothing (Merton, 1974).

So, the key insight in Merton's work is that the equity value can be rewritten as the payoff from an option position, thus option-pricing techniques can be adopted to price the risky debt. Indeed, the bond value at maturity T (B_T) corresponds to its face value D only if $V_T > D$, otherwise it is simply equal to V_T. This means the payoff received by debtholders at time T may also be expressed as:

$$B_T = \min(V_T, D) = D - \max(D - V_T, 0) \tag{3.2}$$

In (3.2), the first component (D) is the payoff from investing in a risk-free zero coupon bond with maturity T and a face value of D, while the second one ($-\max(D - V_T, 0)$), represents the payoff resulting from a short position in a put option on the company's assets V having a strike price D and a maturity date T.

Image 3.1: Decomposition of debt value at time T in Merton model



(Image source: Zieliński, 2013)

The image 3.1 illustrates the necessary steps to evaluate the present value of the risky debt: firstly, should be identified the present value D of the risk-free debt, and then must be subtracted the present value of put option. The second step clearly consists of valuing the put, for which we need an accurate option pricing model (the Black-Scholes model).

First of all it is assumed that the asset value (which represents the underlying of the option) follows the Brownian motion:

$$dV = \mu_V V dt + \sigma_V V dz \tag{3.3}$$

Through the option pricing tools is it possible to calculate the market value of bond and consequently the firm's likelihood of default, which occurs when the market value of company's assets is lower than the book value of its liabilities by the debt's maturity date. So, the equity value E depends upon the asset value V, its constant volatility σ_V and the risk-free rate r, through the relationships:

$$E = call\,(V, D, \sigma_V, r, T) = VN(d_1) - De^{-rT}N(d_2) \tag{3.4}$$

Where: $d_1 = \frac{\ln\left(\frac{V}{D}\right)+\left(r+\frac{\sigma_V^2}{2}\right)T}{\sigma_V\sqrt{T}}$ and $d_2 = d_1 - \sigma_V\sqrt{T}$

Since the model's assumptions state that capital markets are perfect, there are no arbitrage opportunities, hence the put-call parity implies that:

$$put(V, D, \sigma_V, r, T) + V = call\,(V, D, \sigma_V, r, T) + De^{-rT} \tag{3.5}$$

Therefore, since the current bond value B represents the market value of debt and in this model it is given by the difference between the asset value and the equity value ($B = V - E$), it also depends on the asset value V and its volatility σ_V:

$$B = De^{-rT} - put(V, D, \sigma_V, r, T) \tag{3.6}$$

By combining the equations above it results that:

$$B = VN(-d_1) + De^{-rT}N(d_2) \tag{3.7}$$

So, it is clarified that the current bond value B is an increasing function of V and D and decreasing in σ_V: this means that when the default is approaching, equity holders are more incentivized to increase the asset volatility so to foster the value of equity with respect to the value of debt, and this is coherent with the theoretical framework explained in the previous chapters.

However, in this model the directly observable variables are only the equity value E (thanks to the firm's market capitalization) and the face value of debt D, while the asset value V and its volatility σ_V cannot be observed. Hence, through the Ito's Lemma Merton is able to derive another relationship explaining the volatility of equity shares (σ_E) through the other variables of this model:

$$\sigma_E \equiv \sigma_V \frac{V}{E}\frac{\partial E}{\partial V} = \sigma_V \frac{V}{E}N(d_1) \tag{3.8}$$

Hence, in this way Merton has developed a system of two non-linear equations in two variables to be estimated:

$$\sigma_E = \sigma_V \frac{V}{E} N(d_1) \tag{3.9}$$

$$E = VN(d_1) - De^{-rT} N(d_2) \tag{3.10}$$

(Zieliński, 2013).

3.1.2 The computation of credit spread

From the Black-Scholes model Merton has derived further important implications of the option-pricing techniques: by bringing into his model the assumption that the risk-neutral probability of a European call option becoming out-of-the-money (and so, worthless) at the expiry date is higher than its actual (historical) probability, after some calculations he estimated that the insolvency risk, $Q(T)$, which measures the risk-neutral likelihood that the total asset value would be lower than the face value of debt at the expiry date T is equal to:

$$P^{RN}\{V_T < D\} = Q(T) = N(-d_2) \tag{3.11}$$

After that, it is possible to derive the **expected loss (*EL*),** which is the difference between the debt value without bankruptcy and the current debt value incorporating the probability of default:

$$EL = \frac{De^{-rT} - B}{De^{-rT}} = 1 - \frac{B}{De^{-rT}} \tag{3.12}$$

From the last equation is than derived the **loss given default (*LGD*)** and the **recovery rate *R***:

$$R = 1 - LGD = \frac{EL}{N(-d_2)} \tag{3.13}$$

Then, Merton's model can be also used to explain the **credit spread**, which consists of the difference between the yield on the risky debt and the risk-free rate of interest, as explained in the second chapter. So, the bond price can be obtained through the equation (3.7); given that in Merton's model the bond is just equal to a zero-coupon bond, the **promised yield, *y(T)***, if the firm does not incur in default is equal to:

$$y(T) = -\frac{1}{T}\ln\left(\frac{B}{D}\right) \tag{3.14}$$

The corresponding credit spread, *s(T)*, can be finally obtained by subtracting the risk-free rate from the yield rate:

$$s(T) = y(T) - r = -\frac{1}{T}\left(\frac{V}{De^{-rT}}N(-d_1) + N(d_2)\right) \tag{3.15}$$

By introducing the **quasi-leverage ratio *(L)***, defined as the ratio between the present value of the company's debt and its total asset value, the credit spread's formula can be rewritten as:

$$s(T) = -\frac{1}{T}\left(\frac{1}{L}N(-d_1) + 1 - N(-d_2)\right) \tag{3.16}$$

Where: $L = \frac{De^{-rT}}{V}$

From the equation (3.16) Merton suggests that a form's creditworthiness can be represented through the implied credit spread for its debt, depending on three important items: the quasi-leverage ratio L, the volatility of company's assets σ_V, and the probability of insolvency $N(-d_2)$. In particular, in this model is created a credit spread structure for different debt maturities *T,* where the implied credit spreads for short-term debt obligations all tend to zero, as the default is not anymore an exogenous random event but rather it is perfectly predictable (it can occur only at maturity date if the total asset value is lower than the face value of debt, $V_T < D$) (Zieliński, 2013).

3.1.3 The KMV application

Despite its fundamental implications for the credit risk modeling, the Merton model in its pure theoretical specification suffers for some important limitations:

- The asset value V and its volatility σ_V are not directly observable.
- The risk-free rate of interest and the volatility cannot be assumed to be constant in the real world like in the Black-Scholes model.
- The definition of insolvency is too restricted, as it can occur only at debt's maturity date T, so the event of default is always predictable.
- In reality the complexity of capital structures is much higher, especially with respect to the corporate liabilities, so the default risk is actually more difficult to estimate.
- The implied credit spreads computed through this model are significantly smaller than those observable in capital markets.

In order to try to overcome these limitations, the practical implementation of Merton's model has attracted considerable attention and it has been further developed and reshaped, until arriving at the **KMV model** which varies from the original version for some aspects. It was introduced in the late 80's by KMV, a leading company of providing quantitative credit analysis instruments; since than it has been widespread and subscribed by a large number of financial institutions around the world and is now maintained and continuously developed by Moody's KMV, a division of Moody's Analytics that acquired KMV in 2002 (Zieliński, 2013).

Under a theoretical point of view, the KMV model is not highly different from the original Merton's version: however, the KMV approach relies on an extensive empirical testing and it is implemented through a very large database, so to combine market data with historical data in order to improve the ability to predict default. Before assessing the likelihood of bankruptcy, this approach first computes for every company an index called **Distance to Default (DD)**, which is defined as the distance between the firm's expected assets value at the analysis horizon and the default point, normalized by the standard deviation of future asset returns. More specifically, from the Merton's model the probability of default from historical data is given by:

$$P\{V_T < D\} = N\left(-\frac{\ln(V/D) + (\mu_V - \sigma_V^2/2)T}{\sigma_V\sqrt{T}}\right) \tag{3.17}$$

Therefore, the variable $\frac{\ln(V/D)+(\mu_V-\sigma_V^2/2)T}{\sigma_V\sqrt{T}} = \frac{E\{\ln(V_T)\}-\ln(D)}{\sigma_V\sqrt{T}}$ represents a certain measure of the distance to default for a given company and it clarifies that to derive the probability of default for any time horizon for a particular company, must be first calculated its distance to default: the larger DD, the smaller the likelihood that such company will incur into bankruptcy. In its empirical implementation, the distance to default is computed as:

$$DD = \frac{V - D}{\sigma_V V} \tag{3.18}$$

where D represents the default point and it is approximated by summing all the short-term debt and half of the long-term debt and by fixing the time horizon to one year (T=1). Indeed, KMV Corporation has observed from a sample of several hundred companies that firms are usually more likely to default when their asset values reach a certain level somewhere between the value of total liabilities and the value of short-term debt.

Since DD is expressed in terms of standard deviations from the asset value, it gives the number of standard deviations left between the asset value and the default threshold: also for that, this measure incorporates some critical variables such as the firm size and the type of industry, so to allow a better comparison among different companies. Moreover, such estimation of DD is very similar to the variable d_2 originally estimated by Merton, which can be considered as the implication from the relationship between the risk-neutral probability and the actual probability that uses the expected return of the assets in the drift term, while the other one uses the risk-free rate r (Sundaram, 2001).

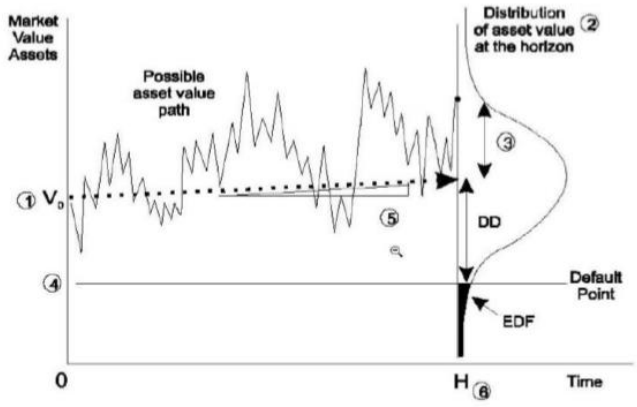
In particular, by combining the equation (3.17) with (3.18), the probability of default (PD) becomes:

$$PD = P\{V_T < D\} \cong N(-DD) \tag{3.19}$$

Such measure of risk maintains the same Merton model's limitations in predicting default because of the assumption of normalization, but it can be successfully used to discriminate the companies. However, because of the issue of fatter tails in real credit loss distribution, the Merton's estimation of the likelihood of default $PD = N(-d_2)$ is underappreciated: for this reason, another distinguishing feature of KMV model is the use of a historical set of frequencies of default rather than a theoretical normal or log-normal distribution. As a consequence, in KMV approach the Probability of Default (PD) is replaced with the **Expected Default Frequency (EDF)**, consisting of the probability that a given company will default within one year according to the KMV methodology: through a database of corporate defaults, KMV has created a correspondence between the different categories of DD and the related default frequency for each one of them. So, by using historical information about consistent samples of companies (including already defaulted firms), it is possible to track, for each time horizon, the proportion of firms of a given category actually defaulted after one year (Zieliński, 2013).

