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Research and analysis of the factors influencing the capital structure in Italian high-tech companies

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Abstract

In this paper, we contribute to the debate on the factors that most influence the financial choices of Italian companies in the high-tech sector. To answer this question, we utilized a panel of 2,143 high-tech companies in our country with data available from 2019 to 2024. For our analysis, we selected seven independent variables: size, age, intangibility of assets, profitability, R&D intensity, liquidity, and growth opportunity; and one dependent variable: leverage. The results of the empirical analysis conducted showed a significant relationship with all the variables analyzed in the sample except for one, the growth opportunity. These results show a mixed situation in financing choices, with a tendency for small and medium-sized enterprises in the high-tech sector to rely on external sources of financing, contrary to initial hypotheses, and instead a propensity of more mature companies to self-finance. In addition, it was observed that the intensity of research and development projects is positively associated with the use of debt, as expected. Finally, liquidity and intangibility of assets were found to have a negative impact on leverage, confirming our hypotheses.

Introduction

The search for optimal capital structure has been and remains one of the most debated topics among scholars. Numerous theories have emerged over the years, some of which assert that capital structure is irrelevant for the evaluation of a company's value, such as Modigliani & Miller's classical theory, while others, adopting a static approach, argue for the existence of an optimal capital structure achieved through balancing all costs in a company, as postulated by the Trade-off Theory. Another theory, the Pecking Order Theory, denies the existence of a perfect capital structure and establishes hierarchies of funding sources, from the most desired, internal sources, to the least, such as equity.

More recent theories, embracing a more dynamic interpretation of financing choices, suggest that a firm should adjust its capital structure according to its life stages. Berger and Udell in 1998, and later Dickinson in 2011, proposed the Financial Life Cycle approach based on this assumption.

The Market Timing Theory is probably the most recent theory on capital structure, which points out that a company should choose its financial structure based on market movements, financing itself with equity when market prices are favorable and vice versa.

As we will see, there are various interpretations regarding this discussed topic, with many more assumptions regarding the optimal capital structure for the high-tech market. In this study, however, we will analyze a topic that has not been so much discussed by the scholars: the high-tech market in Italy. Even being a sector in rapid expansion and with significant growth prospects, the Italian high-tech sector faces strong competition from other European countries and global giants such as Korea, the United States, and Japan.

Therefore, this paper will examine the Italian situation in the technology sector and will analyze which are the factors that most influence the financing choices of high-tech companies.

We considered seven factors for our analysis include company size, age, intangibility of assets, profitability, R&D intensity, liquidity, and growth opportunity.

Our panel consist of 2,143 high-tech companies operating in Italy from 2019 to 2023, obtained through the Aida database. After making hypotheses regarding the relationship between the variables and the dependent variable leverage of our high-tech companies, we conducted a linear regression analysis using Stata to test the actual influence of the independent variables on debt.

The results not only confirmed partially our hypotheses but also highlight that these companies choose their capital structure based on various needs, such as maturity level, the number of

investments in research and development, profitability, and available liquidity. The only non-significant result is about the growth opportunity, for which it is unclear whether it influences or not the financial choices of our panel.

This analysis stresses the need for managers to adopt a financial life cycle approach, making their decisions according to the life stage of each high-tech company.

The structure of this paper is as follows: the first chapter will focus on the different theories of capital structure and empirical studies conducted in recent years on this topic. We will then analyze and describe the factors to be considered for our regression analysis and formulate our hypotheses. The second chapter will provide a description of the high-tech market in Italy from the second post-war period to the present situation. In the third chapter, we will describe our panel and we will analyze the descriptive statistics. The fourth chapter will cover the correlation matrix and regression analysis between the variables. In Chapter Five, we will examine the results and engage in discussions. Our conclusions will follow.

Chapter 1 - Theoretical analysis of the Capital Structure and its determinants

1.1 Main theories of Capital Structure

The first part of this paper deals with a theoretical analysis of the capital structure, analyzing which main economic theories best describe the financing choices of High-Tech companies. Then, goes on to identify which factors influence a company in choosing between equity or debt capital; and, finally, we will assume, based on these theories, the hypotheses that we will subsequently prove through a multiple regression.

To begin with, we must define what a capital structure is. We can describe the capital structure as a combination of debt and equity that a firm allocates to finance its long-term assets (Coleman & M. Robb, 2012). On the other hand, the various costs related to long-term debt and equity are known as the firm's weighed average cost of capital (WACC) (Coleman & M. Robb, 2012).

Over the years, various theories have been formulated concerning the capital structure and its determinants; the first theorem, known as the basic postulate of modern capital structure theory, was published by Modigliani and Miller in 1958. Modigliani and Miller, under certain assumptions, such as perfect market conditions, no information asymmetry and, with the absence of transaction or bankruptcy costs, assumed that the value of a company was independent of the company's financial choices. Rather, the only factor that might influence a company's financial decisions were the expectations of cash flows (Kedzior, Grabinska, Grabinski, & Kedzior, 2020). This first formulation of M&M was an innovation at the time and became a fundamental basis for future theories of capital structure (Alipour & Mohammadi, 2015).

However, the above-mentioned assumptions cannot be applied to all types of companies. In fact, the companies we are going to analyze in this paper, high-tech companies, present a high level of information asymmetry (Coleman & M. Robb, 2012). In addition, the assumptions underpinning M&M's thinking are based on the fact that any company can freely choose how to finance itself; when in reality, in our world, and especially in the type of companies we will analyze in this paper, there are many factors that hinder a company from being able to finance itself either with equity or with debt capital. Indeed, for instance, because of the high expenses, recently founded businesses would not be able to finance themselves by issuing their own shares. (Coleman & M. Robb, 2012). It is also for this reason that in later years new hypotheses began to be formulated.

Thereafter, in 1963, M&M decided to extend their studies adding into the analysis the corporate income taxation. Through this introduction, they reviewed their considerations, saying that the deduction of the passive interests from the income could be a benefit for the company itself. Consequently, the so-called "corner solution," which favors debt financing, replaced the prior conviction that the capital structure shall remain independent from financial decisions (Bontempi & Golinelli, 1996). However, also in this case, because high-tech companies are too risky to be supported by debt and cannot thus take use of the financial shield, the traditional theories of Modigliani and Miller do not apply to them.

From this point on, increasing efforts were made to represent the distinctiveness of the real world in the analysis by positioning the most plausible hypotheses feasible.

In the theoretical study of the capital structure of tech-based companies, we must mention the *Agency Costs Theory*. This theory was developed in the 1970s and was published in 1976 by Jensen and Meckling. As stated by Jensen and Meckling themselves:

> "*We define an agency relationship as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent"* (Jensen & Meckling, 1976).

According to the two authors, both the owner and the manager of a company are utility maximizers and thus they will consistently act in their own self-interest (Jensen & Meckling, 1976). As a result, the owner will need to exert greater oversight over the manager, leading to additional expenses known as "agency costs" (Kedzior, Grabinska, Grabinski, & Kedzior, 2020). To mitigate the challenge of agency costs, there are various strategies available. For instance, one approach involves tying the manager's compensation to the company's performance. Alternatively, another research suggests that leveraging debt can also serve as a mechanism to incentivize managers to make prudent investment choices, thereby reducing agency costs (Novaes & Zingales, 1995).

Agency costs pose a significant challenge for high-tech companies, particularly for young ones. In modern business practices, the separation of ownership from control exacerbates these costs, leading to their substantial growth.

A few years earlier, in 1973, another fundamental theory on capital structure had been formulated by Kraus and Litzenberger: the *Trade-Off Theory* (TOT); later, it will be resumed by Ai, Sanati, and Frank in 2020 with a more in-depth study of dynamic trade-off models. This theory states that the best way to optimize capital structure is to balance all the company's expenses, including those related

to taxes, agencies, bankruptcy, and other costs (Alipour & Mohammadi, 2015). Therefore, as for M&M, also Kraus and Litzenberger assumed the existence of an optimal capital structure as a trade-off between a given level of debt and the associated level of tax shield. And, just as K&L stated in their paper:

> *"The problem of optimal capital structure is, therefore, formulated as the determination of that level of debt such that the resulting division of states (into those in which the firm is solvent and those in which it is insolvent) yields the maximum market value of the firm"* (Kraus & Litzenberger, 1973).

The Trade-Off Theory, as seen, is founded on the balance of positive and negative elements associated with debt financing; the negative ones are the risk of bankruptcy, due to which a company cannot take advantage of the tax benefits, and the agency costs, related to the information asymmetry between shareholders and bondholders. These negative aspects are counterbalanced by the positive ones that debt exerts on the overall value of the company, as well as by the tax advantages (Bontempi & Golinelli, 1996).

By using this approach, businesses can identify the best capital structure that will allow them to minimize borrowing costs and maximize tax deductibility (Kara & Erdur, 2015).

The TOT was the first theory to postulate a relationship between the company's profitability ratios and its capital structure; in fact, Kraus and Litzenberger found a positive correlation between a company's capital structure and its size, growth, and profit.

For innovative companies, financing decisions are highly complex within the framework of the trade-off theory. Estimating risks associated with various funding sources is particularly challenging for such firms, partly due to the rapid growth and continuous innovations, characteristic of high-tech companies. Due to the constant evolution of this market, technological firms lack substantial creditor assurances, making heavy reliance on debt impractical (Kedzior, Grabinska, Grabinski, & Kedzior, 2020).

An alternative approach to that of Kraus and Litzenberger was developed by Donaldson originally in 1961 and modified by Myers and Majluf in 1984; the so-called *'Pecking Order Theory' (POT)*. This theory is based on the assumption that there is no optimal capital structure and that there is a hierarchy between sources of financing (Alipour & Mohammadi, 2015).

Donaldson was the first to intuit, through a study on large, listed companies, that there was not a precise and optimal financial structure. Instead, these companies tended to prioritize internal funding over external sources.

This hierarchy arises from the problem of information asymmetry between shareholders, managers, and creditors. This is explained by the fact that outside investors will tend to underestimate the company's share price due to information asymmetry, which is why directors prefer to first resort to internal sources, such as retained earnings, after use debt, and only then resort to issuing new shares, in order to not dilute shareholder control (Myers & Majluf, 1984).

The Pecking Order Theory is particularly applicable to small businesses or private companies, where external financiers have greater difficulty obtaining financial information, leading to higher levels of information asymmetry. As a result, investors will demand a higher cost for equity capital due to increased risk. It is precisely for this reason that equity capital for small, private firms is the last choice in terms of financing options.

During the startup phase of a company, the informational asymmetry, lack of reputation, positive results, and collateral make it extremely challenging for such businesses to collect external financing. Hence, the capital of the company at this stage primarily consists of capital injected by the entrepreneur.

Regarding the type of companies we will analyze in this writing, the high-tech firms, we can assert that such entities have a high level of informational asymmetries leading them to an undervaluation and a preference for internal financial resources, especially if we are talking about small-sized companies (Kedzior, Grabinska, Grabinski, & Kedzior, 2020). Indeed, within technology firms, the challenge of informational asymmetry primarily arises from the uncertainty surrounding innovative procedures, the intricacies involved in overseeing R&D expenditures, and the consequent challenge for investors in comprehending the technical aspects of future projects (Revest & Sapio, 2012).

