Department of Impresa e Management

Chair of Advanced Corporate Finance

The financial structure of Italian pharmaceutical companies: an empirical analysis

Supervisor:
Prof. *Arturo Capasso*

Co-supervisor:
Prof. *Raffaele Oriani*

Candidate:
Gennaro Pignatiello
Id: 688031

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Foreword

The financial crisis originated in the United States in 2007, following the collapse of the subprime mortgage market, and subsequently spread all over the world, showed that in modern economic systems the financial fragility of companies, both in banking and non-banking sectors, should be one of the main concern of policy-makers.

It is obvious, in fact, that any macroeconomic shock produces effects that are more severe when companies are characterized by a high level of leverage, as in this case the propagating effect of bankruptcies from one company to another is much more likely.

It follows that the determinants of the financial structure of companies are a highly topical field of study and can help to identify the most appropriate tools to prevent, or at least mitigate, the effects of financial shocks.

Starting from the seminal contribution by Modigliani and Miller, the theory of corporate finance has made considerable progress in the study of the factors that affect the financial choices of companies. Numerous other theories have been formulated, thanks also to the developments of the theory of contracts and information asymmetries. However, while there is a substantial agreement on what are the characteristics of the companies (size, profitability, liquidity) that lead them to choose their own financial structure, there are contradictory conclusions about the sign (positive or negative) of their impact on leverage.

Moreover, the most recent contributions have shown that in addition to variables at the firm level, also the institutional and geographical factors, as well as the characteristics

of the financial and banking systems, and then factors at the macro level, play a significant role in determining the financial structure of companies.

Faced with the non-univocal nature of the theory's predictions, empirical studies have assumed a fundamental importance in the search for factors affecting the financial structure. In this thesis we offer a contribution in this sense, proposing a econometric model based on panel data that tries to identify the determinants of the financial structure of Italian pharmaceutical companies. The object of the investigation has been deliberately limited to a specific sector and to a specific country in order to favor as much as possible the homogeneity of the analyzed sample, avoiding in this way the effect of heterogeneity among economic sectors and/or countries.

The thesis is organized as follows. In Chapter 1, we discuss first of all the relationship between leverage and ROE, that is between the degree of indebtedness and the profitability of the company. In fact, between these two variables there is a close relationship in the sense that the indebtedness, producing a cost for interest, ends to also affect profitability, but not necessarily in a negative sense. Where the typical activity of the company present a profitability higher than the average cost of debt, a higher leverage translates into greater profitability, but also in a greater probability of failure, so that the leverage effect can be used up to one certain point and in the case of a typical business crisis results in a loss of profitability higher than what would happen for a less indebted company. Secondly, the different possible definitions of leverage are discussed, since, although they theoretically measure the same aspect, the results an econometric model that studies the determinants of leverage can depend on how the dependent variable is defined. Finally, the chapter offers an overview of the main theories on the financial structure and some empirical contributions that have tried to verify their validity.

Chapter 2 is devoted to the definition of the sector under study and its characteristics in the Italian economic system in terms of profitability, innovation, internationalization

and geographical distribution of the firms. AS it will be clear, the pharmaceutical indusrty is one of the most dynamic and innovative sector of our economy, an this makes it particularly interesting for the purpose of identifying the determinants of the financial structure.

Finally, in Chapter 3 the results of the econometric model are presented and discussed. Since it has been estimated on the basis of a panel of Pharmaceutical companies observed during the period 2007-2016, the methods of estimation and testing in a panel data context are discussed. Subsequently the variables of the model are discussed, as well as the expecyed signs of the corresponding model parameters. A separate discussion is devoted to concentration in the Italian banking markets, as in the last decades this sector was characterized by a significant number of mergers and acquisitions that potentially increased power of credit institutions, exacerbating the constraints on external financing faced by companies. The last two paragraphs of the chapter are discuss the data available and results of the econometric model.

The final Chapter draws some conclusions.

Chapter 1

Theories on the financial structure of companies

1.1 Introduction

In this chapter we first discuss the relationship between ROE and leverage (Section 1.2), in order to show how the use of debt impacts on the profitability, and therefore that the study of the determinants of the financial structure also allows to identify some of the factors affecting the companies' performance.

Since leverage is the dependent variable of the econometric model presented in Chapter 3, in Section 1.3 we illustrate the alternative ways in which this variable can be defined.

Subsequently, theories on the financial structure and studies that tried to demonstrate their validity on an empirical ground are reviewed. Indeed, in the literature it is possible to identify five main theories on the choice of the financial structure: i) the theory of Modigliani and Miller (1958, 1963); ii) the trade-off theory; iii) the theory of the order of choice (pecking-order hypothesis); iv) the theory of market timing; v) the theory

based on agency costs; .[1] The results of these theories will guide the choice of the independent variables used in the econometric model presented in Chapter 3.

1.2 The relationship between ROE and leverage

As it is well known, one of the key performance indicator of a company is the Return on Equity (ROE) which is defined as:[2]

$$ROE = \frac{\text{Net income}}{\text{Book Value of Equity}} \tag{1.1}$$

Since Net Income is a flow variable, sometimes as denominator of formula (1.1) we consider the average of the book value of equity at the beginning and at the end of the year which Net Income refers to.

Basically, the ROE explains the overall profitability of the company on behalf of shareholders. Therefore, it is a measure of the return that shareholders (or owners) have achieved on the capital invested in the enterprise. While the ROE represents a basic measure of profitability, the Return on Common Equity (ROCE) is instead used by analysts. The difference is in the numerator where the Total Comprehensive Income is used. We will use the basic version of profitability for our purposes because the ROCE focuses on the total income realized, even the portion that cannot be distributed.

The ROE can be further decomposed as follows:

$$\begin{aligned} ROE = & \underbrace{\frac{\text{Net income}}{\text{Sales}}}_{\text{Net Profit Margin}} \times \underbrace{\frac{\text{Sales}}{\text{Total Assets}}}_{\text{Asset Turnover}} \\ & \times \underbrace{\frac{\text{Total Assets}}{\text{Book Value of Equity}}}_{\text{Equity Multiplier}} \end{aligned} \tag{1.2}$$

[1] For an extensive review of these theories see Prasade et al. (2005) and Frank and Goyal (2008).
[2] See Berk and De Marzo (2014, p. 42).