To sum up, in the empirical approach of KMV model firstly must be used the data about debt and equity in order to compute the distance to default for each company, than all the firms are divided in different categories ranked by DD, so to obtain classes as homogeneous as possible within them and heterogeneous among them. For each DD category is counted the number of defaults occurred within one year and it is assumed that such failure frequency will be maintained in the future, so to create a relationship between the DD categories and the observed EDFs on which are attributed different ratings to the DD, based on their expected default frequencies.

Image 3.2: The functioning of KMV-Merton model



(Image source: Bohn, Crosbie, 2003)

3.2 Merton's model practical implementation

In the last section has been described the theoretical framework beyond the Merton's model and its further developments set by KMV Corporation. Now it is possible to implement such approach to this analysis in order to derive which relationship is able to link the cost of debt to different debt-to-equity ratios, before assessing which level of leverage can maximize the overall firm value. First of all, the sample chosen for this analysis consists of the ten industrial companies coming from ten different industries (thus excluding banks and other providers of financial services) with the highest market capitalization in the FTSI-MIB index on 31.12.2018, which are:

- **Enel S.p.A.**: public utilities industry
- **Eni S.p.A.**: oil and gas industry
- **Fiat Chrysler Automobiles N.V.**: automotive industry
- **Atlantia S.p.A.**: building products and heavy construction industry
- **Tenaris S.A.**: steel manufacturing industry
- **STMicroelectronics N.V.**: technological and semiconductor industry
- **Campari – Milano S.p.A.**: food and beverage industry
- **Telecom Italia S.p.A.**: telecommunications industry
- **Moncler S.p.A.**: fashion industry
- **Recordati S.p.A.**: pharmaceutical industry

(borsaitaliana.it).

3.2.1 Pricing the cost of debt

The implementation of the Merton's model requires several steps: first of all must be estimated those variables which are not directly observable, namely the company's asset value and its asset volatility. From the last section is reminded that Merton has derived a system of two non-linear equations in order to estimate those variables:

$$\sigma_E = \sigma_V \frac{V}{E} N(d_1) \tag{3.9}$$

$$E = VN(d_1) - De^{-rT}N(d_2) \tag{3.10}$$

Therefore, in this first step are required five fundamental inputs:

- Company's market capitalization (E)
- Company's net financial position (D)
- Company's equity volatility (σ_E)
- Time horizon (T)
- Risk-free rate of interest (r)

The first three variables in this list are firm-specifics: since the time horizon adopted is one year (the fiscal year 2018), the market capitalization for each company refers to 31.12.2018 according to borsaitaliana.it, while the net financial position is calculated as the difference between the book value of debt (referring to the sum of current liabilities and non-current liabilities) and the book value of cash and cash equivalents, according to the FY 2018 annual report for each company. Instead, the computation of the firm's equity volatility requires more steps, as firstly is computed the daily return on each company's stock (the source of stocks' daily prices from 01.01.2018 to 31.12.2018 is finance.yahoo.com) through the equation (3.20):

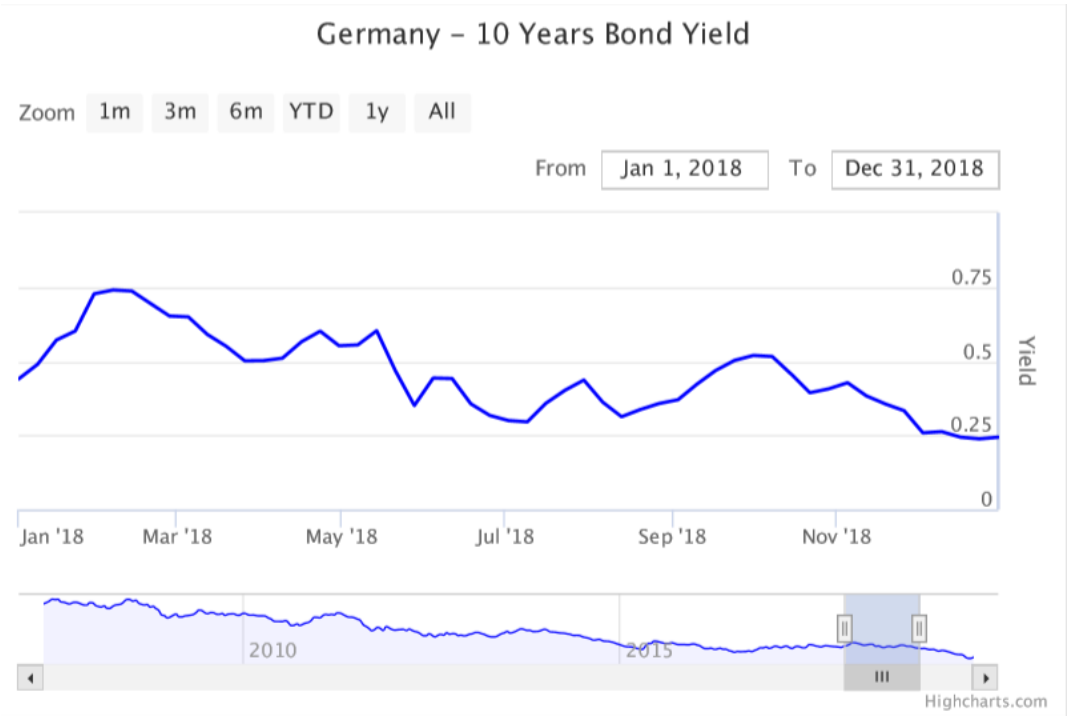
$$Daily\ return = \ln\left(\frac{P_t}{P_{t-1}}\right) \tag{3.20}$$

After that, it is calculated the daily standard deviation of all the daily returns, which is then transformed in the yearly standard deviation (by multiplying it by $\sqrt{252}$, as 252 are the days in which the stock market is open) in order to finally achieve the equity volatility (σ_E).

The last input to be estimated is the risk-free rate (r), which is the theoretical rate of return of a riskless investment and so it represents the minimum interest an investor would expect from an investment with zero risk over a period of time (in this case, the fiscal year 2018). It is important to remind that the risk-free rate is only theoretical as all investments carry some level of risks; therefore, for its approximation is used the average annual return (from 01.01.2018 to 31.12.2018) of the German 10 years-Bund,

as it is rated AAA by rating agencies because Germany shows a low market risk premium compared to other European countries, hence this can be considered as a good approximation of a riskless investment. So, the average annual return of the German 10 years-Bund is equal to **0,46 %** (investing.com).

Image 3.3: German 10 years-Bund trend over 2018



(Image source: investing.com)

After having estimated all the five necessary inputs, it is possible to derive the asset value (V) and the asset volatility (σ_V) for each company included in the sample through the Merton's system of equations previously described. To do so, it is used the solver function in an Excel spreadsheet by considering as objective that the sum of the two restrictions must be equal to zero; such constraints require putting larger than or equal to zero the difference between the values of the equity (E) and the equity volatility (σ_E) given as initial inputs and those values computed through the Merton's formulas (3.9) and (3.10). Given the computation of the asset value, it is then possible to extract also the market value of debt (B), since in Merton's model it is simply approximated as the difference between the value of total assets and the market value of equity ($B = V - E$). So, by keeping a time horizon of 1 year and a constant risk-free rate equal to 0,46 %, the obtained results for our companies are summarized in the following table:

Table 3.1: Asset value and asset volatility for each company of the sample (accounting data in millions)

COMPANY	E	D	σ_E	V	σ_V	B
Enel	51.440,80	110.942,00	20,04 %	161.873,64	6,37 %	110.432,84
Eni	49.886,90	56.464,00	25,65 %	196.091,76	12,06 %	146.204,86
Fiat Chrysler	19.688,00	59.695,00	45,90 %	79.092, 76	11,49 %	59.404,76
Atlantia	14.886,90	58.310,02	36,06 %	72.928,02	7,37 %	58.041,12
Tenaris	11.114,40	1.947,45	32,38 %	13.052,91	27,66 %	1.938,51
STM	11.092,40	2.177,00	38,50 %	13.259,41	32,21 %	2.167,01
Campari	8.565,30	1.805,80	22,44 %	10.362,81	18,55 %	1.797,51
Telecom Italia	7.375,10	42.675,00	30,70 %	49.854,14	4,54 %	42.479,04
Moncler	7.353,90	10,49	33,60 %	7.364,34	33,56 %	10,44
Recordati	6.414,20	1.143,16	29,44 %	7.552,11	25,00 %	1.137,91

Source: personal elaboration of data from finance.yahoo.com, borsaitaliana.it, investing.com, stern.nyu.edu and companies' consolidated financial statements.

After the estimation of the asset value and asset volatility, there are now all the items necessary to price the **cost of debt** for each company, which consists of one fundamental part of a firm's capital structure as it represents the effective rate paid by the company on its current debt, giving also investors an idea of the firm's level of risk compared to others: indeed, a higher cost of debt generally corresponds to larger companies. The cost of debt has been often estimated as the promised yield on newly issued debt of the company, but this is not correct because of the expected probability of default that must be greater than zero if the promised return on debt is positive (as it is always when a company issues instruments of debt financing): given the incorporation of such bankruptcy risk, the expected returns on corporate debt are necessarily lower than promised yields.

So, the Merton model can be used to divide the observed market spreads between the part representing the expected default and the other referring to the expected return premium, so to estimate the expected return on debt relative to its promised yield and to derive a relationship that links debt spreads, capital structure and asset volatility; such equation is linear as follows:

$$R_D = s(T) + R_f \tag{3.21}$$

Indeed, the cost of debt is simply given by the sum between the risk free rate R_f and the credit spread $s(T)$, which again reflects the difference between the yield of a treasury

bond (that approximates the risk free rate, such as the yield of the German 10 years-Bund in this case) and that of a corporate bond of the same maturity T. In particular, in the Merton model the parameter T is highly relevant because it does not only reflect the actual maturities of different debt instruments issued in complex capital structures, but it also incorporates the presence of costs of financial distress and other complications reflected in the observed credit spread, such as for instance the strategic behavior of equity holders (Cooper, 2001).

As already explained in the previous section, by considering the quasi-leverage ratio (L) the credit spread can be given by the equation (3.16): this relationship clearly defines the credit spread (and consequently, the cost of debt) as a function of the level of leverage (L) and the probability of default $N(-d_2)$, therefore it can be used to price the cost of debt, following the purposes of this thesis.