It is precisely from here that the need to resort to internal funding arises, due to an inevitable fear of information leakage and the subsequent loss of competitive advantage in the market (Kedzior, Grabinska, Grabinski, & Kedzior, 2020).

The choice of innovative companies to issue shares rather than seek debt financing is driven by the challenge of accessing loans, particularly due to the lack of assets available as collateral (Carpenter & Petersen, 2002).

Following these reflections, it becomes evident that small firms deviate from the principles of the pecking order theory, as they view issuing shares as their sole financing option due to limited transparency. Conversely, larger corporations adhere to the theory, benefiting from higher profits and reduced informational asymmetries.

As we have just seen, different theories are not equally applicable to all types of companies. And it is precisely for this reason that Berger and Udell developed a new approach to the study of capital structure in 1998, known as *"the financial life cycle approach"*.

In accordance with this approach, capital structure preferences vary depending on the life cycle of the company, whether a company is younger or more mature (Butzbach & Sarno, 2019). Indeed, as stated by Berger and Udell in their writing:

> *"Firms are viewed through a financial growth cycle paradigm in which different capital structure varies with firms' size and age"* (Berger & Udell, 1998).

This approach will later be revisited and expanded upon by Dickinson in 2011. Dickinson divided a company's lifecycle into five phases: introduction, growth, maturity, shake-out, and decline. Additionally, the author also categorized the types of cash flows to be analyzed into three different groups: operating, investing, and financing cash flows (Dickinson, 2011).

Among the theoretical approaches to capital structure, the last one we will analyze is the one developed by Baker and Wurgler in 2002, known as "*the market timing theory of capital structure*". This theory is based on the belief that there is no optimal capital structure and that instead, each individual company chooses the combination of equity and debt depending on the historical market value. In fact, as stated by the two authors: "*capital structure is the cumulative outcome of past attempts to time the equity market*" (Baker & Wurgler, 2002).

Baker and Wurgler, in their studies, start from the principle of *equity market timing*, according to which companies issue shares only when the price of such shares in the market is high, and instead repurchase them when the price decreases (Baker & Wurgler, 2002).

They analyzed the importance of taking market timing into account from various perspectives and concluded by stating that among all the factors that could influence companies' decisions, equity market prices are the ones that most significantly impact financing choices.

1.2 Determinants affecting Capital Structure

In this paragraph, we will analyze various empirical studies regarding capital structure and the key factors that may influence firms' investment decisions, first in a general context, and then specifically regarding the high-tech market.

Until the 1990s, none of the theories we have discussed had ever been experimentally investigated, and the few empirical studies conducted during that time mostly focused on US corporations. Specifically for this reason, Raghuram G. Rajan and Luigi Zingales developed an empirical analysis of the capital structure and the forces influencing it (Rajan & Zingales, 1995).

As a result of using a sample of multinational corporations, they also had to invest time in analyzing the unique features of every nation. Research was carried out in the G-7 countries (the US, UK, Canada, US, Japan, France, Italy, and Germany), and as stated in the report by Rajan and Zingales:

> "*Apart from establishing a framework within which to understand between-country differences, the review of institutions is important because they may affect the within-country cross-sectional correlation between leverage and factors such as firm profitability and firm size. This may help us identify the true economic forces underlying the factors*" (Rajan & Zingales, 1995).

Through their empirical investigation, Rajan e Zingales were able to identify four important variables — size, tangibility, profitability, and market-to-book — that affect the financial choices of a company.

Indeed, the findings of their research indicate that the G7 nations have relatively comparable debt levels, which in turn indicates that the factors affecting financial decisions are likewise comparable (Bouallegui, 2006).

Many empirical studies have also been conducted on high-tech companies, regarding the analysis of determining factors for capital structure. One such study is certainly the research conducted by Neil Lee, Hiba Sameen, and Marc Cowling in 2015. They analyzed the difficulty of access to financing for over 10,000 small and medium-sized enterprises in the UK, and from this analysis emerged two main issues in the financial system. The first is a structural problem in the market that reduces the possibility of accessing external sources of financing, while the second is a cyclical issue related to the impact potential economic crises can have on these companies, such as the one in 2008 (Lee, Sameen, & Cowling, 2015).

In recent years, many studies have been conducted on capital structure choices and the factors that most influence these decisions.

First and foremost, we must emphasize that the sector to which a particular company belongs is crucial for the investigation, precisely because the characteristics of an industry determine the factors that will impact financing choices (Castro Castro, Maria, & Borja, 2014).

Furthermore, it should be noted that in more recent theories, the focus has shifted from a static analysis of capital structure, with a search for an optimal leverage ratio, to a dynamic analysis.

In this dynamic analysis, companies will not necessarily aim to have an optimal capital structure at every stage of their lifecycle. Instead, they will continuously adjust their financing choices. (Haron, 2014).

Regarding the high-tech sector, there aren't many studies specifically investigating the factors that most influence firms' choices. However, we can conduct our dynamic study of capital structure referring to some fundamental factors: the firm's size, age, intangibility of assets, profitability, R&D intensity, liquidity, and growth opportunities (Kedzior, Grabinska, Grabinski, & Kedzior, 2020).

1.2.1 Size

The size of a company is one of the most commonly analyzed parameters in studies on the composition of financial structure.

It's a commonly acknowledged fact that smaller companies face greater challenges in securing funds for their projects, primarily due to their higher perceived risk. This difficulty is particularly heightened in innovative firms, where market imperfections often compel them to rely on internal financing (Veugelers & Schneider, 2008).

We can say that the size of a company is an indicator of its riskiness; indeed, Rajan and Zingales, in their cross-sectional analysis, included size among the factors influencing financial structure and, regarding this, they added the following:

> "*Larger firms tend to be more diversified and fail less often, so size may be an inverse proxy for the probability of bankruptcy*" (Rajan & Zingales, 1995).

Moreover, almost always, larger companies tend to be those with more years of operation, so we could say that size is linked to the age of a company. And age also represents the reputation and stability of a company in the market, which in turn result in higher profits and lower market risks (Kedzior, Grabinska, Grabinski, & Kedzior, 2020).

There are contrasting theories regarding the relationship between a company's size and its level of indebtedness.

Regarding the TOT, the debt ratio should have a positive relationship with the size of a company because, due to the company's stability, it can tolerate a higher level of debt and transfer its costs through economies of scale. (Kedzior, Grabinska, Grabinski, & Kedzior, 2020).

On the contrary, the POT postulates that large companies, despite having a lower level of information asymmetries, have many accumulated retained earnings and therefore do not need external financing (Alipour & Mohammadi, 2015).

Regarding innovative companies, however, their needs are different; they require a large amount of external financing to develop their projects. On the other hand, due to their nature, such companies do not have many tangible assets on their balance sheet, which makes it even more difficult to obtain funds from banks (Giudici & Paleari, 2000).

Finally, as highlighted in the study by Kijkasiwat and Phuensane from 2020: "*Large firms have a greater ability to access external finance to progress research and development (R&D) projects compared with SMEs*" (Kijkasiwat & Phuensane, 2020).

Therefore, we can hypothesize, in the case of high-tech companies, that as the size of the company increases, its investment risks decrease, as well as the level of information asymmetries. Consequently, this fact will make the company more attractive to investors, who will then provide more external funding.

Hypothesis 1 (H1): *There is a positive relation between the size of a high-tech company and the impact on its financial leverage.*

1.2.2 Age

The size of a company is closely linked to its age; in fact, as stated by Kedzior, Grabinska, Grabinski, and Kedzior in their article:

> "*The size of a company is correlated with its age. In other words, bigger companies are usually the older ones, which means that they are already established in the market, have a deeper knowledge of the market and customer preferences, and have higher credibility, which results in lower operational risk"* (Kedzior, Grabinska, Grabinski, & Kedzior, 2020).

Especially in technology fields, this lower level of operational risk translates into easier and faster access to external finances for companies.

The stronger connection between a company's age and its size makes it clear that as a company becomes more mature, it gains more credibility, making it easier to collect funding (Sangeetha & Sivathaasan, 2013).

For what concern high-tech firms, the factor age is crucial. The longer a company has been in the market, the lower its risks linked to technological innovations, resulting in reduced external capital costs. Additionally, consolidated high-tech firms also tends to have lower agency costs, thanks to better governance quality. Conversely, younger companies often face poorer credit standings, leading to increased agency expenses (Giraudo, Giudici, & Grilli, 2019).

On the other hand, just like larger companies, also older firms also tend to utilize first their accumulated retained earnings instead of financing themselves with debt, as described in the POT. On the contrary, for less mature companies, it is easier to turn to equity first than to obtain financing through debt (Naidu, 2011).

The relationship between age and debt, however, is also heavily influenced by the market in which the company operates. In strong private equity markets, such as the US and UK, there is a tendency to rely more on equity in the startup phase, while in bank-based economies, there is a tendency to resort to debt even in the early stages. (Hogan & Hutson, 2015).

Many empirical studies have focused on this relationship, both in the IPO phase and also subsequently, as well as for companies that choose to remain private and independent. We can conclude that, as companies age, high-tech firms will increasingly have more sources of financing available to them, such as bank debt. Therefore, for our analysis, we can hypothesize a positive relationship between a company's age and its use of debt.

Hypothesis 2 (H2): *The age of High-Tech Firms has a positive impact on financial leverage.*

1.2.3 Intangibility of Assets

The study we are carrying out focuses on high-tech companies and their capital structure. When we talk about high-tech companies or innovative firms, we must bear in mind that intangible assets are a fundamental part of their capital structure, and often represent the majority of total assets. Therefore,

studying the relationship between intangibles and leverage is essential to understand the behavior of such companies.

Many empirical studies have analyzed the relationship between tangible assets and leverage, concluding that there is a positive relationship between the number of fixed assets and leverage. This is because tangible assets serve as collateral for bank loans. Therefore, companies with a higher number of fixed assets are more likely to secure loans compared to companies with fewer collateral assets, such as high-tech firms (Frank & Goyal, 2007).

Additionally, tangible assets are preferred over intangibles because they hold greater value in the event of bankruptcy (Bouallegui, 2006).

However, our analysis focuses on high-tech companies, hence we primarily consider the intangibility of assets. Concerning this, it's important to highlight the presence of a valuation problem regarding these assets. Indeed, quantifying intangible assets accurately is challenging due to the phenomenon of "underreporting of R&D outlays" (Kedzior, Grabinska, Grabinski, & Kedzior, 2020).

This issue arises because only a portion of these intangibles is reported in a company's balance sheet, as highlighted by Lim, Macias, and Moeller in their September 2020 article:

> *"Internally-generated intangible assets are largely absent from balance sheets and other corporate reports. Consequently, the empirical capital structure research has struggled to evaluate the effects of intangible assets on financial leverage"* (Lim, Macias, & Moeller, 2020)

In their paper, Lim, Macias, and Moeller aimed first to define the relationship between financial leverage and intangible assets; additionally, they sought to analyze the influence of intangibles on debt compared to tangible assets.

To do this, they made a distinction of this type of assets; they highlighted three categories of identifiable intangible assets, including technology-related intangibles (patents, R&D processes...), marketing-related intangibles (trademarks, trade names), and customer-related assets (backlog, customer contracts...). Additionally, they included a category of unidentifiable intangibles, such as goodwill (Lim, Macias, & Moeller, 2020).