Formula (1.2) shows that the ROE depends on the following three terms: 1) Net Profit Margin, that is the portion of sales translated into profits, which is a measure of efficiency and profitability; 2) Asset Turnover, which is a measure of effectiveness, since it shows the ability of the company to generate sales from its assets; 3) Equity Multiplier, which is a measure of leverage: the higher this ratio, the lower is the amount of the company's assets that are financed by its shareholders or, equivalently, the higher is the portion of assets that are financed by debt.

Since the ROE is a measure of profitability of the company and depends on the leverage (debt-equity relationship), as is visible by the Equity Multiplier, this implies that studying the determinants of the financial structure is equivalent to study also some of the determinants of the overall profitability of companies.

From formula (1.2) it may seem that the ROE increases as the leverage, and so the third term, increases. However, such a conclusion would be wrong as the equation does not explicitly take into account the role of interest on debt. To this end, we break down the Net Profit Margin in two parts as follows:[3]

$$\begin{aligned} \text{Net Profit Margin} = & \frac{\text{After-tax Interest} + \text{Net Income}}{\text{Sales}} \\ & \times \frac{\text{Net income}}{\text{After-tax Interest} + \text{Net Income}} \end{aligned} \tag{1.3}$$

where After-tax Interest $= (1-t)I$, being t the tax rate and $I = iD$ the gross interest

[3]See Brealey et al. (2011, p. 718).

paid on debt. Rewriting equation (1.2) in the light of (1.3), we obtain:

$$\begin{aligned} ROE = & \underbrace{\frac{\text{After-tax Interest} + \text{Net Income}}{\text{Sales}}}_{\text{Operating Profit Margin}} \\ & \times \underbrace{\frac{\text{Net income}}{\text{After-tax Interest} + \text{Net Income}}}_{\text{Debt Burden}} \\ & \times \underbrace{\frac{\text{Sales}}{\text{Total Assets}}}_{\text{Asset Turnover}} \times \underbrace{\frac{\text{Total Assets}}{\text{Book Value of Equity}}}_{\text{Equity Multiplier}} \end{aligned} \tag{1.4}$$

In the last equation, the first term is the Operating Profit Margin[4], which is the portion of Sales that translates into Operating Profit. In particular, the numerator of the first term represents the Net Operating Profit after Taxes (NOPAT).[5] In this case, it is computed with the bottom-up tax allocation method, that is starting from Net Income, adding financial expenses and subtracting the tax benefit (After-Tax Interest).

The product between the first term and the third one is the Return on Assets (ROA), which is an indicator of how much profitable a company is relative to its total assets. Since the numerator is represented by After-Tax Interest plus Net Income (NOPAT) and the denominator is Total Assets, the ROA explains the profitability of operating activities, without considering financial activities. Therefore, the ROA, sometimes referred to as Return on Investments (ROI) depends on the business capabilities of the company but is not influenced by the financial structure.

Conversely, the second and fourth term depend on the debt-equity mix. The former, defined as Debt Burden, measures the portion of the Operating Profit which translates into Net Income and it decreases as debt, and therefore interest, increases. While the relationship between debt and Debt Burden is negative, the relationship between debt and the Equity Multiplier is instead positive.

If the company was entirely financed by equity (zero debt), both the Debt Burden

[4]Sometimes also defined as Return on Sales (ROS) when the numerator is represented by the EBIT.
[5]See Magnanelli et al. (2016).

and the Equity Multiplier would be equal to 1. In this case ROA, that is the product between the first and third therm of formula (1.4), would be equal to ROE.

However, if the company has debt, the Debt Burden is less than 1, while the Equity Multiplier is greater than 1. As debt increases, the former decreases and the latter increases, which means that leverage can either increase or decrease ROE. This result shows the fundamental relationship between ROE and leverage.

This relationship, and so the effect of the financial structure on the overall profitability of the company, can also be explained by the following formula:

$$ROE = ROI + (ROI - i) \times \frac{D}{E} \times (1 - t), \tag{1.5}$$

where i is the average interest rate paid by the company for its financial debt (cost of debt) and t is the tax rate. This formula allows to compute the ROE after taxes and can be divided in two parts. The first part relates to the operating activities (ROI), while the second part relates to the financial structure.

As it is easily observable, the effect of leverage (D/E) on the ROE can be positive or negative depending on (ROI – i), called spread.[6]

If $(ROI - i) > 0$, the effect of leverage (D/E) on the ROE is positive and it is convenient for the company to borrow from external lenders. In this case, there is a positive financial leverage, indeed the remuneration of capital invested in operating activities (ROI) is higher than the cost of that capital (i).

If $(ROI - i) < 0$, the effect of leverage (D/E) on the ROE is negative, and so it is not convenient for the company to increase financial debt. Then, there is a negative financial leverage and the company should finance itself through capital contributions of its shareholders.

[6] See Magnanelli et al. (2016).

1.3 Some alternative definitions of leverage

The definitions of leverage used in equations (1.4) and (1.5) are different but they both highlight that leverage acts as a ROE amplification factor. Indeed, leverage is also called multiplier because it can either enlarge or reduce the effect on the overall profitability. This effect depends on whether the spread $(ROI - i)$ is positive or negative.

If in formula (1.4) the book values of assets and equity are substituted by the corresponding market values, that is the Equity Multiplier is calculated as Enterprise Value/Market Value of Equity, we get an index measuring the financial risk caused by leverage from a shareholders' point of view rather than a firm's one. From a mathematical point of view this definition of leverage is equal to 1 for an unlevered firm and greater than 1 for a levered one.

Moreover, leverage is often measured by means of the debt-equity ratio, defined as the ratio between the amount of debt (both short and long-term) and equity:

$$\text{Debt-Equity Ratio} = \frac{\text{Total Debt}}{\text{Total Equity}} \tag{1.6}$$

It is worth noting that only financial debt must be considered and not also operating liabilities.