So, for each company of the sample are calculated the quasi-leverage ratio, the credit spread and the associated cost of debt for every different level of leverage D/V (ranging from 1% to 100%), so to prepare for the next stage of analysis.

3.2.2 The side effects of debt

It is now possible to estimate the **side effects of debt**, referring to the difference between the (positive) value of the interest tax shields and the (negative) value of the expected costs of financial distress. From the second chapter is reminded that in this analysis the overall firm value (V_L) is considered to be the sum of the unlevered firm value (V_U) and the side effects of debt; the equation (2.1) can be rewritten as:

$$V_L = V_U + (V_{TS} - V_D) \tag{3.22}$$

In particular, both items of the side effects are estimated at their market values for single unit of debt, so the value of interest tax shield (V_{TS}) is given by the leverage ratio at market value multiplied by the corporate tax rate (τ_c):

$$V_{TS} = \frac{B}{V} \times \tau_c \tag{3.23}$$

Since all the firms of the sample consist of group of companies, for each of them the corporate tax rate is approximated as the theoretical statutory tax rate on income of the country where the parent company is resident, so on overall are used four different rates:

- Italy's statutory tax rate = 24,00%, for Enel S.p.A., Eni S.p.A., Atlantia S.p.A., Campari-Milano S.p.A., Telecom Italia S.p.A., Moncler S.p.A., Recordati S.p.A.
- UK's statutory tax rate = 19,00% for Fiat Chrysler Automobiles N.V.
- Luxembourg's statutory tax rate = 26,01% for Tenaris S.A.
- Netherlands' statutory tax rate = 25,00% for STMicroelectronics N.V.

(stern.nyu.edu).

Then, from the second chapter is recalled that the value of the expected costs of financial distress (V_D) computed through the With-costs-of-leverage method developed by Fernandez is given the equation (2.17), which can be rewritten by considering the market value of debt:

$$V_D = \frac{B}{V} \times \left(\frac{R_D - R_f}{R_U}\right) \tag{3.24}$$

where R_U was already introduced in the first chapter and consists of the **unlevered cost of capital**, representing the theoretical cost faced by a company to finance itself without any debt, thus it refers to the equity returns required by an investor to hold the company's underlying assets without the effects of leverage. Its calculation is:

$$R_U = R_f + (\beta_U \times MRP) \tag{3.25}$$

where the market risk premium (MRP) is multiplied by the **unlevered beta ($\boldsymbol{\beta_U}$)**, which in turn measures the firm's market risk without the addition of debt in its capital structure, hence it is particularly important because of its ability to measure the volatility of stock returns by removing the financial effects of leverage so to isolate the risk due only to company's underlying assets. For this reason it is highly considered by investors and it is computed as follows:

$$\beta_U = \frac{\beta_L}{1 + (D/E)(1 - \tau_c)} \tag{3.26}$$

Where β_L represents the levered beta, which instead measures the company's risk compared to the market by including the impact of the firm's actual capital structure and leverage (corporatefinanceinstitute.com).

According to Damodaran, the MRP is considered to be the equity risk premium comprehensive of Italy's country risk premium, so to achieve an overall MRP equal to **9,02%** (stern.nyu.edu).

Then, it is computed for each company of the sample the unlevered beta, the unlevered cost of capital and then the side effects of debt for each level of leverage D/V (ranging from 1% to 100%). In this way it is possible to observe for each firm what is the level of leverage that maximizes the difference between the value of interest tax shields and the value of expected costs of distress, thus theoretically maximizing the overall firm value.

The results found for each company are shown in the table (3.2), where are reported the optimal leverage ratio, the corresponding cost of debt and value of distress costs and also the **distress costs-to-capital ratio**, computed as the ratio between the value of the costs of financial distress and the firm value in order to show the relative size of such expenses with respect to the overall firm value.

Table 3.2: Optimal leverage ratio and consequent results for each company of the sample (accounting data in thousands)

COMPANY	*OPTIMAL LEVERAGE*	*COST OF DEBT*	*DISTRESS COSTS*	*DISTRESS RATIO*
Enel	75 %	0,474 %	3,738	0,00000231 %
Eni	60 %	0,502 %	5,359	0,00000505 %
Fiat Chrysler	60 %	0,479 %	3,486	0,00000441 %
Atlantia	71 %	0,469 %	2,493	0,00000342 %
Tenaris	35 %	0,608 %	7,085	0,00005428 %
STM	30 %	0,624 %	6,834	0,00005154 %
Campari	45 %	0,490 %	6,185	0,00005968 %
Telecom Italia	81 %	0,468 %	2,794	0,00000560 %
Moncler	28 %	0,594 %	5,746	0,00007803 %
Recordati	34 %	0,486 %	5,312	0,00007034 %

Source: personal elaboration of data from finance.yahoo.com, borsaitaliana.it, investing.com, stern.nyu.edu and companies' consolidated financial statements.

These results are than comparable to the data obtained by computing cost of debt, costs of financial distress and distress ratio through the Merton model with the actual level of leverage shown by the companies on 31.12.2018. Such statistics are summarized by the table (3.3).

Table 3.3: Actual leverage ratio and consequent results for each company of the sample (accounting data in thousands)

COMPANY	*ACTUAL LEVERAGE*	*COST OF DEBT*	*DISTRESS COSTS*	*DISTRESS RATIO*
Enel	68 %	0,460 %	0,001	0,00000001 %
Eni	53 %	0,461 %	0,072	0,00000007 %
Fiat Chrysler	75 %	5,425 %	1.067,304	0,00134943 %
Atlantia	80 %	2,032 %	492,796	0,00067573 %
Tenaris	15 %	0,460 %	0,000	0,00000000 %
STM	16 %	0,460 %	0,001	0,00000001 %
Campari	17 %	0,460 %	0,000	0,00000000 %
Telecom Italia	86 %	1,151 %	248,461	0,00049838 %
Moncler	0 %	0,460 %	0,000	0,00000000 %
Recordati	15 %	0,460 %	0,000	0,00000000 %

Source: personal elaboration of data from finance.yahoo.com, borsaitaliana.it, investing.com, stern.nyu.edu and companies' consolidated financial statements.

3.2.3 Data analysis

From those results we can be drawn some preliminary conclusions: it is clear there is not an optimal capital structure in absolute terms, as it rather depends on other factors, such as firstly the industry where the firm operates. The optimal level of leverage achieved through this model ranges from 28% (Moncler) to 81% (Telecom Italia), showing a wide variety across different industries that is confirmed by the actual proportions of debt financing shown by companies in table (3.3). Such industry-specific differences in leverage will be then analyzed more in details in the next section, but for now it is possible to investigate other interesting implications.

With regard to the optimal results, the cost of debt appears slightly higher than the risk-free rate for all the companies (always higher than 0,46% but never reaching the unit) thus confirming that when a company achieves its optimal capital structure, the credit spread associated to its debt is quite low but never equal to zero; this means the component representing default risk is always positive, although it is small, so to demonstrate a strong financial health for such firm. At the same time, in optimal

conditions the value of the expected costs of financial distress is not zero, but it is positive and low through a direct positive correlation with the cost of debt and the credit spread, while the distress cost-to-capital ratio is very close to zero in each case.

A significant implication from the results is the inverse correlation between the optimal level of leverage and the **asset volatility**, which is defined as the rate at which the price (and so the value) of an asset move up and down and therefore it encompasses the operative risk of the business itself; if the company's assets are viewed as a portfolio of the individual securities within the firm, the standard deviation of their returns gives the asset volatility. Several past researches have demonstrated the existence of a non-linear negative relationship between asset volatility, leverage and default risk, and also in Merton model a company's closeness to the default threshold depends on both the expected difference between asset values and debt commitments and the volatility of those results: for a given asset value and capital structure, higher expected asset volatility implies a greater probability that future asset values will not be able to cover debt obligations, hence it is correlated with a larger likelihood to default which in turn increases with greater levels of indebtedness (Correia, Kang, Richardson, 2017).

With regard to this analysis, would be expected a negative relationship between asset volatility and optimal leverage ratio, as a company whose asset returns are less volatile (meaning its operating risk is lower) can afford a higher level of indebtedness. Such theory is then confirmed by the results from this sample, where companies with lower asset volatility show a higher optimal leverage.

Table 3.4: Relationship between optimal leverage ratio and asset volatility for the companies of the sample

COMPANY	*OPTIMAL LEVERAGE*	*COST OF DEBT*	*ASSET VOLATILITY*
Enel	75 %	0,474 %	6,37 %
Eni	60 %	0,502 %	12,06 %
Fiat Chrysler	60 %	0,479 %	11,49 %
Atlantia	71 %	0,469 %	7,37 %
Tenaris	35 %	0,608 %	27,66%
STM	30 %	0,624 %	32,21 %
Campari	45 %	0,490 %	18,55 %
Telecom Italia	81 %	0,468 %	4,54 %
Moncler	28 %	0,594 %	33,56 %
Recordati	34 %	0,486 %	25,00 %

Source: data collection from Tables 3.1 and 3.2

So, this model shows that the optimal capital structure is primarily correlated to the asset volatility (which in turns widely vary, depending on the reference industry, the business undertaken and peculiarities of both), but anyway the small and positive value of both cost of debt and expected costs of distress mean that even in conditions of perfect creditworthiness there is some probability of default, as it should be whenever a company issues an instrument of debt financing. Lastly, the proportion of the optimal value of distress costs to the firm value is roughly approximated to zero, confirming the large majority of researches in this field. Although the use of very large companies such as those included in our sample might be likely to somehow bias the results (the impact of distress costs and the credit spread should be certainly higher for smaller firms), these conclusions seem quite robust, as they confirm the general thoughts and achievements developed by the literature explained so far in the previous chapters.

With regard to the actual results, half of the firms are quite close to the Merton model predictions in terms of leverage (Enel, Eni, Fiat Chrysler, Atlantia and Telecom Italia), but some of them show a value of both credit spread and expected costs of distress strongly approximated to zero, similarly to the other companies that are highly underleveraged with respect to their optimal capital structure. The only three overleveraged firms (Fiat Chrysler, Atlantia and Telecom Italia) exhibit a quite higher cost of debt and larger costs of financial distress, thus demonstrating that when a company overcomes its optimal level of indebtedness, the consequent increase in credit spread and default risk is more than proportional under the classic Trade-Off Theory.

Of course, this model offers a simplistic approach of how the capital structure can be optimized under the Trade-Off framework, in which are considered only the interest tax shields and the expected costs of distress as, respectively, the benefits and costs of debt. The variances registered with respect to the actual results should encompass other factors able to shape the capital structure according to all the other theories previously mentioned.