And as highlighted by themselves: "*Our new and interesting finding is a positive relation between financial leverage and identifiable intangible assets that is both statistically significant and economically large*" (Lim, Macias, & Moeller, 2020).

In sum, not all empirical studies report the same conclusions; some, as Lim, Macias and Moeller, demonstrate how, through the valuation and measurement of certain types of intangibles, those intangibles can serve as collateral and thus positively influence financial leverage. Others, on the contrary, believe that the valuation methods used cannot be considered universal and that, therefore, it is not possible to confidently evaluate and measure intangible assets. Consequently, as they cannot serve as collateral, they have a negative correlation with debt (Vengesai, 2023).

In our analysis, we will posit a negative relationship between financial leverage and the intangibility of high-tech company assets precisely because there are not enough studies demonstrating a positive correlation between these two factors.

Hypothesis 3 (H3): *The Intangibility of Assets has a negative relation with the financial leverage of the high-tech firms.*

1.2.4 Profitability

Regarding the profitability of companies as an influencing factor, there are several schools of thought on its relationship with the leverage ratio.

For the trade-off theory, there is a positive relationship between profitability and leverage due to the tax shield advantage of debt. Therefore, according to this theory, more profitable companies will tend to have higher leverage to benefit from this tax advantage (Gaud, Jani, Hoesli, & Bender, 2003).

On the contrary, the Pecking Order theory follows the idea of a negative relationship between debt and profitability. According to this theory, more profitable companies will first use their retained earnings and only then resort to debt (Myers & Majluf, 1984). Furthermore, the choice to primarily use internal sources is driven by the attempt to reduce information asymmetries between managers and investors, in addition to the fact that using internal sources eliminates the risk of diluting power within the company (Karacaer, Temiz, & Gulec, 2016).

Among empirical studies, many follow the Pecking Order Theory (POT) hypothesis, while others adhere to the Trade-Off Theory (TOT). There are some studies, however, that hypothesize a positive relationship between profitability and short-term debt and a negative relationship with medium-to-long-term debt (Abor, 2005). Others, on the other hand, show no correlation between capital structure and profitability.

However, despite the ambiguity surrounding the topic, most empirical studies highlight a negative relationship between profitability and leverage. Therefore, our fourth hypothesis is as follows:

Hypothesis 4 (H4): *There is a negative relationship between the profitability and the financial leverage of high-tech firms.*

1.2.5 R&D Intensity

As stated earlier, due to the high level of informational asymmetries experienced by high-tech companies, especially small to medium-sized ones, it is quite challenging for such companies to raise funds for their R&D projects.

Many studies indeed highlight how, due to imperfections in capital markets, there is a positive relationship between R&D investments and internal sources of funding (Himmelberg & Petersen, 1994). Furthermore, these studies suggest that companies often find it more profitable to keep their R&D projects secret until completion rather than disclosing them through patenting (Levin, Klevorick, Nelson, & Winter, 1987).

Therefore, concerning leverage, both theory and past empirical studies have found a negative relationship with the intensity of R&D activities (Bradley, Jarrell, & Kim, 1984).

In the study conducted by Atzeni and Piga in 2007 on a sample of SMEs in Italy, it was demonstrated how the financing of such enterprises is indeed influenced by the declared intensity of R&D. In fact, in the case of low R&D intensity, banks are less likely to grant loans, whereas, as the intensity increases, we can observe a corresponding increase in banks' propensity for financing (Atzeni & Piga, 2005).

Therefore, in our analysis, we will hypothesize a positive relationship between R&D intensity and the financial leverage of a high-tech company.

Hypothesis 5 (H5): *There is a positive relationship between the R&D Intensity and the financial leverage of High-Tech Firms.*

1.2.6 Liquidity

Firstly, liquidity helps us understand whether a company has the resources to repay its debts.

In this case as well, theory is divided into two parts regarding the type of relationship between liquidity and the debt ratio.

On one hand, we can hypothesize that a company with more liquidity has a lower risk of insolvency and is therefore viewed more favorably by banks (Ramli, Latan, & Solovida, 2018).

On the other hand, this hypothesis is countered by the one following the Pecking Order Theory (POT), which suggests that companies with high levels of liquidity will tend to finance themselves using internal sources rather than resorting to debt. In this way, not only do they avoid taking on debt, but they also avoid exposing their projects to third parties for fear that information may leak (Kedzior, Grabinska, Grabinski, & Kedzior, 2020).

Furthermore, as liquidity increases, a company also becomes more attractive in the market, which will lead to obtaining more equity purchasers in the future (Haron, 2014).

Regarding high-tech companies, the level of liquidity is crucial because it gives these companies the flexibility to choose how to be financed, either with internal or external capital.

However, for our analysis, we will hypothesize a negative relationship between the level of indebtedness and the level of liquidity.

Hypothesis 6 (H6): *There is a negative relationship between the liquidity and the financial leverage of High-Tech Firms.*

1.2.7 Growth Opportunities

As with the other factors, the relationship between growth opportunities and leverage is subject to controversy among scholars.

Most hypothesize a negative relationship between the two, and this belief is even more entrenched when considering high-tech companies. In fact, in companies where there is a high prospect of growth, such as the companies we are analyzing in this study, and where value derives from intangible assets, internal financing will be preferred over debt to avoid incurring high debt costs due to the lack of collateral.

Compared to the Agency theory, companies with significant growth opportunities are likely to resort to equity financing to avoid disclosing information about their projects and to maintain a competitive

advantage in the market, thereby highlighting a negative relationship between growth and the level of debt (Haron, 2014).

Even for the Pecking Order theory, there is a relationship of this type, as companies prefer to finance themselves first with retained earnings and only as a last resort with debt (Myers & Majluf, 1984). Rajan and Zingales, using the market-to-book value of equity in their analysis for G7 countries, supported Myers' evidence, arriving at the conclusion of a negative relationship between the two factors.

Other types of studies, on the other hand, which used the growth rate of assets as a proxy for growth opportunities, highlighted a positive relationship with debt. This could be attributed to the fact that while the growth rate of assets is a measure of a company's total assets, the market-to-book ratio more prominently highlights intangible assets, which therefore do not favor the obtaining of a loan from creditors. (Chipeta, 2011).

In our analysis, high-tech companies exhibit significantly higher risk compared to other firms, largely due to the fact that their value is solely dependent on intangible assets that cannot serve as collateral. Consequently, we will hypothesize that they are inclined to rely more on equity when they possess higher growth opportunities.

Hypothesis 7 (H7): *There is a negative relationship between growth opportunities and the financial leverage of High-Tech Firms.*

1.3 Summary of explanatory variables

Variables	*Description*	*Expectations*
Dependent variable		
Leverage (LVR)	*Total debt/Total assets*	
Independent variables		
Size (SIZE)	*Natural logarithm of Total assets*	+
Age (AGE)	*Years of life of the firm*	+
Intangibility of Assets (INT)	*Intangible assets/Total assets*	-
Profitability (PROF)	*Return on Equity*	-
R&D Intensity (R&DINT)	*R&D/Sales*	+
Liquidity (LIQ)	*Current assets/Current liabilities*	-
Growth Opportunity (GROWTH)	*Intangible Assests/Sales*	-

Table 1. Definitions of the variables and predictions of the signs of the relationship between financial leverage and the independent variables.

Chapter 2 - Analysis of the high-tech market in Italy

2.1 Technological and industrial context: Italy from the Economic Miracle to the New Millennium

To analyze the high-tech market in Italy, we need to look at our country's past and see which factors led it to be among the top global powers forty years ago, and which ones, on the other hand, have caused it to lose this primacy today.

The period from the 1950s to the late 1960s is still remembered today as the "economic miracle", during which, in the second post-World War II, Italy, by abandoning traditional protectionism, opened up to the international market. The Italian industry also embraced the Common European Market, and technological advancement and diversification levels increased rapidly. The Marshall Plan (European Recovery Program) of 1947 served our country to boost industrial production and technological advancement by introducing new machinery and technical knowledge (Ginsborg, 1989).

All these factors boosted the country internationally, and with the discovery of hydrocarbons and methane in the Val Padana, the Italian economy could also rely on lowered production costs.

Certainly, during those years, factors such as lack of fiscal control, monetary stability, and low labor costs played a significant advantage for our country's economy, which quickly became one of the major global powers (Castronovo, 2012).

Between 1958 and 1963, there was a real economic boom, with a record increase in GDP of 6.3%. However, unlike the previous five years, this growth was not due to domestic demand but rather to a strong increase in exports. As we can observe from the Table 2, exports from our country increased by approximately 516% from 1955 to 1970. These were the years of Italian industrial growth, during which the presence of large public companies such as Eni and Iri was decisive in this process.

YEARS	EXPORT (CURRENT PRICES)	INCREASE (%)
1955	1.628.275,64	
1956	1.888.591,48	16%
1957	2.282.588,70	21%
1958	2.320.394,81	2%
1959	2.556.451,60	10%
1960	3.093.869,90	21%
1961	3.511.721,87	14%
1962	3.909.912,06	11%
1963	4.278.930,79	9%
1964	4.898.909,36	14%
1965	5.845.179,91	19%
1966	6.496.438,83	11%
1967	6.941.572,13	7%
1968	7.883.070,84	14%
1969	9.042.134,26	15%
1970	10.028.000,00	11%
TOTAL INCREASE (1955/1970)		516%

Source: Reconstruction Banca d'Italia-Istat 1861-2017 (from Historical Statistics of the Bank of Italy)

Table 2. Current prices of export and increase in export (%) from 1955 to 1970.

All the companies that today represent the major Italian brands, especially in the sectors of steel, chemicals, electricity, and automobiles, were born in the immediate post-war period, but it was only in this second phase that their development was decisive. Leveraging the significant fiscal and non-fiscal advantages of that period and focusing on strong growth in new technologies, they managed to expand very rapidly and become the big names that still endure today.

This rapid growth, as mentioned earlier, was primarily due to the low cost of labor that industries could rely on, hiring a large number of employees at minimum wages and under hard working conditions. All of this was due to the absence of a stable labor union, which led to the famous "Hot Autumn" of 1969. In fact, between 1968 and 1969, there was an eruption of student protests and workers' strikes, as they began to demand better working conditions after the decade of exploitation that they had endured (Maione, 2019). Indeed, as shown by data extracted from the Historical Statistics of the Bank of Italy and Istat (Table 3.), in 1969, there were 7,507 workers who decided to participate in strikes, and the total hours of work not completed amounted to 302,597 just that year.

YEARS	LABOR CONFLICTS	PARTICIPATING WORKERS	UNWORKED HOURS
1966	2.387	1.887	115.788
1967	2.658	2.243	68.548
1968	3.377	4.862	73.918
1969	3.788	7.507	302.597
1970	4.162	3.722	146.212
1971	5.598	3.891	103.590

Source: Reconstruction Banca d'Italia-Istat 1861-2017 (from Historical Statistics of the Bank of Italy)

Table 3. Number of labor conflicts, participating workers and unworked hours between 1966 and 1971.