However, as in the case of the Equity Multiplier, it may be preferable to consider the market value of equity rather than the book value. In fact, as it is known, the book-value of equity does not correctly reflect the value of the company and can sometimes even be negative, making the index under consideration meaningless.

The Debt-Equity Ratio is equal to zero if the firm is unlevered and greater than zero if it has debt. A value greater than 1 points out that the company finances itself more with debt than with its own resources.

Another alternative definition of leverage is the portion of total assets financed by

debt, known as the debt-to-capital ratio, that is:

$$\text{Debt-to-Capital Ratio} = \frac{\text{Total Debt}}{\text{Total Equity} + \text{Total Debt}} \tag{1.7}$$

Even in this case, the index can be computed by using both book or market values. It ranges between zero (in the case of an unlevered firm) and 1 (if the firm is financed entirely by debt).

As it will be discussed in the next section, the risk of bankruptcy increases with increasing leverage. However, with the same amount of debt, this risk is lower for a company that has more liquid resources or assets that can be readily liquidated without costs. Therefore, in analyzing the financial structure of a company, it is useful to calculate also its Net Debt, that is the debt in excess of its cash reserves:

$$\text{Net Debt} = \text{Total Debt} - \text{Cash \& Short-term Investments} \tag{1.8}$$

In turn, the Net Debt can be used to calculate an index similar to the debt-to-capital ratio, known as the firm's debt-to-enterprise value ratio:

$$\begin{aligned} \text{Debt-to-Enterprise Value Ratio} &= \frac{\text{Net Debt}}{\text{Market Value of Equity} + \text{Net Debt}} \\ &= \frac{\text{Net Debt}}{\text{Enterprise Value}} \end{aligned} \tag{1.9}$$

Among the alternative definitions of leverage presented in this section, the most widely used and easily understandable is the Debt-Equity Ratio. In effect, this definition emphasizes the most important financing methods of a company and directly compares them.

1.4 The Modigliani-Miller theory

One of the first theories dealing with the problem of the optimal financial structure of a company was that proposed by Modigliani and Miller (1958, 1963) (MM). The main result of this theory is that the value of a company does not depend on its financial structure. This means that it does not matter if the company raises its capital through the issuance of shares or debt.

The theorem consists of two distinct propositions, both valid under very shirinking constraints imposed by the fundamental assumption. Indeed, the key assumption which this theorem is based on is that of "perfect capital markets", which in turn means that:

1) all economic agents, whether they are investors or companies, can buy and sell the same securities at the market price, the latter defined as the present value of future cash flows that the security produces. Therefore, investors and companies can borrow at the same rate because there are not information asymmetries.
2) absence of taxes and transaction costs associated with security trading;
3) the cash flows of firms' investment projects are independent of their financial decisions and these do not reveal additional information about the profitability of the projects themselves.

As shown by MM, if these hypotheses are valid, the firm's decisions about its financial structure do not affect its value. The latter will correspond to the market value of cash flows generated by its assets. Intuitively, this result is explained by the fact that, in the absence of taxes and transaction costs (assumption 2), cash flows paid to shareholders and creditors of the company are equal to the cash flows generated by its assets. The equality of the cash flows implies in turn the equality between the value of firm's securities and the value of its assets (since value depends on future cash flows - assumption 1). In other words, the financial structure has no effect on the value of the company, provided that it does not lead to a change in the cash flows associated with

the investment projects (assumption 3).

The same conclusion applies even if investors have different preferences with respect to the financial structure chosen by the company in which they invest. In fact, given that they can borrow and lend at the same rate as the company, they will be able to achieve the desired level of leverage for their portfolio. For example, if an investor believes that the leverage level chosen by the company is too low, he or she can borrow and build a portfolio characterized by a higher level of debt. In other words, the so-called "homemade" leverage is a perfect substitute of the leverage used by the firm.

Formally, the first proposition of the MM's theorem can be written as:

$$E + D = U = A \tag{1.10}$$

where E, D, U, A are the market values of equity of a levered firm, debt, equity of an unlevered firm, and assets respectively. In other words, the market value of a company is equal to the value of its assets regardless of whether or not it is indebted.

The first equality in formula (1.10) can be reinterpreted in terms of returns. That is, the return on a portfolio consisting of securities representing equity and debt of a levered company must be equal to the return on a portfolio of securities of an unlevered one:

$$\frac{E}{E+D}R_E + \frac{D}{E+D}R_D = R_U \tag{1.11}$$

Solving for R_E, one gets the second proposition of the MM's theorem:

$$R_E = \underbrace{R_U}_{\substack{\text{Risk without} \\ \text{leverage}}} + \underbrace{\frac{D}{E}(R_U - R_D)}_{\substack{\text{Risk due to} \\ \text{additional leverage}}} \tag{1.12}$$

The second proposition expresses that the levered return (R_E) is the sum of the unlevered return (R_U) and an extra component which is proportional to the debt-equity

ratio D/E (leverage). This means that a shareholder investing in a levered company will require a higher return than a shareholder investing in a company without debt.

The reason is that in case of debt (levered firm) the risk of bankruptcy exists and therefore the equity cost of capital (R_E) increases. In other words, a higher leverage implies a higher cost of equity because equity-holders demand a higher return due to the increased risk of default. Similarly, the cost of debt (R_D) increases as leverage increases because a more indebted company runs a greater risk of bankruptcy and therefore its creditors demand a higher remuneration.