3.3 Variances analysis

In this section will be made a qualitative analysis on the results collected from the implementation of Merton model on the companies of this sample in order to understand why their optimal leverage ratios vary among them, and why they differ from their actual levels of indebtedness. This analysis must be conducted by keeping in mind the differences across their reference industries, the specific peculiarities and strategies of firms, and their financing choices related to the events occurred to them.

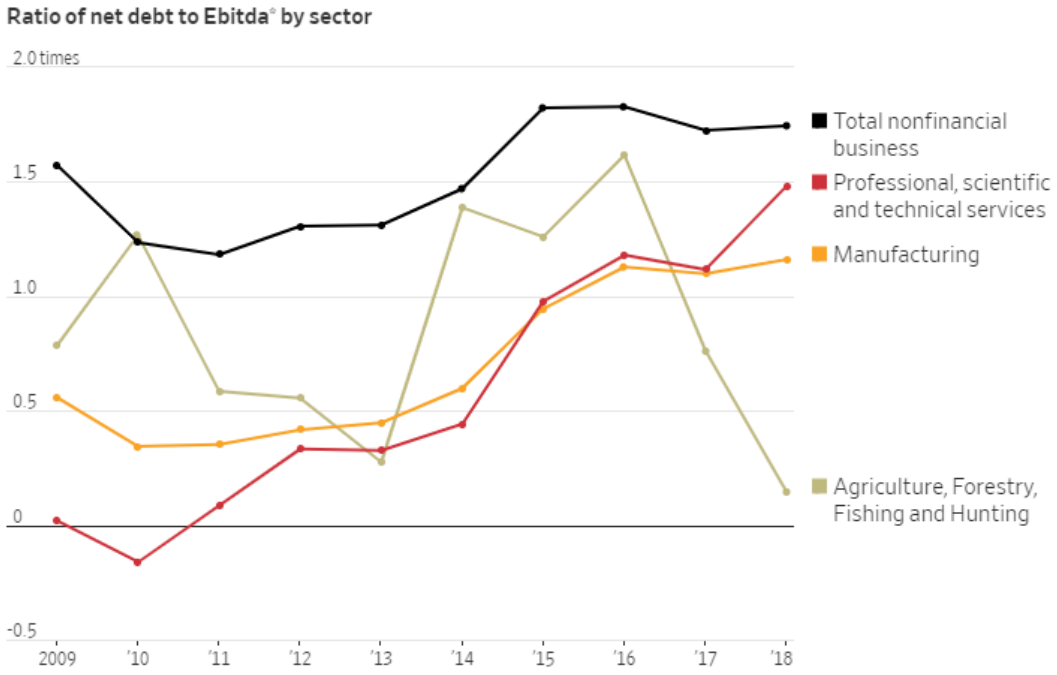
3.3.1 Why the leverage ratio vary

The ten firms from the sample have registered strong differences among their levels of leverage, both in optimal and actual terms, which can be related to several factors.

First of all, the companies come from ten different industries: some of them are similar, while others are pretty different among each other; such industry-specific factors are helpful to give a preliminary explanation about the variances exhibited. An ideal leverage ratio should be around 50%, as it means that no more than half of the company's assets are financed by debt, thus demonstrating a strong creditworthiness and financial health. However, although it might mean larger potentiality for default risk, a higher debt-to-capital ratio is usual for certain industries and it is even a good signaling of a well-performing business. For example, the financial sector leads all the other industries with regard to the indebtedness, but its high average debt-to-capital ratio might be misleading because banks and other financial institutions typically borrow money at a low rate to lend capital at a higher rate, earning a profit on the resulting spread. However, the analysis of this thesis has been focused only on industrial firms, and the first fact that needs to be considered when comparing leverage across different industries is the level of capital requirements: indeed, the proportion of debt financing varies significantly from one sector to another, and even between different firms within a given industry because of different levels of capital intensity. The most capital-intensive industries require large amounts of financial resources to produce goods or services and carry their businesses, such as the telecommunications sector, the public utilities, heavy manufacturing industries or the energy sector: those companies typically require large initial investments that generate high fixed cost, but also the necessary maintenance, upgrades and expansion of service areas need additional capital expenditures that contribute to maintain substantially high the level

of company's assets over all the business life-cycle. For instance, also chemical and pharmaceutical firms bear large fixed costs and R&D expenditures to finance large production units, whereas fashion companies, wholesalers or service industries are usually less capital-intensive, which in turn is generally reflected in lower levels of leverage, everything else being equal.

Image 3.4: Most leveraged industries over the last decade



(Image source: Donheiser, 2018)

Closely related to the reference industry is the debt sustainability of the business itself, hence considering whether the nature of the business allows to manage a large amount of debt. For example, utilities companies typically earn a stable amount of income, since the demand for their services remains relatively constant regardless of the overall economic conditions and cycles; moreover, most public utilities operate as virtual (or actual) monopolies in the local regions where they do business, so they do not fear the entrance of new competitors into the marketplace and they can bear larger amounts of debt with lower risk exposure than a business whose revenues are more subject to price fluctuations because of external factors (Saint-Leger, 2018).

However, the debt sustainability of the business does not only depend on the company's reference industry, but it is especially affected by the asset volatility: if the firm is

subjected to a given business uncertainty (reflected in its asset volatility) and faces significant costs of financial distress, the leverage will be chosen by managers accordingly, given the negative relationship between leverage and asset volatility suggested by the Trade-Off Theory and explained in the previous section (Choi, Richardson, 2016).

Moreover, taking inspiration from the Pecking-order Theory, companies might be pushed to use more debt financing because of earnings restraints: if a firm is susceptible to higher profitability fluctuation, it might often suffer lack of retained earnings from operations and be forced to resort more on leverage, as it often happens to airline companies, that are historically considered to be one of the highest leveraged industries. So, the earnings volatility is another reason beyond the capital structure choices made by company and it is strongly correlated with the cyclicality of the business: if company's profits are more likely to fluctuate accordingly to the general trends of the global economy, or even to a larger seasonality of revenues, the earning profitability is consequently enhanced (sapling.com).

Lastly, should be recalled from the first chapter all the capital structure theories associated with factors such as the agency costs or the information asymmetries: despite the industry's level of capital requirements, the management might choose a different level of indebtedness because of asset substitution effects, other agency issues or because it want to provide the market with certain signals. Linking with that, the signaling theory of credit rating suggests that companies sometimes choose to under-leverage their capitals structure because they might fear an excessive worsening of their credit rating released by rating agencies, thus increasing their difficulties to access external financing when it will be more needed in the future.

3.3.2 Overleveraged firms

In this paragraph will be now analyzed those companies who appear overleveraged with respect to their optimal capital structure calculated through our model.

The company with the overall highest cost of debt is **Fiat Chrysler Automobiles N.V.**, a leading automotive manufacturer, and the peculiarities of its industry give a preliminary explanation of its high leverage. The automotive sector requires large fixed costs throughout the whole business life for the implementation, maintenance and the

expansion of the large scale production of vehicles, thus leading to a continuous employment of huge financial resources; since the use of vehicles is widespread, this sector has also generally been subject to cyclical demand and tends to reflect the overall trend of the global economy, often amplifying its effects (the equity beta is indeed equal to 1,09) while additional factors such as fluctuations in prices of raw materials and fuels could have a certain impact on the automotive companies' operating results and financial condition. Fiat Chrysler faces a strong competition within its sector and needs a constant renewal of product offerings through frequent launches of new models incorporated with innovative technologies; for this reason, over the last years the group has needed a significant rise in investments, especially in its main marketplace of U.S.A., which has required to increase an already significant level of indebtedness, making Fiat Chrysler as the most leveraged company in the automotive sector and reducing its flexibility in seeking financial resources, so that some of the group's companies have increased the requirement of debt covenants and have been restrained to incur additional debt and make certain investments, among other things (fcagroup.com).

However, the dominating position in the automotive sector has been consolidated throughout the decades during which the group has operated, leading to a lower level of operating risk with respect to most competitors, which has contributed to maintain a high level of leverage. The cyclicality of automotive industry's demand also means a potential for earnings fluctuation which is often reflected in a negative working capital: in order to maintain acceptable levels of liquidity to run the day-to-day operation and meet debt obligations, the group needs to maintain a considerable proportion of debt financing, because any actual or perceived limitations of liquidity may weaken the ability or willingness of counterparties to do business with the entity.

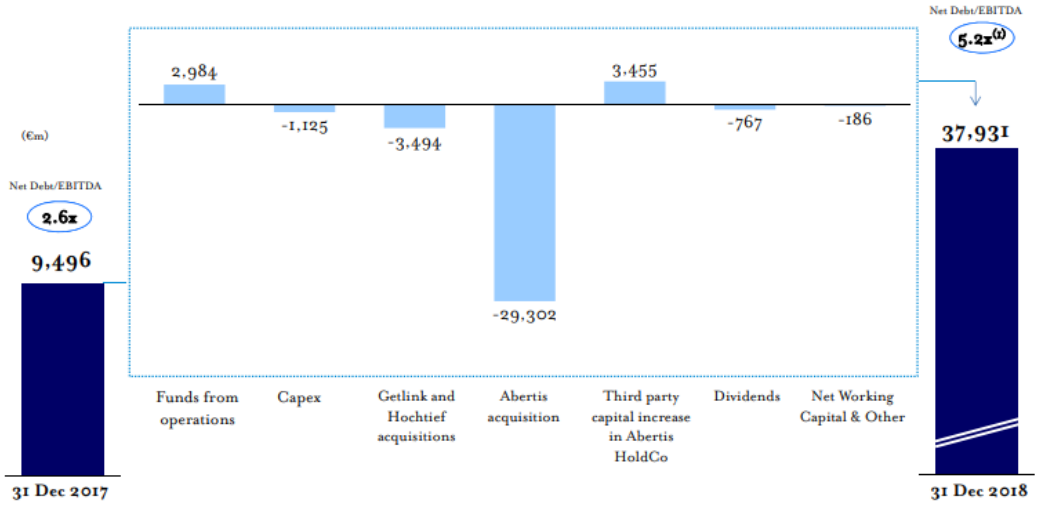
Anyway, Fiat Chrysler has partially de-leveraged its balance sheet during 2018, as it is confirmed by the upgrade on its debt rating made by Moody's from "stable" to "positive" (affirming a Ba2 rating), thanks to the improvement of the group's operating performance and cash flow generation, as well as to the intention to create a captive finance subsidiary fully owned in the USA, that would be strategically positive with respect to the group's competitors in the North America. In doing that, the group shows its intention to gradually move back to its optimal level of leverage by following Myers' pecking order of financing instruments, as the cash flow generation from operations is considered by both Fiat Chrysler's managers and external analysts as the most

important and sustainable way of financing for the entity, followed by the issuance of debt instruments and credit lines, while the entity's capitalization has remained conservative relative to its asset risk and it is avoided any unanticipated dividend payout (moodys.com).