The occurrence of these strikes led to a political imbalance in Italy, which largely altered the economic miracle that our country had experienced in the previous years. These social and financial upheavals led the peninsula into a dark period, marked not only by labor disputes but also, and above all, by waves of extremism and violence. Thus began the so-called "Anni di Piombo" (Years of Lead).

The Years of Lead were characterized by financial instability stemming from the end of the Bretton Woods monetary system, which led to a significant devaluation of the lira against the dollar. Additionally, the ongoing oil crisis since 1973 was one of the reasons for the failure of the European Currency Snake, a new currency system born from the Basel Accords, created by some European countries that imposed fluctuation margins between exchange rates of the countries.

The oil crisis of those years led not only to a crisis in the transportation industry but also to subsequent difficulties for productions heavily reliant on energy, such as the steel, cement, glass, plastic sectors, etc.

All of this, along with the emergence of various terrorist cells and the occurrence of 7 massacres in ten years, culminating in the kidnapping and killing of Aldo Moro in 1978, led the country, for the first time in thirty years, into a recession phase.

It was precisely during these years that, due to the increasing inflation, the population began to spend less. However, at the same time, public spending began to increase, leading the country to a level of indebtedness among the highest in the world.

During these years, the hardest-hit businesses were the larger ones and those employed in energy-intensive industries. Indeed, the verticalization model and economies of scale used up to that point could not withstand such a situation, especially with increasing costs of oil and energy products. For this reason, from those years onward, the Italian industry decided to focus on starting a process of productive specialization and reducing the size of companies, characteristics that our country will carry forward to our days. As we will see later, this will be one of the factors that most limits Italy in terms of growth in research and innovation.

The early 1980s marked an economic turning point, but not yet a political one. Indeed, the period of the "strategia della tensione" (the strategy of tension) continued into the early years of the new decade, and the growth experienced by the country during this period was still overshadowed by high inflation and an unprecedented increase in public debt. This debt, which stood at 35% of GDP in 1970, would rise to 100% by the end of the 1980s (Schlitzer, 2016).

YEARS	PUBLIC ADMINISTRATION DEBT (CONSOLIDATED)
1980	114.066,0
1981	142.427,1
1982	181.567,8
1983	232.385,5
1984	286.744,4
1985	347.592,6
1986	404.335,9
1987	463.083,4
1988	524.528,4
1989	591.618,7
1990	667.847,7

Source: Bank of Italy, Historical Statistics

Table 4. Public Administration Debt from 1980 to 1990.

However, this decade will not only be remembered as a period of a public finance out of control, but also as years when significant modernization and industrial transformation took place. Indeed, from an economic perspective, Italy in the 1980s witnessed a revitalization of large enterprises, with a strong increase in productivity and fixed investments, as well as in industrial reorganization that led

to a rise in global exports (Silva, 2013). In addition, during those years, research and development (R&D) spending increased significantly, rising from 0.75% of GDP in 1980 to 1.3% in 1990 (Table 5).

R&D EXPENDITURE BY RESEARCH SECTOR (BILLION CURRENT LIRA)

YEAR	Total	%GDP
1980	2897,3	0,75
1981	4055,3	0,88
1982	4915,7	0,91
1983	6027,0	0,95
1984	7323,0	1,01
1985	9132,9	1,13
1986	10189,1	1,13
1987	11696,0	1,19
1988	13281,3	1,22
1989	14800,7	1,24
1990	17001,2	1,30

Source: Bank of Italy, Historical Statistics

Table 5. Increase in R&D as % of GDP between 1980 and 1990.

However, the reasons for this rapid growth are primarily to be found in a state action aimed at garnering consensus in a society still shaken by the serious events of the previous decade (Schlitzer, 2016); and, as Schlitzer himself states in his article in Il Sole 24 Ore: "il paese vive al di sopra delle proprie possibilità" (the country lives beyond its possibilities), an attitude that will lead it into a profound crisis in the subsequent 1990s. This "shadow economy," with its black-market labor and tax evasion, will restore Italy to its position among the top industrial powers in the world. However, it will also restrict all attempts at fiscal reforms, which will never be fully supported by the political class (Casalino, 2012).

The legacy of previous governments had consequences on the economy of our peninsula as early as the early 1990s. Italy found itself facing a currency crisis, the devaluation of the lira, and withdrawal from the European Monetary System (EMS), events that plunged the country into a recession.

In those years, the Italian economy could no longer rely, as in the past, on continuous devaluations of the lira and low wage levels. Moreover, competitiveness was not keeping pace with other countries, especially in high-tech goods, where the situation was critical. Between the early and late 1990s, the share of trade in these goods decreased by 40%. Additionally, research spending, in absolute terms, saw Italy only ranked twelfth (Table 6).

GROSS DOMESTIC SPENDING ON R&D, TOTAL, % OF GDP, 1990 – 1999

LOCATION	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CANADA	1.475	1.535	1.578	1.631	1.685	1.654	1.607	1.614	1.710	1.750
FRANCE	2.274	2.277	2.283	2.319	2.268	2.241	2.223	2.147	2.095	2.108
GERMANY	2.606	2.387	2.273	2.206	2.126	2.135	2.145	2.188	2.216	2.348
ITALY	1.201	1.142	1.104	1.051	0.981	0.934	0.946	0.988	1.005	0.981
JAPAN	2.662	2.630	2.579	2.525	2.471	2.563	2.643	2.722	2.827	2.847
UNITED KINGDOM	1.948	1.872	1.840	1.864	1.836	1.645	1.573	1.536	1.546	1.621
UNITED STATES	2.556	2.621	2.543	2.423	2.328	2.410	2.450	2.477	2.496	2.544

Source: OECD (2024), Gross domestic spending on R&D

Table 6. Gross Domestic Spending on R&D, Total, % of GDP, From 1990 to 1999.

Italian companies witnessed the failure of previous industrial policies, which were based on large public transfers and state-owned enterprises. As already experienced in the 1970s, it was the large industries that suffered the most from the situation. Many of them failed to complete various alliance programs abroad, such as the case of Olivetti with Société Générale.

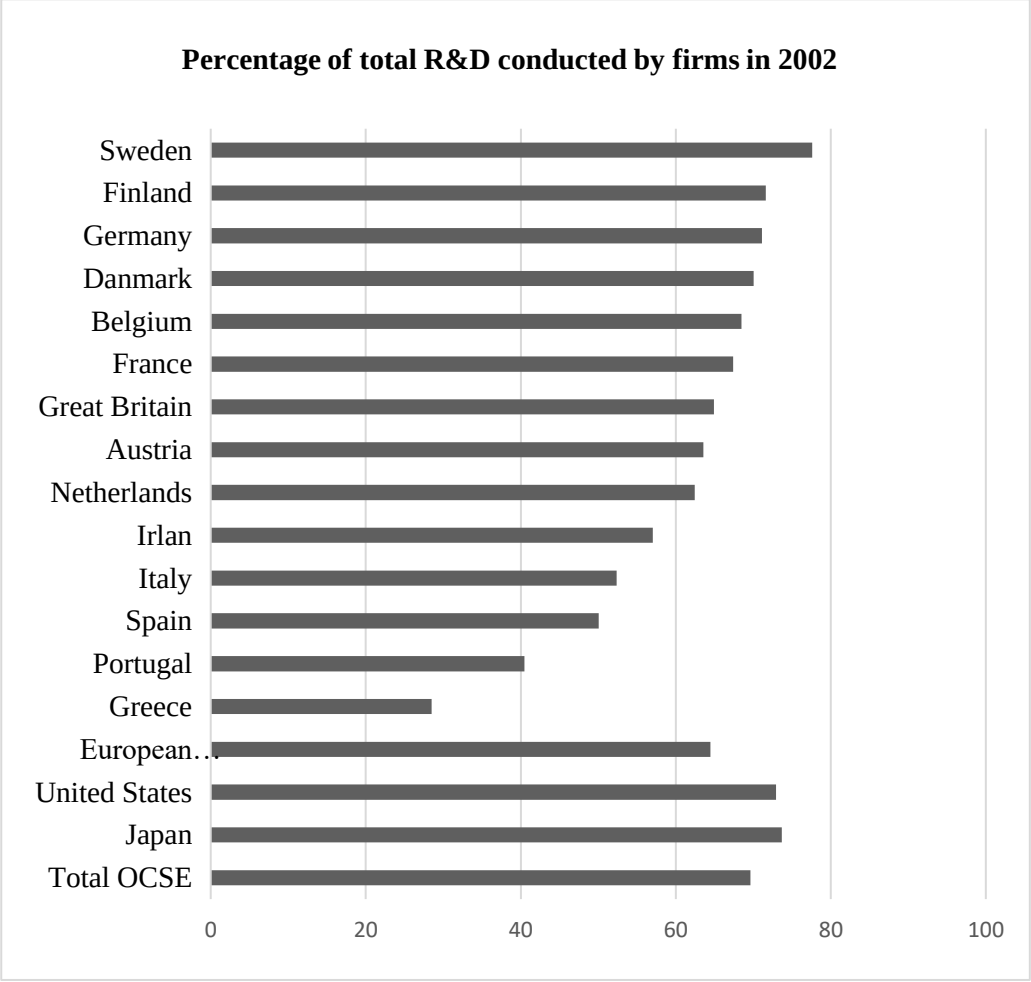
The Italian high-tech sector was downsized, and companies like Olivetti for Information Technology, Montedison for Chemicals, and Telecom and Omnitel for Telecommunications were unable to develop and become globally competitive.

Thus, as had happened twenty years earlier, Italy continued to rely on a model of specialization and business downsizing, focusing more on sectors such as traditional consumer goods and specialized capital goods. However, it remained marginal and weak in sectors with a high rate of technological innovation, such as computers, telecommunications, aerospace, and pharmaceuticals (Onida, 2004).

With the beginning of the new millennium, the technological situation of our country does not change radically; there are hints of economic growth recovery, but the gap with America and the growing China is ever wider.

In those years, technological development became increasingly significant with the uninterrupted increase in high-tech product trade. A technological revolution is underway worldwide, and at the forefront of this new economy are the United States.

Italy, as can be seen in Chart 1, was among the lowest performers in terms of R&D expenditure by firms in 2002, with the United States, Sweden, and Japan taking the top spots.



Source: OECD, *Main Science and Technology Indicators*.

Chart 1. Percentage of total R&D conducted by firms for each country in 2002.

2.2 The evolution of the high-tech industry from the 2008 crisis to the present

The period from 2008 to 2013 saw Italy hit by a deep economic crisis and the subsequent recession of those years. Consequently, our country experienced a decline in GDP levels and an inevitable decrease in R&D spending. It was only between 2015 and 2018 that investments in R&D began to rise again, slowly returning to pre-crisis levels. One difference that occurred was the shift in spending from the public and university sector to the private sector, with an increase in self-financing (Istat, 2021).

The years following the crisis are years of recovery, during which Japan and especially Korea emerge as leaders in the sector, surpassing China, and accounting for more than half of global high-tech trade. In contrast, the United States begins a period of decline, with a share of trade that stood at about 10% in 2016.