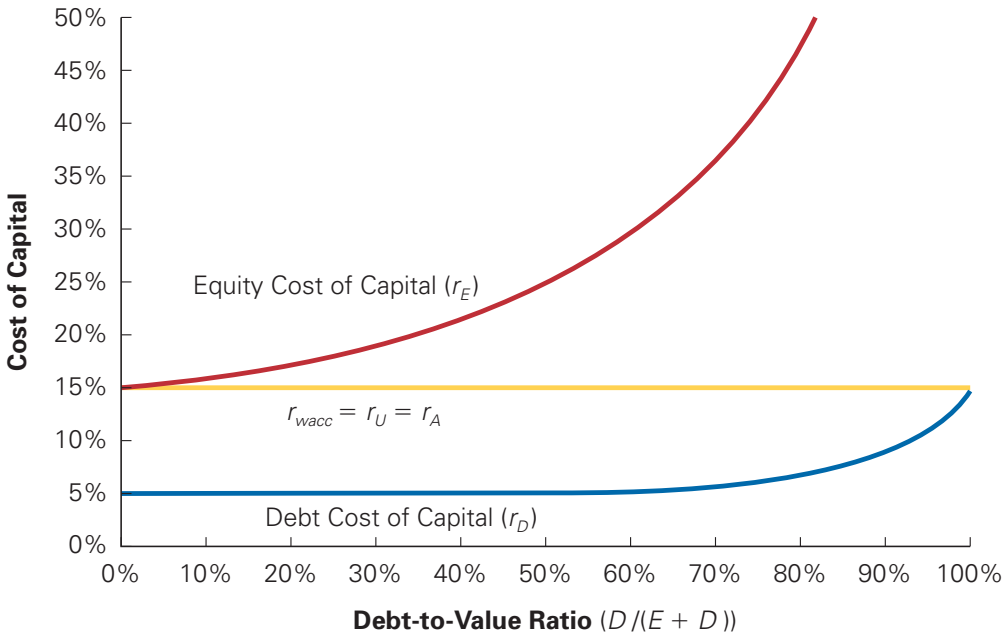
The second proposition of MM also involves that, in case of perfect capital markets, the Weighted Average Cost of Capital ($WACC$) of the firm is independent of its capital structure and is equal to its equity cost of capital if it is unlevered, which in turn is equal to the cost of capital of its assets.

As highlighted in Figure 1.1, as the fraction of the firm financed by debt increases, both the equity and debt become riskier and their cost of capital rises. However, since the weight of debt in the financial structure increases and R_D is generally lower than R_E, the $WACC$ remains constant. In other words, the $WACC$ does not change with a changing leverage.

The MM's theorem might seem negligible because both propositions are based on assumptions that are not met in the real world. Actually, the theorem is of great importance because it demonstrates that the financial structure matters. Indeed, it influences the value of the company exactly because one or more fundamental assumptions are violated in the real markets. Hence, the theorem is a cornerstone of corporate finance even if it is not applicable to the real world.

In light of the MM's result, the theme of the optimal financial structure has given raise to the "trade-off theory". As argued by Kraus and Litzenberger (1973), companies choose the financial structure that maximizes their value and, in doing so, they must seek a compromise between benefits and costs. Benefits are represented by the tax

Figure 1.1 - WACC and Leverage with Perfect Capital Markets



Source: Berk and De Marzo (2014, p. 490).

deductibility of interest, also referred as the tax benefits of debt. On the other hand, costs are due to the fact that a higher leverage leads to an increase in the probability of bankruptcy. Thus, the optimal ratio between debt and equity is that for which marginal benefits and marginal costs are equal.

Another example of the cost of debt is the so-called "debt overhang", highlighted by Myers (1977), which means that indebted companies may not undertake investment projects with positive net present value since part of the cash flows would benefit company's creditors and not shareholders. The consequence is that the optimal debt-equity ratio is lower than that would result from the model of Modigliani and Miller (1963).

1.5 The pecking-order theory

After MM's seminal contribution, a flourishing economic literature has emerged. In fact, alternative theories on the financial structure have been elaborated, which try to avoid the constraints given by the MM's initial hypotheses. The pecking-order theory was originally developed by Myers (1984) and Myers and Majluf (1984). They, without coming to affirm that financial decisions are irrelevant to the value of the company, as stated by the MM's theorem, argue that companies do not have an optimal capital structure.

Indeed, due to information asymmetries between shareholders and managers on the one hand, and potentials external lenders on the other hand, companies tend to adopt a perfect hierarchical order of funding: first, they use internal funds, that is retained earnings; if external financing is needed, they issue low risk debt; only in the last resort, when the ability to issue high quality debt is exhausted, the company issues new shares.

Therefore, the pecking order theory, unlike the MM theory, is based on the information asymmetries. Indeed, managers have more information about their company than external potential investors. Hence, lenders and investors will require a higher return because of the higher risk. Moreover, the company has to incur other costs to issue debt and shares. For all these reasons, internal financing is better and cheaper than external financing. If retained profits are not sufficient, then the company will use external financing. In this case, managers prefer debt over equity because the cost of debt is lower than the cost of equity. However, at a certain point, the company will shift to equity as a too high leverage can be really risky.

Another reason why it is preferable to use self-financing is to avoid sharing profits with external lenders. If internal sources are not enough to finance the project, it is better to issue low-risk debt, thus paying a reduced and fixed fee to lenders and withholding the residual profits to benefit shareholders. The issuance of shares is the

least advantageous solution since, by increasing the shareholder base, it reduces profits for the original shareholders.

Ultimately, leverage at a given time simply reflects external financing needs, without the tendency to converge towards a particular optimal level.

1.6 The market-timing theory

The non-existence of an optimal financial structure is also stated by the market timing theory (Stein, 1996; Baker, Stein, et al., 2003) which, going further, argue that financial decisions of companies are completely determined by the often non-rational behavior of financial markets.

When the price of the company's shares is high, it prefers to issue new equity rather than debt to finance its investment projects. In fact, in this case, the firm can collect the necessary resources by issuing a limited number of new shares and thus diluting to a less extent the participation of the original shareholders. On the other hand, the firm will resort to the debt or postpone the investment when the market in general, or its own shares in particular, is falling. Therefore, this theory states that companies choose the cheaper form of financing at the time of the investment project without paying attention to their current level of internal resources, equity and debt.

Ultimately, according to the market- timing theory there is not an optimal financial structure, and leverage at a given time is nothing but the result of factors external to the company, rather than its optimizing decisions.

1.7 Agency costs and capital structure

On the other hand, the agency theory (Jensen and Meckling, 1976) states that the optimal financial structure is the one that reconciles the needs of shareholders and

managers with those of the company's creditors. In this case too, therefore, it is a matter of finding an optimal trade-off between conflicting forces, although benefits and costs are of a different nature from those highlighted by the previous theories.