Another overleveraged firm from the sample is **Atlantia S.p.A.**, which is an Italy-based company globally active and engaged in the construction and development of toll roads and airport management; more specifically, the firm operates in five segments: Italian motorways, Overseas motorways, Italian airports, Overseas airports, and other activities, including infrastructure-related services, such as engineering, maintenance and electronic payment services provided through the group's subsidiaries. The core business is focused on the motorway activities in which Atlantia is the global leader through the management of more than 14.000 kilometers of toll motorways under concession in 16 countries, while the airport activities involve the operation of airports in Italy and France.

Similarly to the automotive sector, also the building products and heavy construction industry is highly capital-intensive, requiring companies to bear large fixed costs and continuously high capital expenditures for the maintenance and improvements of products and services. Atlantia has become the leader of its industry also thanks to a robust financial and patrimonial condition, in which the capital-intensive nature of his reference sector and its pretty low asset volatility has allowed to maintain a consistent level of indebtedness; however, during 2018 the group has substantially increased its leverage because of the acquisition of Abertis Group, which has let Atlantia to consolidate its leading position in the global toll roads and infrastructure industry but it also increased its level of leverage with respect to the optimal condition, as it can be shown in the image 3.5 (atlantia.it).

Image 3.5: Change in Atlantia's net debt during 2018



(Image source: atlantia.it)

The 60% of takeover has been funded by the issuance of debt, while the remaining 40% has been provided through an equity contribution from shareholders, which will be partially compensated by the sales of minority stakes, the planned disposals of some noncore assets, and the exploitation of some synergies from the joint operation of assets in overlapping regions; this reflect Atlantia's typically prudent risk management in avoiding the issuance of new shares, following the Pecking Order Theory.

Such acquisition has been the main reason for which the company has increased its overall cost of debt and both Moody's and Standard & Poor's have rated as "negative" the outlook of its debt, despite the rating agencies' still high expectations that Atlantia could effectively manage the decline in its credit ratios: the group has always benefited from a stable and high profitability over time, as well as its liquidity is supported by well-established relationships with banks, generally high standing in capital markets, and effective risk management. The combination of disposals, synergies, and strong growth of the consolidated group's cash flows derived from the acquisition of Abertis is probably going to strengthen Atlantia's competitive position and to allow a quick de-leveraging of its capital structure (autostrade.it).

The last overleveraged firm resulting from our model is **Telecom Italia S.p.A.**, one of the biggest companies in the telecommunications industry, which is another significantly capital-intensive sector characterized by substantially high costs required

to invest in both hardware and software innovative infrastructures across all the multiple segments and business areas of the whole telecommunications sector, and to continuously improve their networks to steal costumers from competitors. As a consequence, the industry is highly competitive and even the biggest companies might suffer a decline in their incomes and market share in few years, thus leading to the strong necessity to constantly improve their offerings and change their business models. This is a remarkable peculiarity of this sector, where the increasing need for telecommunication services let persist the global demand, regardless the general trends of the world's economy, but individual players can rise and fall quite quickly, as technological advances or some aggressive M&A transactions might induce the decline of big companies in a relatively little time, despite the low earnings volatility generally associated to this industry (telecomitalia.com).

Given this picture, it is not surprising to observe a high optimal leverage for telecommunication firms, but Telecom Italia's indebtedness has been enormous over the last twenty years, reaching a ratio between net debt and EBITDA even larger than 3,5 in 2018. Telecom Italia was born as a publicly-owned company and it was one of the most florid during 90s, but since its privatization in 1997 it has been subjected to several hostile takeovers founded through high financial leverage; in particular, in 1999 the group was the target of the biggest leveraged buyout transaction ever occurred in Italian history, in which Telecom Italia was forced to bear the total amount of liabilities of the acquiring company, thus increasing even more its leverage. Since then, the company suffered other similar transactions and continued to make considerable profits, but the necessity to repay the consistent debt obligations and to distribute dividends to the owners prevented the company to grow more and to reduce its massive indebtedness, which has instead grown more and more, but the bankruptcy has been avoided only through the reduction of strategic investments, the disposal of core assets and subsidiaries and the fire of thousands of employees (Decina, 2016).

This corporate example can be related to the agency costs models for capital structure, where the majority shareholders has often addressed the (not always independent) management to pursue actions in their best interests, relieving the consequences of their actions to the company itself and therefore to the minority shareholders, as the extreme equity volatility resulting from those takeovers have often turned in huge losses for them, corresponding to large profits for the biggest owners; moreover, the

frequent changes in senior management have hindered the ability to execute any strategy actually oriented toward the long-term growth. As a consequence, Telecom Italia's rating has always been severe, and also in 2018 the group has not been able to de-leverage its balance sheet as it was planned at the beginning of the year, while the significant investments made to acquire the rights to dispose of the new 5G frequency recently developed have maintained an extremely high level of leverage. For this reason, Telecom Italia's cost of debt has remained higher than the optimal and the rating agencies have maintained a negative outlook, especially because of the increasing competitiveness the company has to face, the expectations of revenues decline and the continued need for capex investments, which have restricted the amount of cash flows available and the ability to de-leverage the balance sheet (repubblica.it).

3.3.3 Underleveraged firms

After the analysis of the overleveraged companies, now will be evaluated those firms that are resulted underleveraged from this model.

The first company is **Campari-Milano S.p.A.**, the world's sixth-largest firm in the premium-spirits sector of the beverage industry, with leading positions in Europe and the Americas thanks to a strong geographical diversification and a wide portfolio of profitable spirit brands. The beverage industry is a mature sector including both nonalcoholic and alcoholic products, and it has highly evolved over the last few decades in terms of product quality, constant introduction of innovative products and packaging solutions and requirements of high orders, as the global demand is somewhat inelastic across expansion and recession periods. The optimal level of leverage achieved through the Merton model for Campari revolves around 45 %, due to a lower capital-intensity nature of the beverage industry and a medium asset volatility (marketresearchreports.com).

Campari is one of the brightest companies in our sample with regard to capital structure: the group has been always established as a solid brand, but especially during the last three years has registered outstanding results in terms of both operative margins and financial strength. By seizing favorable market conditions, Campari had carried out some important liability management actions aimed at reshaping its debt structure, reducing the amount of interest expenses and lengthening debt maturities,

following a strategy mainly focused on the organic generation of operating cash flows; since 2016, the group has doubled its level of earnings, strongly reduced its short-term indebtedness and increased its liquidity through the higher profitability registered and the sale of some no-strategic businesses, thus substantially improving its net financial position (camparigroup.com).

Therefore, Campari seems to follow the Pecking Order Theory's view, by relying on internally generated equity as primary source of funding, then on medium/long-term debt instruments; this is confirmed also by considering that the net payout per single dividend is increased, but the overall dividend payout-ratio has highly reduced (19,3% in 2018 against 35,4% in 2014) and the last equity issuances is back at 2010. Another management's aim is probably signaling to markets a financial solidity, in order to attract more potential investors and increase the market capitalization. Those positive results have been confirmed by rating agencies that have maintained the Campari's rating as "BBB" with a stable outlook: this substantially reflects the sustained improvement of the group's credit metrics over the last years and the overall financing policy oriented towards the achievement of a balanced and prudent capital structure, the mitigation of liquidity risk and the maintenance of a relatively low cost of debt, as it is also confirmed by the implementation of Merton model (crifratings.com).

Another company is **Tenaris S.A.**, a leading global manufacturer in the steel industry through the supply of steel pipe products and related services for the global energy industry and for other industrial applications across the world; in particular, the group operates in a highly competitive marketplace where are required the development of specific skills and considerable investments in manufacturing facilities, as well as the costs to comply with the legislation about energy and environment across all the world. Moreover, the steel industry's major consumer is the oil and gas industry, so, like its competitors, Tenaris's profits are highly sensitive to the fluctuation in oil and gas prices that have always shown a strong volatility. Therefore, it is easy to understand that Tenaris' prices and revenues are affected by several factors, hence the optimal capital structure should not be too leveraged because the highly capital-intensive nature of industry is counterbalanced by a quite large asset volatility and operating risk (ir.tenaris.com).

However, Tenaris shows a relatively low level of leverage compared to the optimal one of its industry: this is mainly due to its historical willingness to maintain a conservative

capital structure in order to not suffer the heavy consequences of an excessive indebtedness during negative trends in the economy. As a matter of fact, despite its considerable volatility of assets, Tenaris has achieved to successfully adapt its cost and capital structure during the most recent oil and gas downturn on 2014, by maintaining low leverage ratios, high profitability metrics and positive operating cash flows. This strong credit profile has been obtained also through a geographically well diversified portfolio of production facilities, which is able to reduce its exposure to any single market and, consequently, to the overall business risk. As a result of these consistently robust credit metrics, the group is usually given a positive rating also in periods of downturn, as rating agencies appreciate Tenaris's conservative financial policies oriented towards managing its liquidity and capital resources to ensure adequate flexibility to manage its planned capital spending programs, to service its debt and to effectively address short-term changes in such volatile business conditions. Moreover, given its historical track record, the group has plenty of leverage capacity and its partner banks are not usually reluctant in offering considerable amounts of financing at short notice. This strong attention to ratings assigned, together to the willingness to build long-term relationships with financial intermediaries, also shows that Tenaris is probably focused on sending signals to capital markets about its solid creditworthiness also in negative periods, so to improve their perception about the company's solidity and increase the easiness in accessing external financing, as states the signaling theory (reuters.com).

Especially in 2018 the group has achieved outstanding results in terms of margins and compliance with all of its debt covenants, thus consolidating its financial position which has result in an "A-" credit rating and a positive outlook affirmed by Fitch Ratings (cbonds.com).

A similar analysis can be made for **STMicroelectronics N.V.**, which is a global leader in the semiconductor market of the technological industry, whose product portfolio addresses four broad markets: automotive, industrial, personal electronics and communications equipment, computers and peripherals. Again, the semiconductor industry is characterized by an intense competition, high fixed costs associated with large capital requirements and a strongly cyclical nature due to both global economic conditions and industry-specific issues. STM's investments are generally higher compared to other competitors, as a result of its choice to maintain control of a large

portion of its manufacturing technologies and capabilities without outsourcing, so that are required significant capital expenditures to maintain and upgrade such facilities in the long run in order to support key strategic initiatives.