In Europe high-tech exports are growing, with Germany, France, and the United Kingdom among the major players. Italy, on the other hand, ranks in the lower half of the ranking, with a share of exports accounting for approximately 2% of global exports in 2016 and with a share of high-tech exports representing 11% of total manufacturing exports in our country. These data highlight a situation that has been known for a long time, that our country has focused mainly on traditional sectors rather than technological areas and has neglected high-tech sectors, especially in terms of electronic components, telecommunications, materials, and optical materials. Instead, the high-tech sectors in which our country maintained a trade surplus in 2016 are industrial automation, aerospace, and thermomechanical energy (Palma & Coletta, 2018).

Between 2019 and 2020, Italy, like the rest of the world, was heavily hit by the pandemic crisis, resulting in a significant decrease in GDP of 9% in 2020. Contrary to expectations, our country showed good resilience, and even the high-tech sector did not suffer much from the downsizing of production levels.

The Monitor of Intesa Sanpaolo on high-tech sectors of 2022 analyzes the evolution of the turnover of high-tech companies in Italy for the years 2019/2020, highlighting the impact that the pandemic had on the profitability and production levels of these companies.

From these observations, we can see that the high-tech sector has not been heavily affected by the crisis, with a decrease in turnover of 2.3%, a relatively low percentage compared to the 9.4% in manufacturing; and this aspect can be seen also in the Table 7 below which shows that in 2020 the Total Factor Productivity for the manufacturing industry decreases from 103,5 to 98,1, while in the

branch of scientific research and development, despite the crisis, this factor increased from 115,8 to 122,7. However, the results show a disparity among different types of companies, with positive results for the pharmaceutical sector, ICT and TC services, and negative results for the biomedical, commerce, and aerospace sectors (IntesaSanpaolo, 2022).

Total Factor Productivity (based on value added) - Index 2015=100

TIME	2019	2020	2021
BRANCH OF ECONOMIC ACTIVITY (ATECO 2007)			
MANUFACTURING INDUSTRY	103,5	98,1	105,1
SCIENTIFIC RESEARCH AND DEVELOPMENT	115,8	122,7	123,5

Source: Istat Database

Table 7. Total Factor Productivity based on value added – Index 2015=100.

In 2021, Italy seems to experience a downturn, as we can see from Table 8, with a slight decrease in R&D expenditure as a percentage of GDP compared to the previous year. Public institutions play a crucial role, with a +9.7% increase in R&D spending compared to 2020, and universities also show growth at +7.9%. However, businesses appear to be the only ones not to have overcome the pandemic crisis fully. There was only a modest increase of 1.1%, attributed solely to large enterprises, while small and medium-sized enterprises recorded a decrease in R&D expenditure of -4.5%.

Gross domestic spending on R&D (%)

Location	2018	2019	2020	2021
China (People's Republic of)	2.141	2.245	2.407	2.433
France	2.197	2.192	2.282	2.219
Germany	3.110	3.167	3.131	3.129
Italy	1.424	1.462	1.507	1.454
Japan	3.219	3.218	3.269	3.296
Korea	4.516	4.627	4.796	4.930
OECD - Total	2.496	2.570	2.741	2.718
Singapore	1.814	1.897	2.217	
United Kingdom	2.705	2.666	2.931	2.915
United States	3.010	3.170	3.468	3.457

Source: OECD (2024), Gross domestic spending on R&D (indicator).

Table 8. Percentage of Gross domestic spending on R&D.

Today, our country, like the rest of the world, is increasingly focused on innovation and digitalization, with a year-on-year increase in the percentage of spending on high-tech by both businesses and the public administration. Consider, for example, the portion of resources from the National Recovery and Resilience Plan (PNRR) allocated to the project for digitization, innovation, competitiveness, and culture, amounting to approximately 40 billion euros.

At the global level, as we can observe from the table below, Italy still lags behind in the ranking of countries with the highest R&D spending as a percentage of GDP, but it has high growth expectations. South Korea leads the list, followed by the United States, Sweden, and Japan. Conversely, China has halted its growth in research and has been overtaken by the more advanced United States.

Percentage of GDP on R&D

TIME PERIOD	2019	2020	2021	2022
REFERENCE AREA				
FRANCE	2.19	2.27	2.22	2.18
GERMANY	3.17	3.13	3.13	3.13
ITALY	1.46	1.51	1.43	1.32
JAPAN	3.22	3.26	3.28	3.41
KOREA	4.63	4.80	4.91	5.21
SWEDEN	3.39	3.49	3.40	3.41
UNITED STATES	3.15	3.42	3.48	3.59
CHINA (PEOPLE'S REPUBLIC OF)	2.24	2.41	2.43	n.d

Source: OECD (2024), Gross domestic spending on R&D (indicator).

Table 9. Percentage of Gross domestic spending on R&D from 2019 to 2022.

From this analysis, which focused on our country, we can draw some considerations and predictions for the future; first of all, we have seen how there is a tendency among Italian companies towards the so-called "family capitalism", which involves a management style that restricts the growth and innovation of a company, focusing on the family and overly specialized production. These types of businesses, which were prevalent in Italy in the past, primarily relied on short-term bank debt, avoiding any possibility of selling ownership stakes to outsiders. This trend significantly limited

investments, particularly in the technological field, with less inclination towards research and innovation, and notably less drive towards international expansion.

To date, this propensity of Italian companies has greatly diminished; even our country has opened up to the venture capital market aimed at financing startups and thus promoting growth in the high-tech sector. The market, in fact, has now stabilized at over 1 billion euros of investments in Italian high-tech startups every year, with the entry of new international players, including independent, corporate, and governmental venture capital funds.

The current geopolitical situation, along with the resulting increase in interest rates and inflation, has certainly not made investments easier; but precisely in this moment of political and technological challenges, Italy should focus on the birth and development of new high-tech companies, incentivizing funding through loans and increasing spending on research and development.

Chapter 3 - Identification of the sample

3.1 Data

In this third chapter, we will identify and explain the panel to be taken for our analysis, and then proceed with the development of the descriptive statistics, going on in the next chapter with the correlation matrix, and finally linear regression among the various factors.

Our study focuses on a sample consisting of Italian companies in the high-tech sector. To identify high-tech sectors with greater specificity, we considered only companies recognized with certain ATECO 2007 codes. In particular, the selected codes were as follows: ATECO 21, 26, 266, 303, 325 331600, 465, 582, 61, 62, 631.

After that, we considered only joint-stock companies with a minimum of 10 employees, active and with at least the financial statements of the last 5 years available.

For the extraction of our sample, we used the AIDA database, and we extracted a total of 4,267 high-tech companies in Italy with data available from 2019 to 2023.

After eliminating all companies with certain missing data, our panel decreased to 2,143 Italian companies in the high-tech sectors. Therefore, our final analysis has a total number of observations equal to 10,715 (Table 10).

Subsequently, we also added the distinction of companies based on the region to which they belong and, as mentioned earlier, to the ATECO 2007 denomination.

As we can see from the pie chart below, the percentage of high-tech companies taken through our sample is much higher in regions such as Lombardia, Lazio, Piemonte, Emilia-Romagna, and Veneto compared to other regions such as Valle d'Aosta and Molise.

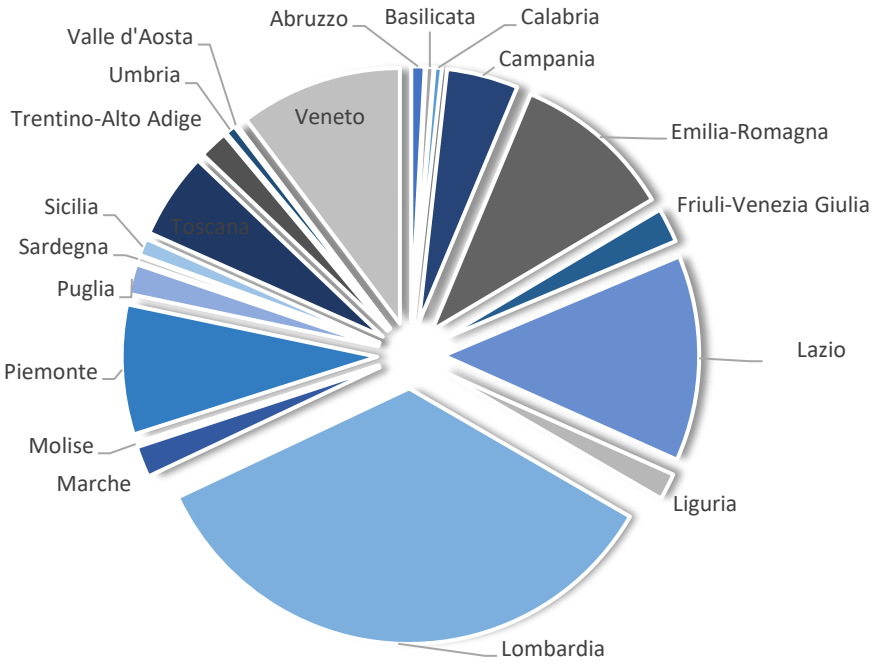


Chart 2. Division of the companies in our panel per region.

The years we chose as reference for our analysis were selected both for their greater ease of availability and to observe whether the factor of years could influence the results of our regression, particularly considering the year before and the years immediately after the COVID pandemic.

Data	Wide	->	Long
Number of observations	2,143	->	10,715
Number of variables	44	->	13
j variable (5 values)		->	year
xij variables:			
LEVERAGE2019 LEVERAGE2020 ... LEVERAGE2023		->	LEVERAGE
SIZE2019 SIZE2020 ... SIZE2023		->	SIZE
AGE2019 AGE2020 ... AGE2023		->	AGE
INTANG2019 INTANG2020 ... INTANG2023		->	INTANG
PROFIT2019 PROFIT2020 ... PROFIT2023		->	PROFIT
RDINT2019 RDINT2020 ... RDINT2023		->	RDINT
LIQ2019 LIQ2020 ... LIQ2023		->	LIQ
GROWTH2019 GROWTH2020 ... GROWTH2023		->	GROWTH

Table 10. Number of observations and variables with the use of Stata.

For the calculation of the variables, we have to look at Table 1 in the first chapter, where we described the methodology for calculating each analyzed variable.

In addition, to conduct a more accurate analysis, we had to modify the evaluation method regarding the Growth Opportunity factor.

Instead of looking only at listed companies, we conducted a comprehensive study, considering both large and small to medium enterprises in determining their capital structure. For this reason, the calculation of this factor was based on intangible assets over sales rather than the market value of the single company.

3.2 Descriptive Statistics

Before moving on to the study of our panel through linear regression among the various variables, through the help of Stata, we reproduced the descriptive statistics of the sample. These statistics provide an idea of the number of observations, the mean, the standard deviation of the results, and the minimum and maximum values of the different factors.

Looking at table 11, we can observe how leverage has an average of nearly 50%, indicating that debt is one of the most important sources of financing for Italian high-tech companies. Furthermore, a standard deviation of 0.20 suggests that there is a moderate variability in leverage results across our sample.

For what concern the size, a standard deviation of 1.7 indicates significant variability in this factor within the panel.

With regard to age, it has an average of approximately 26 years and a quite high standard deviation of 15.34, indicating a wide dispersion within the sample in the age of each company.

On the other hand, for the type of companies we are analyzing, intangibility has a relatively low average. In fact, the mean indicates that only about 7.4% of a company's assets are intangible assets. However, as we can observe from the minimum and maximum values, the range of those varies from 0% to 93%, indicating that there are still companies within the sample with a large volume of intangibles.