More precisely, agency costs associated with the shareholders-manager[7] relationship (agency costs of equity) decrease as leverage increases, since in this case investments are financed more and more with creditors' and not shareholders' resources. Indeed, as leverage increases, equity-holders are less interested in the undertaken projects and so they support less costs to control their managers.

On the other hand, the agency costs associated with the creditors-shareholders relationship (agency costs of debt) increase with increasing leverage; in fact, as shareholders are protected by limited liability, they will tend to implement risky projects, with the consequence that creditors will demand a greater interest rate.

The optimal level of leverage is therefore the one that minimizes the sum of the two types of agency costs.

Another contribution to the agency theory is that of Jensen (1986), who argues that the agency costs characterizing shareholders and managers increase as "free" cash flows increase. These are the cash flows that managers could use for non-productive expenses and thus shareholders seek to minimize them. In this perspective, a higher debt entails a reduction in agency costs because it involves a payment of a fixed amount of money (interests) that reduces "free" cash flows available to management.

As a summary, there is a negative relationship that can be exploited between the leverage and agency costs.

[7]Principal and agent of the agency relationship, respectively.

1.8 Empirical studies on the determinants of the financial structure

The theories discussed above have been empirically tested by numerous authors. Following the MM's model, Bradley et al. (1984) test the trade-off theory and so the existence of an optimal financial structure. Unlike most previous studies, they use data at the firm level rather than aggregate data. The existence of an optimal financial structure lies in the trade-off between tax advantages resulting from the deduction of interest on debt, which drives the company to borrow more, and the cost of bankruptcy that instead acts in the opposite direction. While the former are obvious and easily measurable, the latter are more evanescent.

In order to verify whether such benefits and costs have any role and therefore if an optimal financial structure exists, the authors regress the debt-equity ratio on a measure of profits' volatility, tax benefits and expenses in Research & Development. The most interesting result is that the profits' volatility is inversely related to the debt-equity ratio: the greater the risk, the lower the use of external financing. This implies that the risk of bankruptcy has a role in the financial choices of companies and that it is therefore possible to talk about an "optimal financial structure".

Maloney et al. (1993), on the other hand, try to verify if there is empirical support to the theory that emphasizes the importance of agency costs in determining the optimal capital structure. In particular, in the contribution of Jensen (1986) described above, debt is seen as a means of regulating the actions of managers, thus reducing the agency costs associated with their relationship with shareholders. If this is true, then we must expect that more indebted companies have a higher market value. In order to verify this hypothesis, Maloney et al. (1993) analyze 428 merger transactions and 389 acquisition transactions occured in the period 1982-1986, finding a positive relationship between the valuation of the targets and their level of indebtedness.

In addition to the determinants highlighted by economic theory, more recent studies state that other factors factors affecting the financial structure of companies exist. These factors are related to the country, such as the tax system, the bankruptcy law and the development of the banking and financial system, bbut also to the socio-demographic characteristics of the entrepreneur.

For example, Rajan and Zingales (1995) study the determinants of leverage considering a sample of companies operating in the G-7 countries. Based on a descriptive analysis, they show that, with regard to the aspects mentioned above, there is a considerable difference among countries, which could explain the differences in the leverage of the companies operating in each of them. In fact, estimating an econometric model of the debt's determinants (such as fraction of fixed assets on assets, size, profitability, etc.), it turns out that these factors are statistically significant in some countries but not in others. Moreover, the unexplained variability of leverage is quite large, meaning that institutional factors (not considered in the analysis) have a significant role in determining the financial structure.

As regard the pecking-order theory, one of the first works to empirically test it is that of Shyam-Sunder and Myers (1999). Basically, the theory in question states that when internal funds generated by investment projects are insufficient to finance other investments and the payment of dividends, the company issues new debt. Then, it issues new shares only when the cost of bankruptcy associated with debt becomes excessive.

Based on these premises, the two authors show that there is an extremely simple empirical strategy to test the theory. In fact, if the theory is true, there should be a one-to-one relationship between the debt variation (in absolute terms) and the financial need, the latter defined as the sum of dividends and investments (fixed and circulating) net of operating cash flows. This implies that by regressing the debt variation from one financial year to another on the financial needs, the corresponding coefficient and the

model constant must be statistically equal to 1 and 0, respectively. Using a sample of 157 companies observed in the period 1971-1986, Shyam-Sunder and Myers (1999) find robust statistical evidence in favor of the pecking-order theory.

However, Murray and Goyal (2003), applying the Shyam-Sunder and Myers (1999) method to a more up-to-date sample, question the result above, in the sense that the validity of the pecking-order theory loses statistical significance in the last years of the period under study, especially in the case of small firms. Furthermore, the use of debt is significant and the use of equity, which in theory should be the last alternative, seems to prevail over third-party loans. Therefore, the authors demonstrate that the theory fails where it should hold. In fact, in the case of small firms, information asymmetry is usually an important problem and so the other theories on the capital structure should not be worth.

Finally, it is worth mentioning a study that tests the market timing theory, according to which the company issues new shares when its market value is high and repurchases them when prices are low, so that the debt-equity ratio is nothing but an effect of the performance of the stock markets. In other words, firms do not care about their form of financing and just choose the method which, at a certain time, is more valued by financial markets.

The study in question is that of Baker and Wurgler (2002), who verify whether the relationship between market and book values of companies (market-to-book ratio), along with a set of control variables (fixed assets, size, profitability, etc.), is a statistically significant determinant of leverage. Results show that the low-indebted companies issue new capital when prices are high and, conversely, highly-indebted companies are those issuing new capital when their market value is low. Thus, fluctuations in share prices have an important effect on the financial structure and this effect persists over time.

Looking at this short examination of the literature it is clear that, from an empirical point of view, none of the theories that try to explain the financial structure of companies

prevails over the others. There are works that support one or the other theory, without being able to draw up an order of validity. It seems, therefore, that economic theory can only partially drive the choice of the variables able to explain the phenomenon.