Despite such large need for funding, the optimal level of indebtedness remains medium because the cyclical downturns to which the semiconductor industry is subjected increase the overall business risk, which is reflected in a relatively high asset volatility. Moreover, STM seems to prefer equity financing because are relatively frequent equity issuances and stock repurchases, probably in order to signal to investors that markets are undervaluing their stocks, so to try to increase the company's market capitalization. STM seeks for debt financing only when the market conditions are pretty favorable, and, more important, it has implemented over time a series of collaborations with other semiconductor industry companies, research organizations, universities, customers and suppliers in order to obtain several benefits such as the sharing of costs, reductions in their own capital requirements and the acquisitions of technical know-how. So, similarly to what occurs with Tenaris, all of these factors let understand that STM adopts conservative financing policies oriented towards the maintenance of a solid financial position and a relatively low cost of debt, especially through the generation of considerable cash flows from operations. This overview is confirmed by a stable outlook assigned by Moody's, Standard & Poor's and Fitch Ratings in 2018, when the group has reported very profitable results (investors.st.com).

A company coming from a completely different industry is **Recordati S.p.A.**, an Italian leader in chemical and pharmaceutical sector that is particularly specialized in the research and development of innovative drugs for rare diseases, finding in this niche a profitable opportunity fully exploited over time. Nowadays the pharmaceutical operations represent 97% of group's total revenues and are carried out in several countries and markets across the whole world. Such direct presence in these markets has been progressively extended mainly through the acquisition of existing commercial organizations with the aim of supporting proprietary drugs as well as through multi-territorial licenses to local products (recordati.com).

The pharmaceutical industry does not require the same level of capital intensity of the heavy manufacturing sectors, however it needs considerable amounts of resources especially for research and developments activities and for licenses for distribution. Some researchers have shown that pharmaceutical companies have increased their

ratio of intangible assets to productive capital and cash, implying that they rely more on rent-generating assets rather than their productive capacity in order to generate profits; at the same time, to bear the higher costs the financial leverage of pharmaceutical companies has also increased over the years (Baranes, 2017).

However, Recordati has always achieved to maintain relatively low its level of indebtedness, following several peculiarities of the Pecking Order Theory: the group has put in place a sustainable and profitable business mostly characterized by an appreciable ability to generate net earnings, which have been more than doubled from 2011 to 2017; as a consequence, the company's market capitalization has highly risen and the group time by time has increased its dividend payouts and made share repurchases to exploit the huge rise in stock value (as shown by the image below), thus signaling to capital markets the forecast of future positive results.

Image 3.6: Recordati's stock value trend over the last 5 years

(Image source: educazionefinanziaria.com)

The Enterprise Value/EBITDA, which measures the ratio between the firm market value net of debt and the capacity to generate free cash flows, is around the double of the average value of pharmaceutical industry; given such strong generation of internal equity, Recordati has always decided to maintain a prudent leverage. This has been a wise choice because nowadays banks and financial intermediaries are less willing to grant loans to pharmaceutical companies, so the external growth would be surely more struggling for a company like Recordati (Marsilio, 2018).

Also for such willingness to not increase its leverage for competing more with the biggest global pharmaceutical companies, during 2018 Recordati decided to sell the 51,8% of his shares (originally belonging to Recordati family, while the remaining shares are widespread in capital markets) to the private equity fund CVC Capital Partners. This acquisition has been favored by the positive outlooks always released by rating agencies, which have always appreciated the strong credit position and ability to generate free cash flows of the entity (moodys.com).

Therefore, it might also be that Recordati has never wanted to increase its indebtedness also to receive favorable ratings from agencies and appear more attractive not only to individual investors in capital markets, but also to potential buyers.

Another company coming from a particular industry is **Moncler S.p.A.**, an Italy-based company engaged in fashion industry which designs, produces and distributes clothing and accessories through its own brand. The fashion industry has some peculiarities: first of all it does not require huge capital investments in tangible assets like manufacturing sectors, focusing more on the importance of brand and other intangible assets in order to shape the value proposition in consumers' minds. Moreover, since the demand for luxury clothes naturally reflects the overall trends of the economy, this sector suffers for a certain degree of cyclicality and, consequently, the earnings volatility is quite high. These peculiarities contribute to maintain a relatively low optimal leverage in fashion industry, which is usually characterized by high gross margins and huge amounts of liquidity to cover debt obligations, especially within the Italian market (monclergroup.com).

Moncler shows a current leverage ratio smaller then the optimal one, due to the implementation of a financial policy strongly aimed at de-leveraging its balance sheet through the extinction of most long-term debts and the use of certain credit policies that limit the overall exposition with banks and financial institutions: as a result, the debt-to-equity ratio has moved from 143,7% to 9,4% over the last 5 years, while the EBIT is perfectly able to cover the amount of interest expenses. This policy is probably due to the willingness to improve its credit ratings and the overall outlook with respect to the other competitors, as the luxury industry is highly competitive and most of Moncler's competitors (such as Armani, among the others) already benefit from huge liquidity resources and high-value ratings (proiezionidiborsa.it).

3.3.4 A particular case: firms from energy sector

Lastly, this paragraph concludes the analysis by evaluating two companies from this sample operating in two similar industries with a focus on the same field, the energy sector.

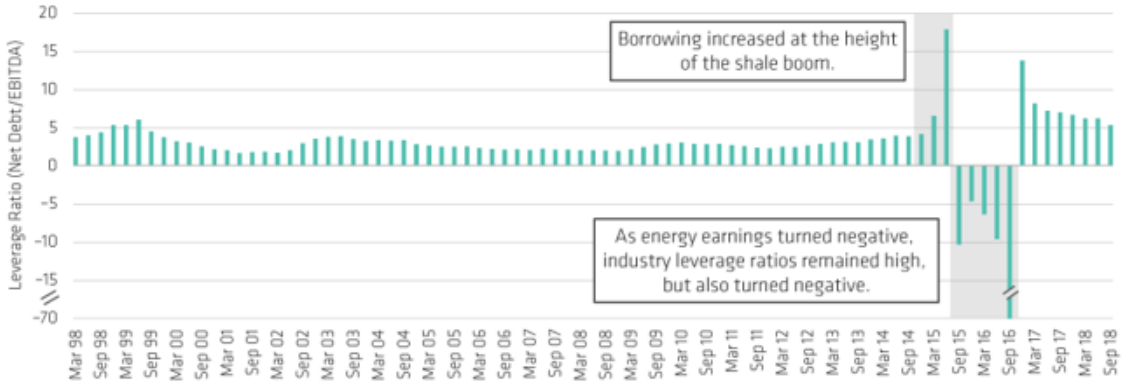
The first one is **Enel S.p.A.**, the largest Italian electricity provider and ranked among the leading energy companies of European and Latin American markets; it was born as a public owned company, but it was later privatized and listed in capital markets in 1992, with the Italian government as the largest shareholder owning 23,6% of shares. Enel operates in the public utilities industry, which encompasses all companies whose core business involves producing, generating or distributing the basic utilities: gas, electricity and water. Utilities companies typically offer products and services considered to be essential and not easily replaceable: therefore, the demand for their regulated services usually exhibits low cyclicality. In this industry companies are usually monopolistic that operate through exclusive concession to serve a specified territory, in exchange for the obligation to serve all customers in that area and comply with the regulation of its operations, hence those firms are generally shielded from direct competition and face low asset volatility. As a consequence, utilities companies usually earn large and stable amounts of income with low fluctuations in profitability, as revenue growth is expected to generally match GDP when economic conditions are positive. The utilities industry is also highly capital-intensive, so their firms often carry large levels of debt as their operations require consistent and periodic capital expenditures in infrastructures; however, they also have a huge amount of equity investment because they are such "bedrock" stocks, as they are included in the investment portfolio of many funds and individual investors (spglobal.com).

This analysis perfectly fits also for Enel: given the nature of its industry, its level of indebtedness is expected to be particularly high without facing a substantial credit risk, as it can count on stable levels of profitability and huge market capitalization. Enel's current leverage ratio is slightly lower than the optimal one, probably due to its intention to improve its credit rating from the last years: indeed, at the beginning of 2019 the major rating agencies have turned Enel's outlook from stable to positive, especially because of its progress in de-leveraging, as the net financial debt has increased in 2018 but it has more than proportionally compensated by the generation of free cash flows from operations; moreover, were evaluated also the excellent results

in all the economic-financial indicators and the increasing international diversification that helps reduce the earnings volatility (moodys.com).

A similar analysis can be made for **Eni S.p.A.**, a leading company engaged in oil and gas industry that sells gas, electricity and oil products in both European and extra-European markets, covering 43 different countries. Oil and gas sector is one the biggest industries in the world and, similarly to the utilities industry, it is one of the sectors known to be largely capital-intensive and leveraged; for this reason, high leverage ratios are usually tolerable in this sector, though indebtedness and overall profitability are strongly correlated to the oil and gas prices, which dramatically dropped during the 2007-09 global recession thus causing a persistent rise in the leverage of oil companies since then, as well as the bankruptcy of some of them. Therefore, the oil and gas industry is reasonably considered to be strongly cyclical and with the highest default risk for incumbent firms if debt is not managed well or if the global economic conditions result in downturns and let oil prices drop consistently: when the crude's price hit lows, the industry's overall earnings often turn negative, as it shown by the image 3.7 (Karim, Syed-Noh, Zaid, 2017).

Image 3.7: Volatility of leverage ratios in oil and gas industry



(Image source: Smith, Distenfeld, 2018)

Given such strong correlation with macroeconomic factors, companies from oil and gas industry usually bear higher asset volatility and larger expected costs of financial distress than utilities; this is confirmed also by this model, where Eni has a slightly lower optimal leverage ratio than Enel, but its asset volatility, cost of debt and distress expenses are more than the double, reflecting the larger overall risk.

In its challenging scenario, Eni has remained one of the strongest leaders: after the oil downturn, since 2014 the group began a process of transformation of its business model through which it has become more financially sustainable and resilient to the volatile context, also facilitated by the recent rise in oil prices. Its strategy guidelines concern basically the maximization of cash generation driven by production growth and geographical diversification strategy, in order to better manage the earnings volatility and reduce the need of debt financing. In this way, the entity seems to prefer Myers' pecking order approach, as the priority is to fund the capital spending with as much internally generated cash flows as possible; at the same time, the dividend policy has been always suited on the planned capital spending programs and the amount of cash flows produced, thus avoiding any sudden distribution of dividends . As a consequence of this more prudent financial policy, Eni's leverage ratio has turned to be the lowest of the last 12 years and among the best of the overall industry: it is a bit smaller than the optimal ratio, probably due to the necessity of improving its credit ratings that are also constrained by the relatively bad Italian sovereign rating and the volatile nature of oil and gas prices (moodys.com).

So, despite the high default risk of the energy sector and the huge capital requirements, both Eni and Enel have achieved to build and maintain a strong business model able to ensure sustainable results and growth; as a consequence, their leverage ratios are close to their optimal values and their expected costs of financial distress are extremely low, so the their probability of default is minimized.

CONCLUSIONS

At the end of the analysis made in this thesis it is possible to draw up some conclusions, regarding the results obtained and their implications for the literature about capital structure and leverage.