Another factor to analyze is certainly the R&D intensity, especially considering the vast range of values it can assume, going from a minimum of 0% to a maximum of over 704% over sales. This suggests that there are some companies that do not invest in R&D while others that invest significantly more than their revenues.

The same pattern emerges for Growth Opportunity, where the number of intangibles over sales can go from a low of zero percent to a maximum of about 1394%. However, it's important to note that the standard deviation is about 51%, meaning that could be an high variability in our sample.

Variable	Obs	Mean	Std. dev.	Min	Max
LEVERAGE	10,715	.4873391	.2057862	.008931	.9908994
SIZE	10,715	9.332977	1.699789	2.54231	18.02573
AGE	10,715	25.87308	15.3447	1	126
INTANG	10,715	.073673	.1272669	0	.9301605
PROFIT	10,715	.1687535	.2414528	-1.4958	1.1948
RDINT	10,707	.0210704	.1301841	0	7.044098
LIQ	10,715	2.00031	1.363911	.09	9.88
GROWTH	10,707	.1394624	.5120802	0	13.94758

Table 11. Descriptive statistics of variables.

Chapter 4 – Methodology

4.1 Correlation Matrix and results

Having analyzed the descriptive statistics of our panel in the previous chapter, we can proceed now to observe, first of all, the degree of correlation between the various factors, in order to avoid any intercorrelation between the different variables that we are considering. Next, we will conclude by conducting a regression analysis to observe whether or not our independent variables can influence the dependent variable, leverage.

From Table 12, we can observe a moderate correlation between age and firm size. Additionally, there is a moderately high level of correlation among all those factors that share similar components, such as between growth opportunity and intangibility, and between growth opportunity and R&D intensity.

The point that is immediately apparent is undoubtedly the strong negative correlation between liquidity and leverage, suggesting that companies with a high level of liquidity will tend to rely less on debt to finance themselves and vice versa.

The correlation analysis we conducted highlights some differences between what we hypothesized through our theoretical study and our empirical results. Specifically, regarding the correlation between the age of a company and its level of indebtedness, we can see that the positive relationship which we hypothesized, actually, came out to be negative. This suggests that as a company becomes more mature, it relies less on leverage and, instead, focuses more on using its retained earnings first, following in this case the Pecking Order Theory.

On the other hand, with regard to company size, the results are in line with our theoretical hypotheses, showing a positive correlation with leverage. This supports the idea that when a company expands, it gains access to more debt from banks. Furthermore, as hypothesized in the first chapter, the positive correlation between size and the intensity of R&D projects has also been confirmed, although very low.

In our empirical analysis, we also hypothesized a negative correlation between the intangibility of a company's assets and its level of indebtedness. This position was taken solely due to the lack of sufficient empirical studies on the matter.

However, in our case, the correlation is positive. This suggests that intangible assets, even if are difficult to quantify, are also crucial for a company's value, increasing its worth and making it easier to access debt.

Additionally, the correlations between R&D intensity and liquidity reflect the theoretical analysis conducted earlier. However, the correlation with growth opportunity is positive, contrary to what was hypothesized.

	LEVERAGE	SIZE	AGE	INTANG	PROFIT	RDINT	LIQ
LEVERAGE	1.0000						
SIZE	0.0343	1.0000					
AGE	-0.1739	0.3054	1.0000				
INTANG	0.0715	0.1858	-0.0856	1.0000			
PROFIT	-0.0386	-0.1538	-0.1120	-0.1954	1.0000		
RDINT	0.0673	0.0101	-0.0479	0.2752	-0.0977	1.0000	
LIQ	-0.6685	-0.2151	-0.0058	-0.1667	0.1095	-0.0675	1.0000
GROWTH	0.0337	0.2607	-0.0455	0.6263	-0.1485	0.3837	-0.0944

	GROWTH
GROWTH	1.0000

Table 12. Correlation Matrix with Stata.

In addition to our analysis, it is important to consider the issue of multicollinearity, which could cause problems in interpreting the results. Indeed, with a high level of multicollinearity, it is difficult to clearly establish the influence that a single variable has on the dependent variable.

In our case, this problem is not present. Even though there are variables with a fairly high degree of correlation, such as between leverage and liquidity and between growth opportunity and intangibility, these values do not exceed a threshold of excessively high correlation. As Gujarati and Porter (2003) explain, the problem of multicollinearity among the variables of a regression would be present in the case of a correlation between the different variables exceeding 80% (Gujarati & Porter, 2003).

4.2 Regression Analysis

After checking the degree of correlation between the different variables of interest, we proceeded with the regression analysis to empirically observe if there was a relationship between our independent variables and leverage. This was done to understand which factors may influence the financial choices of high-tech companies in our country.

Through the use of Stata, we conducted several regression analyses: the first without fixed effects, the second with fixed effects of years, the third with fixed effects of regions, and the last one with fixed effects of different Ateco codes.

From Table 13, we can look at the various outcomes and assess whether the analysis was influenced by different fixed effects. In the table, we indicate "Y" if the effect was significant and "N" if it was not.

Starting from the regression without fixed effects, we can see that leverage depends negatively on firm size. Specifically, an increase of one unit in size leads to a decrease in leverage of 0.006, with a significance level of 1%. Similarly, age, also significant at 1%, has a negative relationship with leverage, decreasing by 0.002 for each additional year.

Intangibility, with a significance level of 1%, is also negatively related to debt choice, showing a reduction of 0.087 in leverage following a unit increase in intangible assets on the balance sheet.

In addition, intangibility has a standard error of 0.015, indicating that the actual results may signify an even higher level of negativity between the two factors.

Moving forward, as can be seen from the table, productivity appears to have a positive relationship with leverage. However, since it is not statistically significant, we cannot establish a real relationship between the two. Indeed, our analysis suggests a p-value (0.002) that exceeds the significance level of 0.1.

On the other hand, R&D intensity in high-tech companies shows a positive relationship with leverage, indicating an increase in indebtedness of 0.049 for each unit increase in R&D activity, with a standard error of 0.013.

VARIABLES	REGRESSION WITHOUT FIXED EFFECTS	REGRESSION WITH YEARS FIXED EFFECTS	REGRESSION WITH REGIONS FIXED EFFECTS	REGRESSION WITH ATECO CODES FIXED EFFECTS
SIZE	-0.006***	-0.007***	-0.006***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
AGE	-0.002***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
INTANG	-0.087***	-0.087***	-0.092***	-0.084***
	(0.015)	(0.015)	(0.015)	(0.015)
PROFIT	0.002	0.002	-0.002	-0.015**
	(0.006)	(0.006)	(0.006)	(0.006)
RDINT	0.049***	0.049***	0.041***	0.043***
	(0.013)	(0.012)	(0.012)	(0.012)
LIQ	-0.104***	-0.104***	-0.103***	-0.104***
	(0.001)	(0.001)	(0.001)	(0.001)
GROWTH	-0.001	-0.001	-0.002	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)
CONSTANT	0.816***	0.818***	0.822***	0.702***
	(0.009)	(0.010)	(0.018)	(0.012)
YEAR FIXED EFFECTS		N		
REGION FIXED EFFECTS			Y	
ATECO CODE FIXED EFFECTS				Y
OBSERVATIONS	10,547	10,707	10,707	10,707
R-SQUARED	0.485	0.484	0.495	0.510
	Standard errors in parentheses			
	*** p<0.01, ** p<0.05, * p<0.1			

Table 13. Regression Analysis with and without fixed effects of Years, Regions, and Ateco Codes.

In contrast, liquidity shows a negative association with debt, indicating that as liquidity increases, there is a decrease in debt financing. Specifically, a one-unit increase in liquidity causes a reduction in debt level of 0.104, with a significance level of 1%.

Lastly, as with profitability, , we cannot establish any relationship with leverage for growth opportunities because the effect of this factor is not statistically significant. Therefore, the lack of empirical evidence keeps us from formulating any conclusive relationship.

The R-squared of our analysis is 48.5%, indicating that our model explains approximately half of the variations in leverage in our panel of high-tech firms.

After analyzing the results of the linear regression between leverage and our independent variables, we decided to magnify our analysis by adding some fixed effects to the regression that we believed could potentially influence the obtained results.

The first fixed effect we chose to include was the effect of years, with the purpose to observe if there are systematic variables across different years that could affect a company's leverage.

As we can observe from Table 13, the coefficients of the regression with those fixed effects of the year are not significantly different from the results obtained without the addition of the fixed effects. This suggests that the model is not overly influenced by the events occurred in the various years of observation.

By adding those effects, we are examining the difference in leverage across different years relative to a reference year, which in our case is 2019. From this, we were able to observe that 2020 overall had a lower debt level compared to 2019, while 2021 and 2022 concluded with a positive difference, and 2023 exhibited a negative variation.

However, all these coefficients were found to be not statistically significant (Table 14), implying that there may be no empirical evidence of a relationship between leverage and the influence of years.

VARIABLES	YEARS FIXED EFFECTS
YEAR_2020	-0.004
	(0.005)
YEAR_2021	0.005
	(0.005)
YEAR_2022	0.003
	(0.005)
YEAR_2023	-0.002
	(0.005)

*** p<0.01, ** p<0.05, * p<0.1

Table 14. Year effect on leverage

Following the insignificance of the fixed effect of years, we decided to explore other variables that could potentially influence leverage. Thus, we continued our analysis by adding fixed effects of regions.

To do this, after converting the geographical values into numerical values using Stata, we conducted the regression considering the systematic effects that individual regions might have on our dependent variable.

We created regional dummy variables to account for this. The coefficients of the model explain to us how influential a particular Italian region is in the choice of leverage for high-tech companies, relative to a reference region.

While the coefficients of the regression did not vary significantly, the R-squared increased, indicating that adding the fixed effect of regions improved the model's ability to explain our leverage variable.

As we can observe from the table below, some regional dummy variables have significantly negative coefficients, indicating that the leverage of companies in those regions is lower compared to companies in the reference region, which in our case is Abruzzo. This is evident in regions such as Basilicata, Emilia-Romagna, Friuli-Venezia-Giulia, Molise, Sicily, and Veneto. On the other hand, some regions have significantly positive coefficients, as seen in the case of Campania. Many others, however, are not statistically significant, so we cannot establish any statistical relationship for them.

VARIABLES	REGIONS FIXED EFFECTS
BASILICATA	-0.054**
	(0.026)
CALABRIA	-0.002
	(0.026)
CAMPANIA	0.028*
	(0.017)
EMILIA-ROMAGNA	-0.032**
	(0.016)
FRIULI-VENEZIA-GIULIA	-0.051***
	(0.018)
LAZIO	0.022
	(0.016)
LIGURIA	0.003
	(0.019)
LOMBARDIA	-0.013
	(0.016)
MARCHE	0.016
	(0.018)
MOLISE	-0.151***
	(0.041)
PIEMONTE	0.003
	(0.016)
PUGLIA	0.014
	(0.019)
SARDEGNA	0.011
	(0.028)
SICILIA	-0.045**
	(0.021)
TOSCANA	-0.009
	(0.017)
TRENTINO-ALTO-ADIGE	-0.025
	(0.019)
UMBRIA	0.009
	(0.023)
VALLE D'AOSTA	-0.021
	(0.041)
VENETO	-0.041**
	(0.016)

*** p<0.01, ** p<0.05, * p<0.1

Table 15. Region fixed effects on leverage

After analyzing the influence that both years and individual regions may have on the financing choices of high-tech companies in Italy, we decided to expand our analysis to observe how individual sectors within the high-tech industry could affect the choices of our sample. In other words, we examined how different segments of the high-tech industry in which a company operates could influence its decision to finance itself through debt.