For example, some authors, especially with reference to small businesses, have stressed the role of the socio-demographic characteristics of entrepreneurs. In fact, the literature discussed above has mainly used data on large companies and thus characterized by the separation between ownership and control as well described by Marris (1964)'s model of the "managerial enterprise".

In small businesses, the link between the firm and the entrepreneur is very tight and therefore one should consider that the degree of risk aversion (Pettit and Singer, 1985), the social conditions (Ando, 1988; Bates, 1989) and the socio-demographic characteristics of the entrepreneur (Bates, 1990) may have an impact on management choices, including those of financial nature.

A study that simultaneously takes into account all the factors mentioned above as potential determinants of the financial structure is that of Scherr et al. (1993). Estimating an econometric model based on a sample extracted from a population of about 125,000 small businesses, they find that the debt-equity ratio is negatively correlated to the age of the entrepreneur. The explanation may be that older owners have more internal resources to use and are more risk averse because their investment time horizon is shorter. Moreover, they find higher debt position for married than never-married owners, probably because lenders prefer owners with many sources of income. Then, male owners are more indebted than female owners, perhaps due to women's risk aversion and discrimination by lenders. The same result occurs for black versus white entrepreneurs, maybe for similar reasons.

A more recent study about startup firms' financial structure is that of Sanyal and Mann (2010). Their main results can be summarized as follows:

- tangible assets are positively correlated to the level of indebtedness, given their

higher liquidation value in the case of bankruptcy. Startups that instead have human capital impersonated in the entrepreneur or intellectual property assets are less likely to use financial debt because of the higher specificity and lower collateral value of these assets;

- smaller firms are less indebted than larger ones, given their greater opacity from an informational point of view. Thus, they compensate the lack of external funding through the resources of the entrepreneur or of his relatives and friends;
- firms managed by more educated and white founders are, on average, more indebted than others firms. This may be due to the fact that lenders are more likely to provide credit to entrepreneurs with more years of education. The second result is surely due to a problem of discrimination by lenders;
- the financial structure of women-owned firms does not differ from that belonging to men;
- the financial structure of hi-tech firms significantly differs from that of firms operating in more traditional sectors.

1.9 Summary

In this chapter, after discussing the concept of leverage and clarifying its relationship with profitability, the main theories that try to explain factors affecting the financial structure chosen by companies were discussed. Some of them, such as the MM's theory, the trade-off theory and that based on agency costs, argue that companies are able to select their optimal financial structure. This optimizing decision comes from a process of maximizing the value of the company, choosing the right trade-off between benefits and costs or from minimizing the costs associated with the various sources of financing.

Others, such as the pecking-order theory or the market-timing theory state, vice-versa, that there is no optimal financial structure. Indeed, according to them, the

financial structure is the temporary result of financial market trends or simply derives from the preference of shareholders for internal rather than external resources.

The validity of one or the other theory is therefore an empirical question, but unfortunately even under this point of view it is not possible to draw definitive conclusions. Moreover, more recent studies show that the institutional characteristics of countries and/or the socio-demographic characteristics of entrepreneurs, although not yet considered by the economic theory, have a role in affecting financial choices.

Chapter 2

The Italian pharmaceutical industry

2.1 Introduction

In this chapter we analyze the characteristics and trends of the Italian pharmaceutical industry. The analysis is conducted on the entire population of pharmaceutical companies in relation to the manufacturing sector as a whole. The aspects under study are therefore of a "macro" type and concern the degree of competitiveness, research and innovation, internationalization and localization. Afterwards, there is an analysis concerning the comparison between the Italian and European pharmaceutical industries. At the end of the chapter, some weaknesses of the Italian pharmaceutical industry and its challenges for the future are discussed. The analysis at a firm level is included in Chapter 3, in which, based on data gathered from the AIDA database, an econometric model will be estimated in order to identify the determinants of the financial structure of Italian pharmaceutical companies.

2.2 Industry definition and related activities

According to the Italian classification of the economic sectors, known as "ATECO 2007", the pharmaceutical industry is part of the manufacturing sector and can be divided into the following three main activities: 1) Manufacture of basic pharmaceutical products (*Fabbricazione di prodotti farmaceutici di base*, code 21.10.00); 2) Manufacture of in vivo radioactive diagnostic substances (*Fabbricazione di sostanze diagnostiche radioattive in vivo*, code 21.20.01); 3) Manufacture of medicines and other pharmaceutical preparations (*Fabbricazione di medicinali ed altri preparati farmaceutici*, code 21.20.09).[8]

Particularly, the first activity consists of: a) manufacture of active medicinal substances to be used, for their therapeutic properties, in the manufacture of pharmaceutical products: antibiotics, vitamins, salicylic and acetylsalicylic acids; b) manufacture of blood derivatives for pharmaceutical use; c) manufacture of chemically pure sugars; d) processing of glands and production of extracts of glands.

The third activity deals with: a) manufacture of medicines: immune sera and other blood constituents, vaccines, various medicines, including homeopathic preparations; b) manufacture of contraceptive chemical preparations for external use and hormonal contraceptive medicines; c) manufacture of diagnostic medical preparations, including pregnancy tests; d) manufacture of biotechnological pharmaceutical products; e) manufacture of wadding, gauze, bandages, patches, impregnated or covered with pharmaceutical substances; f) preparation of botanical products (grinding, selection, mincing) for pharmaceutical use.

[8] See https://www.istat.it/it/archivio/17888.

2.3 Characteristics and trend of the pharmaceutical industry in Italy

2.3.1 Competitiveness

The Italian economy is recovering after the financial crisis of 2007–2008, but at a still too weak pace. This is why the country needs sectors capable of driving growth, such as the pharmaceutical industry, which is one of the most dynamic and innovative sectors in the Italian economy.