Within the framework of the With-costs-of-leverage method developed by Fernandez, the Merton model has been confirmed to be a suitable approach to derive the credit spread for a certain company, given its data; in particular, it has empirically proved to be an increasing function of the leverage ratio, the probability of default and the asset volatility of that firm. Its calculation has allowed the determination of the side effects of debt for each debt-to-equity ratio and the consequent optimal leverage ratio for every company of the sample, showing an inverse correlation of the latter with the volatility of assets: the higher the likelihood that future asset values could be smaller than the market value of total liabilities, the lower the convenience for the company to increase its indebtedness, thus confirming the previous researches in this field.

However, the scope of this analysis is a bit restrained, because of the limitations of the pure Merton model: the assumptions of constant asset volatility and risk-free rate are too simplistic, as well as the complexity of the capital structure (especially the liabilities) is probably not entirely considered in the model. As a result of these shortcomings, the resulting credit spread, cost of debt and costs of financial distress estimated seem to be too small compared to the values usually observed in capital markets, especially with regard to the analysis made through the current leverage ratios of the firms, in which the cost of debt of some overleveraged companies (such as Telecom Italia or Fiat Chrysler) appears actually too low with respect to their actual situation. The use of a KMV model specification would have probably been able to overcome some of those limitations, but it would have required a pretty larger database of companies instead of this sample of ten firms. Moreover, should have underlined that the companies analyzed in this thesis are very big entities with some of the highest market capitalizations of the FTSI-MIB index, so in reality they have pretty complex capital structures not so easy to analyze through a single simplified model.

Despite the limitations, this work has provided several interesting implications, also confirming some researches previously conducted in these fields regarding the validity and boundaries of the Trade-off Theory, under whose framework has been developed this analysis. Apart of the already discussed correlation exhibited by the costs of financial distress and the optimal leverage ratio with the company's assets and their volatility, it has been further demonstrated that a certain capital structure chosen by a firm is not an internal solution, but rather it mostly depends on the states of things and external conditions; companies facing lower risks and operating in less cyclical businesses will be more likely to benefit from a longer and more stable situation of financial health, so they will be allowed to borrow more funds with more easiness. Moreover, the analysis made in this thesis has been conceptually developed within the static framework of the Trade-off Theory, but can be easily recognized some implications of its dynamic approach: if the target debt ratio is enlarged in a 10-15% range of optimal values, almost all of the companies from the sample basically fall over there, and some examples (like Campari, Moncler, Eni) have demonstrated to tend their levels of leverage towards the optimal values in the long-run through de-leveraging processes empirically put in place.

However, despite its robustness, the scope of this analysis has also shown the typical limits of the Trade-off Theory: since all the actual leverage ratios currently exhibited by the companies from the sample diverge from their optimal values computed through the Merton model, the Trade-off Theory is not able to encompass all the factors affecting the capital structure, as Myers stated back in 1984 when he developed his *"The Capital Structure Puzzle"*. In particular, the analysis made in this thesis basically confirms most of the results discovered by Fama and French in their comparison between the Trade-off Theory and the Pecking Order Theory conducted in their paper *"Testing Trade-off and Pecking Order predictions about dividends and debt"* (2002). Indeed, also in this work has been found out that higher levels of investments (usually led by more capital-intensive industries) are associated with larger indebtednesses, as stated by both theories, while the most profitable companies are often less leveraged, thus contradicting the Trade-off Theory; this fact can be due to several reasons, but in this sample the main cause was the preference for internally generated equity through the organic free cash flows production as primary source of financing, giving credits to the Pecking Order Theory. To support this fact, many companies have also shown to adjust

their dividend policies with respect to their financial condition, thus demonstrating that retaining earnings is generally considered to be one of the most important factors to contrast fluctuations in profitability and operating risks. Moreover, apart of the strong empirical relevance of the Pecking Order Theory, also agency costs and informational asymmetries have confirmed their impact in capital structure choices, like it can be seen in the case of Telecom Italia, as well as even the signaling theory might be taken into consideration: the frequency by which the firms from the sample decide to de-leverage their balance sheets might be also seen as a willingness to improve their ratings released by external agencies, although would be required more specific tests to actually prove this fact.

Anyway, these factors are typically not included in the predictions made within the Trade-off Theory's framework, where the capital structure is just the resulting balance between the value of the interest tax shields and the expected value of the costs of financial distress. Despite such limitations, however, this theory has provided the fundamental steps to achieve the optimal capital structure for any entity, and its robustness in corporate finance literature and practice has been proved over the years, as also this thesis has further confirmed.

IMAGES LIST

TABLES LIST

BIBLIOGRAPHY

AHMETI F., PRENAJ B., (2015), *A critical review of Modigliani and Miller's theorem of capital structure*, International Journal of Economics, Commerce and Management, Volume 3.

AJANTHAN A., (2013), *Capital structure and financial performance: a study of listed trading companies in Sri Lanka*, An International Multidisciplinary Research Journal, Volume 3.

ALTMAN E., (1968), *Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy*, The Journal of Finance, Volume 23.

ALTMAN E., (1984), *A Further Empirical Investigation of the Bankruptcy Cost Question*, The Journal of Finance, Volume 39.

ALTMAN E., KISHORE V., (2001), *The Default Experience of U.S. Bonds*, Working Paper, Salomon Centre.

BALCOMBE J., (2016), *Optimizing Capital Structure and the Level of Debt Assumption*, [online], BvaGroup, November 4. Available on <https://www.bvagroup.com/publications/2016/04/11/optimizing-capital-structure-and-the-level-of-debt-assumption>

BARANES A., (2017), *Financialization in the American Pharmaceutical Industry: A Veblenian Approach*, Journal of Economic Issues, Volume 51.

BARCLAY M., SMITH C., (2005), *The Capital Structure Puzzle: The Evidence Revisited*, Journal of Applied Corporate Finance, Volume 17.

BEAVER W., (1966), *Financial Ratios as Predictors of Failure*, Journal of Accounting Research, Volume 4.

BEAVER W., CORREIA M., McNICHOLS M., (2010), *Financial Statement Analysis and the Prediction of Financial Distress*, Foundations and Trends in Accounting, Volume 5.

BERK J., DEMARZO P., (2016), *Corporate Finance*, 4th edition, Pearson Education Limited.

BOHN J., CROSBIE P., (2003), *Modeling default risk*, KMV Corporation.

BOWEN R., DALEY L., HUBER C., (1982), *Evidence on the Existence and Determinants of Inter-Industry Differences in Leverage*, Financial Management, Volume 11.

BRANDER J., LEWIS T., (1986), Oligopoly *and Financial Structure: The Limited Liability Effect*, The American Economic Review, Volume 76.
BREALEY ET AL., (2012), *Principles of Corporate Finance*, McGraw-Hill Education.
CASTANIAS R., (1983), *Bankruptcy Risk and Optimal Capital Structure,* The Journal of Finance, Volume 38.
CHEN J., STRANGE R., (2005), *The Determinants of Capital Structure: Evidence from Chinese Listed Companies*, Economic Change and Restructuring, Volume 38.
CHOI J., RICHARDSON M., (2016), *The volatility of a firm's assets and the leverage effect*, The Journal of Financial Economics, Volume 121.
COOPER I., (2001), *The Cost of Debt*, Working Paper, London Business School.
CORREIA M., KANG J., RICHARDSON S., (2017), *Asset Volatility*, Review of Accounting Studies, ISSN 1380-6653, London School of Economics.
CREMADES A., (2018), *Debt vs. Equity financing: pros and cons for entrepreneurs*, [online], Forbes, August 19. Available on <https://www.forbes.com/sites/alejandrocremades/2018/08/19/debt-vs-equity-financinpros-and-cons-for-entrepreneurs/#19c1249f6900>
DAMODARAN A., (2016), *Damodaran on Valuation: Security Analysis for Investment and Corporate Finance*, 2nd edition, John Wiley & Sons.
DECINA M., (2016), *Telecom, un "mostro" chiamato debito*, [online], ScenariEconomici.it, April 23. Available on <https://scenarieconomici.it/telecom-un-mostro-chiamato-debito-di-maurizio-matteo-decina-analista-finanziario-ed-economico/>
DIAMOND D., (1989), *Reputation Acquisition in Debt Markets*, Journal of Political Economy, Volume 97.
DONHEISER J., (2018), *A Few Industries Are Behind Rising Corporate Leverage*, [online], The Wall Street Journal, August 18. Available on <https://www.wsj.com/articles/a-few-industries-are-behind-rising-corporate-leverage-11566129600>
DUDLEY E., (2007), *Testing Models of Dynamic Trade Off Theory*, SSRN Electronic Journal.
FAMA E., FRENCH K., (2002), *Testing Trade Off and Pecking Order predictions about Dividends and Debt*, The Review of Financial Studies, Volume 15.
FAMA E., FRENCH K., (2005), *Financing decisions: who issues stocks?*, Journal of Financial Economics, Volume 76.

FERNANDEZ P., (2007), *Valuing companies by cash flow discounting: ten methods and nine theories*, Managerial Finance, Volume 33.
FISCHER E., HEINKEL R., ZECHNER J., (1989), *Dynamic Capital Structure Choice: Theory and Tests*, The Journal of Finance, Volume 44.
HARRIS M., (1991), *The Theory of Capital Structure*, The Journal of Finance, Volume 46.
HARRIS M., RAVIV A., (1988), *Corporate control contests and capital structure*, Journal of Financial Economics, Volume 20.
HARRIS M., RAVIV A., (1990), *Capital Structure and The Informational Role of Debt*, The Journal of Finance, Volume 45.
HORVATOVA J., MOKRISOVA M., (2018), *Risk of Bankruptcy, Its Determinants and Models*, Risks, Volume 6.
ISRAEL R., (1992), *Capital and Ownership Structures, and the Market for Corporate Control*, The Review of Financial Studies, Volume 5.
JALIVAND A., HARRIS R., (1984), *Corporate Behavior in Adjusting to Capital Structure and Dividend Targets: An Econometric Study*, The Journal of Finance, Volume 39.
JAROS J., BARTOSOVA V., (2015), *To the capital structure choice: Miller and Modigliani model*, Procedia Economics and Finance, Volume 26.
JENSEN M., MECKLING W., (1976), *Theory of the firm: managerial behavior, agency costs and ownership structure*, Journal of Financial Economics, Volume 3.
JONES S., HENSHER D., (2008), *Advances in credit risk modelling and corporate bankruptcy prediction*, 1st edition, Cambridge University press.
JUDE M., (2016), *Measuring a company's risk of bankruptcy*, [online], Shenehon, August 24. Available on <http://www.shenehon.com/measuring-companys-risk-bankruptcy/>
KARIM Y., SYED-NOH S., ZAID N., (2017), *Financial risk and leverage relationship of oil and gas companies in Malaysia*, International Journal of Business, Economics and Law, Volume 14.
KLIESTIK T., MISANKOVA M., (2015), *Logit and Probit application for the prediction of bankruptcy in Slovak companies*, Procedia Economics and Finance, Volume 12.
KRASKER W., (1986), *Stock Price Movements in response to Stock Issues under Asymmetric Information*, The Journal of Finance, Volume 41.
KRAUS A., LITZENBERGER R., (1973), *A state-preference model of optimal financial leverage*, The Journal of Finance, Volume 28.