To do this, we first gathered all the Ateco codes within the high-tech sector. Then, we isolated only the first two digits of these codes to group the various companies by sector. As shown in Table 16, we grouped all the companies in our sample into 10 different Ateco codes. Among these, the most frequently appearing ones are 62 and 26, representing the production of software, computer consultancy, and related activities, and the manufacturing of computers, electronic, and optical products, respectively.

FIRST TWO ROWS	FREQ.	PERCENT.	CUM.
21	995	9.29	9.29
26	2,340	21.84	31.12
30	175	1.63	32.76
32	760	7.09	39.85
33	65	0.61	40.46
46	910	8.49	48.95
58	80	0.75	49.70
61	330	3.08	52.78
62	4,205	39.24	92.02
63	855	7.98	100.00
TOTAL	10,715	100.00	

Table 16. First two rows of each Ateco code, with the frequency, percentage over the total and cumulated results.

The fixed effects of individual Ateco codes turned out to be collectively significant, suggesting that by adding these variables to the regression, we better explained the behavior of the sample. Indeed, as observed in Table 13, the R-squared increased to 0.510, indicating that the variables we used in our analysis were able to explain 51% of the sample, a significant improvement compared to the 48.5% from our regression analysis without fixed effects.

VARIBLES	ATECO CODES FIXED EFFECTS
26	0.045***
	(0.006)
30	0.060***
	(0.012)
32	0.044***
	(0.007)
33	0.077***
	(0.019)
46	0.137***
	(0.007)
58	0.097***
	(0.017)
61	0.054***
	(0.009)
62	0.096***
	(0.006)
63	0.057***
	(0.007)

Table 17. Ateco code fixed effects on leverage.

As noted in Table 17, all the Ateco codes we added to the regression are significant for our dependent variable, leverage, at a 1% significance level. This positive relationship among all codes indicates that companies in different high-tech sectors tend to finance themselves more with debt than other types of sectors.

These findings are crucial for our analysis as they shed light on the extent to which the Italian high-tech market relies on debt financing versus self-financing.

Moreover, returning to the coefficients in Table 13, with the addition of fixed effects of Ateco codes, profitability, which had previously been found to be statistically insignificant in other regressions, now shows a significance level of 5%, emphasizing a negative relationship between profitability and a firm's tendency to finance itself through debt.

Finally, we decided to examine the results of a linear regression that incorporates all the different fixed effects together.

As shown in the table below, the R-squared of our regression increased to 52%, indicating the improved ability of the model to explain the data. This means that about 52% of the financing choices of high-tech companies in Italy are explained by the independent variables and fixed effects we

considered in our analysis. Furthermore, it implies that the 48% of these companies' choices depend on additional factors that we did not take into account or external factors beyond our consideration.

Regarding the coefficients of our independent variables, they have changed modestly from the regression without fixed effects. The only notable difference concerns profitability, which went from being statistically insignificant to being significant at the 1% level. This points a negative relationship between leverage and profitability of a high-tech company, implying that a one-unit increase in profitability would result in a 1.6% decrease in the company's reliance on debt.

While, for the growth opportunity, even in the case of the regression with the addition of all fixed effects, this variable remains statistically insignificant. Therefore, it cannot be considered in our study.

VARIABLES	**LEVERAGE**
SIZE	-0.002**
	(0.001)
AGE	-0.002***
	(0.000)
INTANG	-0.087***
	(0.015)
PROFIT	-0.016***
	(0.006)
RDINT	0.038***
	(0.012)
LIQ	-0.104***
	(0.001)
GROWTH	-0.001
	(0.004)
CONSTANT	0.714***
	(0.019)
OBSERVATIONS	10,707
R-SQUARED	0.520

Table 18. Regression with all the fixed effects.

In summary, in this fourth chapter, we initially calculated, with the help of Stata, the correlation between our dependent variable, leverage, and seven independent variables. This provided us with significant results, particularly for the relationship between leverage and liquidity, which shows a negative correlation of about 66%. We also observed positive correlations of around 30% between

leverage and age as well as size, and around 27% between profitability and intangibility. Additionally, a positive correlation of approximately 62% was found between growth opportunity and intangibility.

After observing the correlations between the variables, we continued our study by conducting a regression analysis. First, we calculated the regression between leverage and the independent variables without adding any fixed effects. This model revealed a negative relationship between leverage and the size, age, intangibility, and liquidity of the firms in our panel. In addition, a negative relationship emerged between leverage and R&D intensity, profitability, and growth opportunity, although the latter two variables were not statistically significant.

After this, we extended our analysis by adding years fixed effects to the regression, followed by regions, and then by Ateco codes. Finally, we conducted a regression with all fixed effects together. The final result confirmed the negative relationship between leverage and size, age, intangibility, and liquidity. The positive relationship with R&D intensity was also confirmed.

However, what emerged as different was the independent variable profitability. While it was not statistically significant in our initial analysis, now, it indicates a negative relationship with leverage with a significance level of 1%.

On the other hand, the growth opportunity remains statistically not significant for our analysis, so we cannot consider it in our study.

Chapter 5 - Findings and Discussion

5.1 Research Findings

In this final chapter, we will analyze the results of the regressions conducted in Chapter 4 and compare them with the hypotheses we proposed in Chapter 1 of our study.

This comparison will allow us to observe whether our theoretical assumptions have been confirmed or refuted by the empirical analysis we conducted.

By doing so, we will be able to draw conclusions about the tendency of Italian high-tech companies to finance themselves through debt or equity. Additionally, we will determine whether our hypotheses are accepted or rejected by the model.

The theoretical hypotheses advanced in the first chapter of this work primarily revolve around two major economic theories: the Trade-off Theory, which is based on the assumption that an optimal capital structure exists and can be found by balancing all the different costs within a company, and the Pecking Order Theory, which denies the existence of an optimal capital structure and instead asserts that there is a hierarchy of financing methods, with internal financing methods, such as retained earnings, being preferred over debt, and equity being the last choice for financing for such companies.

Our analysis was conducted on seven different independent variables: size, age, intangibility of assets, profitability, R&D intensity, liquidity, and growth opportunity; and one dependent variable, which is leverage.

For each variable, we formulated hypotheses based on theoretical studies conducted in the past. In this chapter, we will examine, one by one, whether the relationship between each variable and leverage, as emerged from the regression analysis conducted in Chapter 3, aligns with, or diverges from the theoretical hypotheses previously made.

The first variable we will analyze is size. As previously mentioned, this variable is undoubtedly one of the most commonly used in regression analyses, but the hypotheses about its influence on debt are not necessarily in agreement.

Indeed, as we have seen, the theory highlights different schools of thought on this matter. The Trade-off Theory (TOT) hypothesizes a positive relationship with debt, suggesting that as companies grow in size, they can tolerate higher levels of debt. On the other hand, the Pecking Order Theory (POT) suggests a negative relationship, arguing that as a company's size increases, so does its profitability and, consequently, its retained earnings that can be used as internal financing sources.

We, in our study, followed the thinking of TOT, assuming a positive relationship between Size and Leverage, whereby, as a high-tech company's Size increases, it will have less risk relative to its investments, which will lead to a lower level of information asymmetry, which will then allow it to resort to a higher level of debt.

In the previous chapter, on the other hand, through regression analysis, performed initially without fixed effects, and later with the addition of such effects, we were able to observe that empirically the Size of a high-tech company is instead negatively related to its level of leverage, with a significance level of 1%.

Therefore, these results are inconsistent with existing theory and literature, and instead follow Pecking Order theory, for which the relationship between size and Leverage is negative.

So, we must reject our first hypothesis H1.

The second variable to be analyzed is Age, which is closely related to the size of a company, and therefore their relationship with leverage is also the same.

Due to this fact, both theory and existing literature have always shown that the sign of the relationship between size and leverage is the same as the sign of the relationship with age.

Our hypothesis in this regard showed a positive relationship with debt, since the more mature a company was, the higher its size, and consequently the better it knew the market and had more credibility with its customers; all of which resulted in lower operational risk and easier access to external financing methods.

This was due in part to the lower agency costs that were created by the use of debt.

Again, however, the results observed as a consequence of our regression analysis were inconsistent with theory and our assumptions, showing instead a negative relationship with leverage with a significance of 1%.

Therefore, for this variable as well, we must reject our second hypothesis H2.

As with the size, also the age of a high-tech company in Italy is negatively related to the level of debt, indicating how the more mature a high-tech company is in our country, the less it will need to resort to debt, and instead, as evidenced by Pecking Order Theory, it will first resort to internal financing, and only then to the external ones; so as not to dilute power within the company and probably so as to be able to avoid any possible external disclosure regarding studies in research and development.

For intangibility, our study was quite complicated, mainly because of the absence of sufficient literature on the subject.

Intangibility is certainly one of the most important variables for our analysis since it precisely represents the intrinsic value of a high-tech company. However, as noted in Chapter 1, the problem found in past literature has been the difficulty in calculating these intangible assets, namely the so-called phenomenon of underreporting of R&D outlays, highlighted by Lim, Macias & Moeller in 2020.

This phenomenon made it difficult to determine a real relationship between the intangibility of a high-tech company's assets and its level of leverage; therefore, we posed our hypothesis by showing a negative relationship between the two variables.

The results of the regression analysis were in agreement with our third hypothesis H3, showing a negative relationship between asset intangibility, calculated as the ratio of intangible assets to total assets, and the level of debt financing for the high-tech companies in our sample in Italy.

Therefore, our third hypothesis H3 was accepted.

Moving on, we looked at the influence that profitability has on the financing choices of the companies in our sample.

This variable is also largely discussed in the literature, since some scholars, following TOT, point out that as a company's reliance on debt increases, the tax advantage given by debt also increases, and therefore so does profit. Others, on the other hand, pursuing the Pecking Order theory, assign a negative sign between debt and profit, stating that, how as profits increase, a company will tend to use its retained earnings initially and only then resort to debt to finance itself.

Regarding the regression analysis, the results were highly variable, in fact, while initially, in the regression without any fixed effects, there was a positive relationship with leverage but not statistically significant, later, in the analysis with the addition of the fixed effects of the Ateco codes and in the regression analysis with the addition of all fixed effects together, the relationship between profitability and leverage was negative with a significance of 1%.

Therefore, the final results were in agreement with what is our fourth H4 hypothesis, showing that as its profitability increases, a high-tech company in Italy tends initially to self-finance, and only later to resort to external financing; probably also to withhold information regarding R&D projects and to reduce agency costs.

So, our fourth hypothesis H4 was accepted.

On the other hand, our fifth hypothesis concerned the intensity of R&D projects, which are also essential for a company in technology. Regarding past literature and theory, many studies have pointed out the tendency of high-tech companies to keep their projects secret until the end, thus tending to finance themselves internally; so, in this sense there would be a positive relationship between internal funding sources and the number of R&D projects.