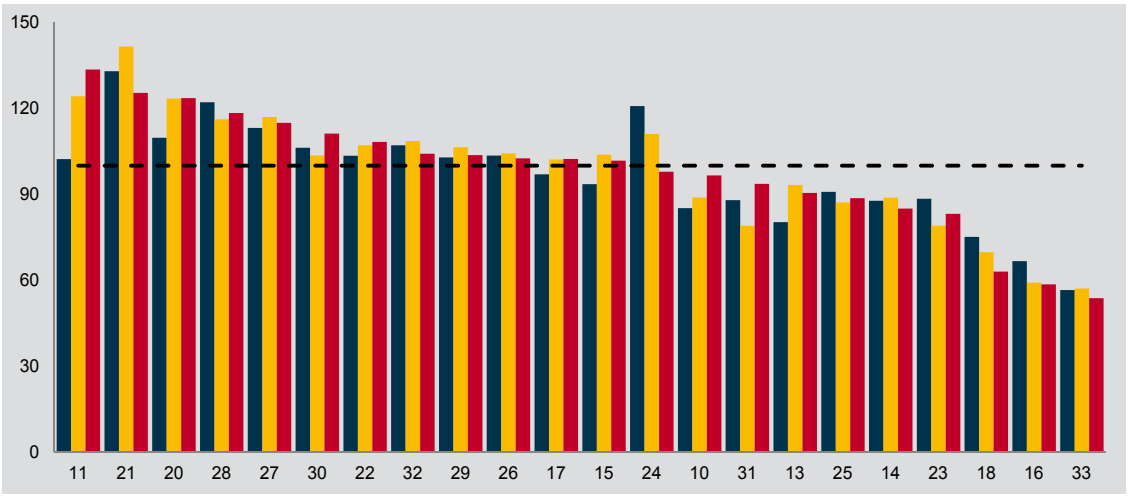
In fact, since 2010, the pharmaceutical industry is at first position in terms of growth of production (+19% compared to -5% for the manufacturing average) and of exports (+69% compared to +33%), allowing it to contribute positively to the Italian GDP both during the crisis and economic recovery.

Besides, in recent years, it has always been ranked in the top positions of the competitiveness ranking of the economic sectors compiled yearly by the Italian National Institute of Statistics (Istat).[9]

The "Synthetic Competitiveness Index" (ISCo) provides a measure of the performance of each sector compared to that of the whole manufacturing industry. It also allows to define a ranking of the manufacturing sectors taking into account four dimensions of competitiveness, expressed by five basic indicators: 1) cost competitiveness; 2) profitability; 3) performance on foreign markets and 4) innovation. The indicators measuring the four dimensions considered are: cost competitiveness (ratio between added value per employee and cost of labor per employee), gross profitability (ratio of gross operating profit to added value), the propensity to export (exported share of turnover), the variation in exports (compared to the three-year reference period 2005-2007) and the propensity to innovation (share of innovative companies).

[9] See Istat (2018a).

Figure 2.1 - Competitiveness index (ISCo)[(a)] by manufacturing sector[(b)] - Years 2008, 2011 and 2015

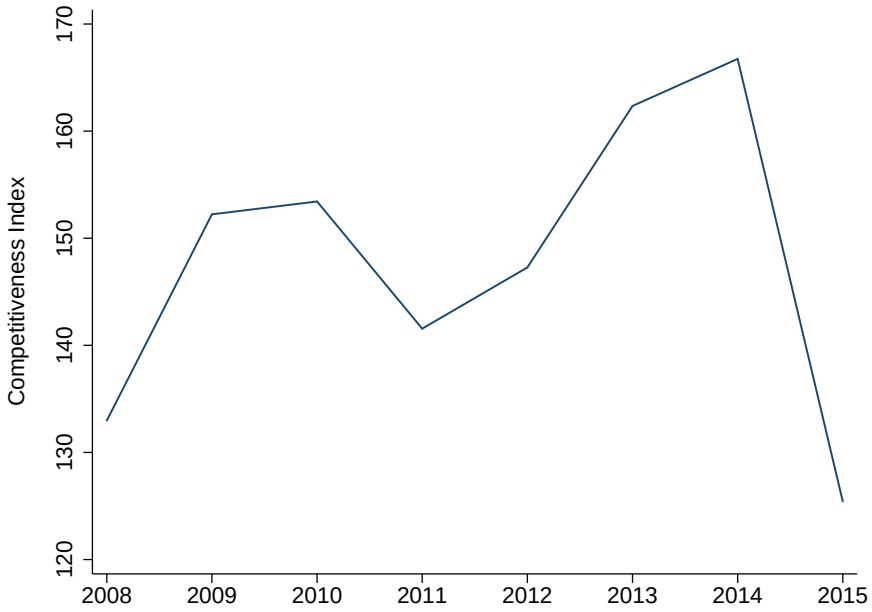


[(a)] Manufacturig sector = 100.
[(b)] 10=Food; 11=Beverage; 13=Textile; 14=Clothing; 15=Leather garments; 16=Wood; 17=Paper; 18=Printing; 20=Chemical products; 21=Pharmaceutical products; 22=Rubber and plastic; 23=Non-metallic minerals; 24=Metallurgy; 25=Metal products; 26=Computer and electronic devices; 27=Electric devices; 28=Machinery and equipment; 29=Motor vehicles; 30=Other means of transport; 31=Furnishings; 32=Other manufacturing industries; 33=Repair, maintenance and installation of machinery and equipment.
Source: Istat (2018a).

As can be seen from Figure 2.1, in recent years, the pharmaceutical sector has always been ranked at the top of the competitiveness ranking with an index value abundantly higher than 100, that is the value of the whole manufacturing industry taken as a reference. The other sectors of the Italian manufacturing industry characterized by high competitiveness were: Beverage (11), Chemical products (20), Machinery and Equipment (28) and Electric devices (27).

With reference to 2015, the last year for which data is available, the sector's competitiveness has undergone a significant fall, although it has remained above the manufacturing average (Figure 2.2). The peak was reached in 2014, with an index value above 160.

Figure 2.2 - Competitiveness Index* - 2008–2015



*Manufacturig sector = 100.

Source: Our elaboration on Istat data.