MAKSIMOVIC V., (1988), *Capital Structure in Repeated Oligopolies*, The RAND Journal of Economics, Volume 19.
MARSILIO C., (2018), *Due saldi estivi da non perdere: Recordati & Prysmian*, [online], GBInvesting, July 6. Available on <https://www.gbinvesting.com/articoli/1075-due-saldi-estivi-da-non-perdere-recordati-prysmian>
MERTON R., (1974), *On the pricing of corporate debt: the risk structure of interest rates*, The Journal of Finance, Volume 29.
MILLER, M., (1977), *Debt and taxes*, The Journal of Finance, Volume 32.
MODIGLIANI F., MILLER M., (1958), *The Cost of Capital, Corporation Finance and the Theory of Investment*, The American Economic Review, Volume 48.
MYERS S., (1984), *The Capital Structure Puzzle*, The Journal of Finance, Volume 39.
MYERS S., MAJLUF N., (1984), *Corporate financing and investment decisions when firms have information that investors do not have*, Journal of Financial Economics, Volume 13.
NARAYANAN M., (1988), *Debt versus Equity under Asymmetric Information*, Journal of Financial and Quantitative Analysis, Volume 23.
OHLSON J., (1980), *Financial Ratios and the Probabilistic Prediction of Bankruptcy*, Journal of Accounting Research, Volume 18.
OPLER T., TITMAN S., (1994), *Financial Distress and Corporate Performance*, The Journal of Finance, Volume 49.
PAGANO M., (2005), *The Modigliani-Miller Theorems: A Cornerstone of Finance*, Centre for Studies in Economics and Finance (CSEF), Working Paper n.139.
PINDADO J., RODRIGUES L., (2005), *Determinants of Financial Distress Costs*, Financial Markets and Portfolio Management, Volume 19.
PRIYA C., (2019), *Capital Structure*, [online], TheInvestorsBook, February 28. Available on <https://theinvestorsbook.com/capital-structure.html>
ROSS S., (1977), *The Determination of Financial Structure: The Incentive-Signalling Approach*, The Bell Journal of Economics, Volume 8.
SAINT-LEGER R., (2018), *What Industry Typically Has The Highest Debt-to-Equity Ratios?*, [online], The Nest, June 28. Available on <https://budgeting.thenest.com/industry-typically-highest-debttoequity-ratios-24143.html>
SARIG O., (1988), *Bargaining with a corporation and the capital structure of the bargaining firm*, Working Paper, Tel Aviv University.

SMITH W., DISTENFELD G., (2018) *Will Energy Bonds Hold Up In A Volatile Oil Market?*, [online], SeekingAlpha, November 13, available on <https://seekingalpha.com/article/4221590-will-energy-bonds-hold-volatile-oil-market>

STIGLITZ J., (1969), *A Re-Examination of the Modigliani-Miller Theorem*, The American Economic Review, Volume 59.

STULZ R., (1990), *Managerial discretion and optimal financing policies*, Journal of Financial Economics, Volume 26.

SUNDARAM R., (2001), *The Merton/KMV Approach to Pricing Credit Risk*, Working Paper, Stern School of Business, New York University.

SWANSON Z., SRINIDHI B., SEETHARAMAN A., (2003), *The Capital Structure Paradigm: Evolution of Debt/Equity Choices*, Greenwood Publishing Group.

TITMAN S., (1984), *The effect of capital structure on a firm's liquidation decision*, Journal of Financial Economics, Volume 13.

WARD T., FOSTER B., (1997), *A Note on Selecting a Response Measure for Financial Distress*, Journal of Business Finance & Accounting, Volume 24.

WARNER J., (1977), *Bankruptcy Costs: Some Evidence*, The Journal of Finance, Volume 32.

WEISS L., (1990), *Corporate Bankruptcy: Economic and Legal Perspectives*, Cambridge University Press.

WEISS L., (1996), *Bankruptcy resolution: direct costs and violation of priority of claims*, Cambridge University Press.

WILKINSON J., (2013), *Financial Distress Costs*, [online], TheStrategicCFO, July 23. Available on <https://strategiccfo.com/financial-distress-costs/>

WOODRUFF J., (2019), *The advantages and disadvantages of debt and equity financing*, [online], Chron, March 4. Available on < https://smallbusiness.chron.com/advantages-disadvantages-debt-equity-financing-55504.html>

YUSOF M., JAFFAR M., (2012), *The analysis of KMV-Merton model in forecasting default probability*, Conference Paper, 2012 IEEE Symposium on Humanities, Science and Engineering Research.

ZIELINSKI T., (2013), *Merton and KMV models in credit risk management*, Working Paper, University of Economics in Katowice.

SITOGRAPHY

www.atlantia.it: *Annual Report 2018*, available on <https://www.atlantia.it/documents/20184/27156/atlantia_annual_report_2018.pdf>

www.autostrade.it: *Standard & Poor confirms Autostrade per l'Italia's rating, upgrading outlook to stable*, May 15, 2018, available on <https://www.autostrade.it/en/investor-relations/comunicati-stampa-finanziari?p_p_id=comunicatiinvestor_WAR_comunicatiportlet&p_p_lifecycle=2&p_p_state=normal&p_p_mode=view&p_p_resource_id=downloadAttachment&p_p_cacheability=cacheLevelPage&p_p_col_id=column-1&p_p_col_count=1&_comunicatiinvestor_WAR_comunicatiportlet_id=1726&_comunicatiinvestor_WAR_comunicatiportlet_jspPage=%2Fhtml%2Finvestor%2Fview.jsp&_comunicatiinvestor_WAR_comunicatiportlet_action=viewDetail&_comunicatiinvestor_WAR_comunicatiportlet_itemId=1308>

www.borsaitaliana.it: *Borsa Italiana: Capitalisation FTSE MIB basket on 28.12.2018*, available on <https://www.borsaitaliana.it/borsaitaliana/statistiche/statistiche-storiche/capitalizzazioni/2018/201812/capitalizzazionesep_pdf.htm>

www.camparigroup.com: *Davide Campari Milano S.p.A. Annual report at 31 December 2018*, available on <https://www.camparigroup.com/sites/default/files/docs/annual_report_2018.pdf>

www.cbonds.com: *Fitch Ratings affirms Tenaris at "A-" (LT Int. Scale (foreign curr.) credit rating); outlook positive*, February 26, 2018, available on <http://cbonds.com/news/item/986089>

www.chron.com: *Risk of both debt & equity capital to companies*, available on <https://smallbusiness.chron.com/risk-debt-equity-capital-companies-46350.html>

www.corporatefinanceinstitute.com: *Unlevered cost of capital*, available on <https://corporatefinanceinstitute.com/resources/knowledge/valuation/unlevered-cost-of-capital/>

www.crifratings.com: *CRIF Ratings upgrades Campari's unsolicited long term issuer rating to "BBB". Outlook is "stable"*, March 21, 2019, available on <https://www.crifratings.com/en/rating-actions/campari-spa-21032019-rating-update-unsolicited/>

www.educazionefinanziaria.com: *Azioni Recordati, investire nella farmaceutica italiana*, August 25, 2017, available on <https://www.educazionefinanziaria.com/investire-in-borsa/azioni-recordati-farmaceutica-italiana/>

www.enel.com: *Annual Report 2018*, available on <https://www.enel.com/content/dam/enel-com/governance_pdf/reports/annual-financial-report/2018/annual-report-2018.pdf>

www.eni.com: *Eni Annual Report 2018*, available on <https://www.eni.com/docs/en_IT/enicom/publications-archive/publications/reports/reports-2018/Annual-Report-2018.pdf>

www.fcagroup.com: *2018 Annual Report*, available on <https://www.fcagroup.com/it-IT/investors/financial_regulatory/financial_reports/files/FCA_NV_2018_Annual_Report.pdf>

www.finance.yahoo.com: available on <https://finance.yahoo.com/>

www.investing.com: *Rendimento obbligazione Germania 10 anni*, available on <https://it.investing.com/rates-bonds/germany-10-year-bond-yield-historical-data>

www.investors.st.com: *Annual Report 2018*, available on <http://investors.st.com/static-files/a478aa6f-d026-4902-860f-b4ce3bfdec64>

www.ir.tenaris.com: *Annual Report 2018*, available on <http://ir.tenaris.com/static-files/34474989-39a1-42c7-8686-5ee8cab38ef3>

www.marketresearchrepost.com: *Beverages*, available on <https://www.marketresearchreports.com/beverages>

www.monclergroup.com: *Annual Report 2018*, available on <https://www.monclergroup.com/wp-content/uploads/2018/04/Moncler_Annual-Report-2018_ENG.pdf>

www.moodys.com: available on <https://www.moodys.com/>

www.proiezionidiborsa.it: *Moncler: sarà ancora un titolo sul quale puntare?*, January 28, 2019, available on <https://www.proiezionidiborsa.it/moncler-lusso-rialzo-borsa/>

www.recordati.com: *Annual Report 2018*, available on <https://www.recordati.com/resources/Pubblicazione/__481cdc6f736d449ca4e8eb3aa337f62d_/annual_report_rec_18-.pdf>

www.repubblica.it: *Fitch vede nero sulla futura qualità del debito di Telecom*, October 5, 2018, available on <https://www.repubblica.it/economia/finanza/2018/10/05/news/fitch_vede_nero_sulla_futura_qualita_del_debito_di_telecom-208248790/>

www.reuters.com: *Fitch Affirms Tenaris' IDR at 'A-'; Outlook Revised to Positive*, March 14, 2017, available on <https://lta.reuters.com/articulo/fitch-affirms-tenaris-idr-at-a-outlook-r-idLTAFit992669>

www.sapling.com: *What Industry Typically Has The Highest Debt Equity Ratios?*, available on <https://www.sapling.com/8274597/industry-highest-debt-equity-ratios>

www.spglobal.com: *Key Credit Factors For The Regulated Utilities Industry*, November 19, 2013, available on <https://www.maalot.co.il/Publications/MT20180809101627.PDF>

www.stern.nyu.edu: *Country Default Spreads and Risk Premiums*, available on <http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ctryprem.html>

www.telecomitalia.com: *2018 Annual Report*, available on <https://www.telecomitalia.com/content/dam/telecomitalia/en/archive/documents/investors/Annual_Reports/2018/TIM-Annual-report-2018.pdf>