On the other hand, the more a company implements its R&D projects, the more chances it will have to obtain funds from banks, which led us to our fourth hypothesis, positing a positive relationship between the intensity of R&D projects and the use of debt by high-tech companies in our country.

In this case, the results of the regression analysis confirmed our hypothesis, supporting the positive relationship with leverage with a significance of 1%, both in the initial regression and in the regression with the addition of fixed effects.

Therefore, our fifth hypothesis H5 was accepted.

Also in the case of liquidity, the hypothesis given above agreed with the results of the regression analysis.

Initially we found discordant theories and studies regarding this relationship, with versions theorizing a positive relationship, given that the more liquidity a firm has, the lower its risk of default and the greater its attractiveness to banks.

Other theories, on the other hand, point to a negative relationship, such as POT, whereby a company will tend to finance itself initially through its own liquidity, without in this way, especially for high-tech companies, also having to make its research projects public.

Our hypothesis follows the latter theory, and as we observed, it was found to be in agreement with our regression analysis, obtaining a negative relationship between leverage and liquidity of the high-tech companies in our sample. In fact, for both the initial analysis and the regression analysis with the addition of years, regions and Ateco codes fixed effects, we always found a negative relationship with leverage with a significance of 1%, from which we can observe that a company in the field of

technology in Italy will tend to finance itself, if possible, through its own internal resources instead of debt, again avoiding exposing information about its projects on innovation to third parties.

We can therefore accept our sixth hypothesis H6.

The last variable we are going to observe is instead the Growth Opportunity of a high-tech company, and what influence it may have with respect to the choice of external financing.

The results regarding this variable, in our regression, are the only ones that reported values that were not statistically significant.

In fact, the latter variable is much debated in the literature, due to different valuation methods.

There are theories that show a negative relationship with leverage, such as for the Pecking Order Theory, in which, for high-tech companies, so, for those companies with a high growth prospect and a majority of intangible assets, internal financing proves to be the best choice, so as to avoid high debt costs due to the absence of adequate collateral assets.

This first theory also derives from the valuation method used, which, as in the case of Rajan and Zingales, was based on market-to-book value, thus specifically taking intangible assets into account.

Other studies, on the other hand, suggest a positive relationship between the two variables, which, however, are based on calculating the growth rate of assets, thus taking into account all of a company's assets.

In our case, neither method was more explanatory for our sample; in fact, while for the first method we would have had to consider only companies listed in Italy, thus going to exclude from the study all small and medium-sized companies in the sector, for the second method we would have had to consider all assets within the balance sheet, a method that is not suitable for assessing the real value of a high-tech company.

For these reasons, we preferred to use the ratio of intangible assets to total assets as the method of evaluating Growth Opportunity, thus focusing solely on the growth derived from innovative projects and research and development.

The results of the regression analysis, while agreeing with the negative sign of the relationship between the two variables, in none of the analyses performed turns out to be statistically significant, even with the addition of fixed effects within the model.

Therefore, the final result for this variable is non-significant and, for this reason, our seventh hypothesis H7 was rejected.

To summarize the results, in Table 19 we reported the individual variables, dependent and independent with the individual evaluation methods we used during the regression analysis; at the end we added our hypotheses regarding the influence of different variables on leverage and the actual results of the analysis.

As we mentioned, during the model study we found differences between our hypotheses and the results, such as in the case of the variable Size and Age, for which we had to reject our hypotheses H1 and H2.

Whereas, the results agreed with our hypotheses in the case of asset intangibility, profitability, R&D intensity, and liquidity.

Only for Growth Opportunity we could not consider the final result, being not statistically significant for our analysis. This outcome, as previously mentioned, could be caused by the fact that the evaluation method used is not adequate enough to be able to explain the variable within our sample of high-tech companies.

Therefore, even in the latter case we had to reject hypothesis number 7.

Finally, we saw how the model manages to explain around 52% of the variation in financial leverage, and that, although in need of further evaluation, it could be quite significant, taking into consideration that, in any case, the high-tech market is a highly variable market with factors that are sometimes difficult to identify exactly.

VARIABLES	*DESCRIPTION*	*EXPECTATIONS*	*RESULTS*	*HYPOTHESIS*
DEPENDENT VARIABLE				
LEVERAGE (LVR)	*Total debt/Total assets*			
INDEPENDENT VARIABLES				
SIZE (SIZE)	*Natural logarithm of Total assets*	+	-	*H1 is rejected*
AGE (AGE)	*Years of life of the firm*	+	-	*H2 is rejected*
INTANGIBILITY OF ASSETS (INT)	*Intangible assets/Total assets*	-	-	*H3 is accepted*
PROFITABILITY (PROF)	*Return on Equity*	-	-	*H4 is accepted*
R&D INTENSITY (R&DINT)	*R&D/Sales*	+	+	*H5 is accepted*
LIQUIDITY (LIQ)	*Current assets/Current liabilities*	-	-	*H6 is accepted*
GROWTH OPPORTUNITY (GROWTH)	*Intangible Assests/Sales*	-	*Not significant*	*H7 is rejected*

Table 19. Hypothesis Results.

5.2 Discussions

Thanks to this study, we were able to learn more about the financial structure of high-tech businesses, which expanded on an investigation of the technology industry in our nation that had not been adequately investigated previously.

Contrary to what we first thought, it turns out that a company's propensity to use debt to finance its projects increases with age and size. This data, along with the observation that high-tech businesses in Italy are often rather young, leads us to the conclusion that, in this particular industry, these businesses are oriented toward outside funding. Thus, this pattern supports the findings of Pecking Order Theory and, consequently, the theories of Myers and Majluf (Myers & Majluf, 1984).

For asset intangibility on the other hand, as mentioned in the previous paragraph, our hypotheses coincide with the actual results of the analysis, showing a negative relationship with the leverage variable; but our hypothesis was posed because of insufficient studies in this regard, and it goes against what is Lim, Macias & Moeller's hypothesis of a positive relationship between the two factors. In fact, in their studies, they pointed out how, in order to escape the problem of "underreporting of R&D outlays," an alternative method of valuing intangible assets could be used (Lim, Macias, & Moeller, 2020).

Again, we can observe that the more intangible assets a company has, the more it does not need to resort to external financing; and, assuming that the younger a company is, the fewer assets it has on its balance sheet, including intangible assets, therefore, this will lead to its need to resort to debt to finance itself.

The relationship between profitability and leverage also follows the Pecking Order Theory of (Myers & Majluf, 1984) and (Karacaer, Temiz, & Gulec, 2016), with a negative relationship among its variables, due in part to companies' desire to safeguard the privacy of R&D projects.

For R&D intensity, our initial hypotheses were confirmed, showing a positive relationship between the two factors. This carries forward the theories of (Atzeni & Piga, 2005) in this regard, while rejecting what are the hypotheses of (Himmelberg & Petersen, 1994), which stated instead the need to self-finance in order to be able to maintain secrecy until the end of projects.

Finally, with regard to liquidity, we have seen how, a firm that holds more liquidity on its balance sheet will tend to self-finance instead of obtaining financing from banks, thus again going to confirm the Pecking Order theory of (Myers & Majluf, 1984) and the later hypotheses of (Kedzior, Grabinska,

Grabinski, & Kedzior, 2020) and instead rejecting those examined by (Ramli, Latan, & Solovida, 2018).

For Growth Opportunity, as mentioned earlier, we cannot consider any results due to the absence of significance within the model; therefore, we cannot say whether this factor manages to influence, positively or negatively, or at all, the financial choices of high-tech companies in Italy.

Conclusion

Through this study, we aimed to observe the factors that most influence the financial choices of companies operating in the high-tech sector in Italy.

To conduct this analysis, we considered a panel of 2,143 high-tech firms in our country with data available over the past five years, from 2019 to 2023. Ultimately, our sample consisted of a total of 10,715 observations.

After studying various capital structure theories up to contemporary ones and analyzing the high-tech market in Italy from the second post-war period to the present day, we formulated our hypotheses.

We considered seven different independent variables, including size, age, intangibility of assets, profitability, R&D intensity, liquidity, and growth opportunity. Our intention was to observe how these variables influenced a company's financial leverage in the Italian technological market.

To analyze this relationship, we conducted a regression analysis, with and without fixed effects, which highlighted some agreements and some disagreements with our initial hypotheses.

In conclusion, we observed how factors such as the age and size of a company negatively influence leverage, and so, how high-tech companies, being mostly small to medium-sized and relatively young, need more financial support for their growth, as they cannot rely on internal sources of funding.

We also noted how the intangibility of a company's assets tends to reduce the amount of debt in its capital structure. This highlights how high-tech companies with a large number of intangible assets, such as R&D projects, tend to keep such projects secret, not exposing them to external financiers.

The firm’s profitability, even if initially not significant, becomes significant and negatively influential on the level of indebtedness with the addition of fixed effects of regions, years considered, and different Ateco codes. This is in line with the Pecking Order Theory and underscores how the most profitable high-tech companies in Italy tend to prioritize internal sources of financing over debt. This result also ties into the earlier consideration of companies in research sectors keeping their projects confidential.

Another significant factor that emerged from our analysis is the intensity of R&D, which was found to be positively correlated to the level of indebtedness. Indeed, it was shown how companies that invest more in R&D tend to have higher levels of indebtedness.

This relationship is probably due to the fact that, as mentioned earlier, most of the companies in our sample are small to medium-sized; therefore, they have more need for growth and development, and, having lower profitability due to their size and age, they cannot afford to finance themselves internally.

Liquidity also appeared as a significant factor, showing a negative relationship with leverage.

From this, we can deduce that high-tech companies in Italy tend to finance themselves through their internal sources when they have the opportunity, thus, once again, avoiding disclosing sensitive information about their projects.

This study has certainly highlighted the complexity of financial decisions for companies in the high-tech sector in our country.

Due to the rapidly evolving and highly competitive environment, these companies must adopt varied financial strategies to meet different needs.

The high-tech sector is certainly one of the riskiest in terms of finance, and managers must find a capital structure that balances investments in research and development with the various risks associated with them and their realization.

Furthermore, we have seen how the geographical location in which a company operates can significantly influence its financial choices.

Indeed, depending on the location, there is consequently a different regulatory and political context, which can lead companies to orient themselves towards one method of financing rather than another.

Therefore, the managers of these companies should consider, for the choice of their financial structure, not only factors such as size, age, intangibility of assets, profitability, R&D intensity, and liquidity but also factors such as the region in which individual companies are located and the specific sectoral context to which they belong, as well as the effects that events occurring in various years may have on a company's balance sheet.

To conclude our analysis, however, we must also say that the model we observed does not fully explain the Italian high-tech market since, as we have seen, the R-squared is approximately 52%.

While this result is satisfactory, explaining more than half of the fluctuations in financial leverage among high-tech companies, it also tells us that there are other factors or variables not considered in our study or simply not yet observed that would explain the remaining 48% of variations in this financial leverage.

Therefore, our initial question is not uniquely answered by the analysis conducted, which indeed, by approaching for some aspects the financial life cycle approach, shows that depending on the characteristics of the individual high-tech company, its financial choices can vary significantly.

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