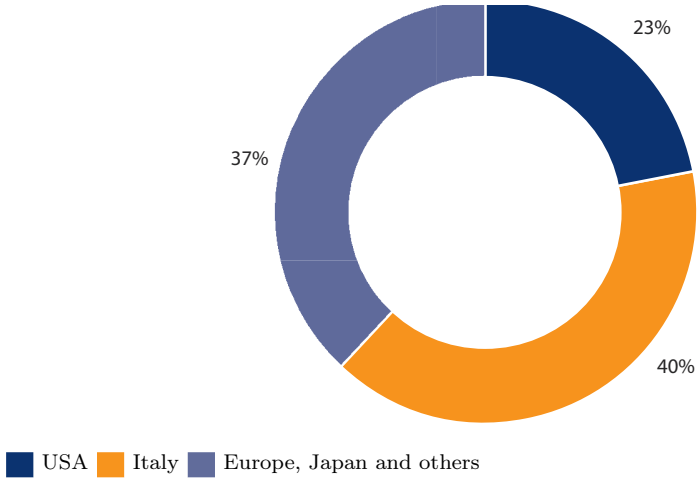
2.3.2 Structural characteristics and economic results

The Italian pharmaceutical industry is characterized by a unique composition in Europe, with Italian-controlled companies that make up 40% of the industry, and foreign-owned companies, which instead determine the last 60%. Among the latter, 23% belong to the USA and the remaining 37% to other countries (Figure 2.3).

Moreover, Table 2.1 shows some structural characteristics and some performance indicators of the pharmaceutical sector and compares them with those of the manufacturing sector as a whole. In 2015, the pharmaceutical sector was made up of 453 companies, that is just 0.12% of manufacturing companies, which amounted to around 390,000 units. In terms of employees, the pharmaceutical industry accounted for 1.60% of the manufacturing sector (58,000 employees out of 3.6 millions).

It is therefore a small sector, but characterized by a high productivity as in 2015 it produced 3.8% of the manufacturing added-value. This is also evident from the high added-value per employee of around 140,000 Euros compared to about 60,000 of the

Figure 2.3 - Pharmaceutical industry by nationality of companies' capital - Year 2016



Source: Farmindustria (2017).

manufacturing sector. It is also true that pharmaceutical labor costs were higher as they amount to around 70,000 Euros per employee, compared to an average of 42,000. However, taking both these data into account at the same time, the cost competitiveness, given by the ratio between the added-value per employee and the cost of labor per employee, is considerably higher than that of the manufacturing sector (201.9 against 138.8). This implies a greater efficiency of the pharmaceutical sector compared to the average, which translates into higher profitability: in 2015 it was over 50%, while the manufacturing sector as a whole stopped at 31.3%.

The added-value was produced to a large extent (72.6%) by large companies that accounted for a substantial part of the total. In fact, as shown in Table 2.2, companies with more than 250 employees were 13% of the total; this percentage rises to 40% if 50 employees are considered as the minimum threshold. The large size of the companies that make up the sector is also evidenced by a concentration index CR5 (sum of the market shares of the 5 largest companies) equal to 23.6%. In the pharmaceutical sector, however, there was also a large percentage (36%) of small businesses, that is, with less than 10 employees.

Thus, the average size of pharmaceutical firms is certainly larger than that of manufacturing firms, but this is true also for the most highly capital-intensive sectors. Nevertheless, small and medium-sized companies represent an important component of the sector from a quantitative point of view, but also for their qualitative characteristics, for example in terms of added-value and qualification of human resources.

Finally, companies in the pharmaceutical sector were slightly more vertically integrated than the average: the ratio between added-value and turnover[10] in 2015 was equal to 31.7% compared to 24.1% of the manufacturing sector as a whole.

Table 2.1 - Structural characteristics and economic results - Year 2015

Index	Pharm.	Manuf.
Structural characteristics		
Number of companies	453	389,317
Number of employees	57,573	3,618,368
Added-value (% of total manufacturing)	3.8	100
Added-value of large companies (in % of the total sector)	72.6	33.9
Concentration ratio (CR5) (%)	23.6	
Vertical integration (added-value/turnover) (%)	31.7	24.1
Economic Results		
Added-value per employee (thousands of Euros) (A)	139.8	58.8
Cost of labor per employee (thousands of Euros) (B)	69.3	42.4
Cost competitiveness (% ratio between A and B)	201.9	138.8
Gross profitability[(a)] (%)	50.5	31.3

[(a)]Ratio between gross operating profit and added-value.
Source: Istat (2018b).

In the pharmaceutical industry, the high investments in research and the high probability that these investments do not translate into positive economic results entail a high risk profile of the activity, which in turn calls for a legal form that guarantees the limited liability of the entrepreneurs. Then, it is not by chance that, as can be seen from Table 2.3, more than 95% of the companies in the sector are constituted in the form of a *società di capitali*. Moreover, this legal form facilitates, more than

[10]The greater the added value compared to the value of production (turnover), the lower the value of intermediate goods used and therefore the greater the degree of vertical integration.

Table 2.2 - Distribution of firms by number of employees - Year 2015

Number of employees	Firms (%)
0 – 9	36.0
10 – 19	9.7
20 – 49	14.3
50 – 249	26.9
250 and over	13.0
Total	100

Source: Istat (2018b).

other forms, the raising of capital in the financial markets and therefore facilitates the financing of the considerable investments required by the pharmaceutical production.

Table 2.3 - Distribution of firms by legal form - Year 2015

Legal form	Firms (%)
Impresa individuale	0.7
Società di persone	1.8
Società di capitali	95.4
Others	2.2
Total	100

Source: Istat (2018b).

An important feature of the pharmaceutical industry with respect to the rest of the Italian economy is the qualification of employees. Indeed, graduates are 54% of employees compared to 21% in the manufacturing industry. People holding a degree or a diploma represent 90% of employees, compared to 63% of the industry average.

Moreover, female presence is high in the pharmaceutical industry. Women are 44% of employees, significantly more than the average of the manufacturing industry (25%). Most of women are managers and they also represent 52% of employees in R&D.

Thanks to investments and quality of human resources, the pharmaceutical sector has high added-value and higher salaries than the average of the manufacturing industry. Therefore, the quality of Human Resources is an important factor of competitiveness

for Italy and the main factor that attracts investments in the country from abroad.

2.3.3 Innovation

One of the critical success factors in the pharmaceutical industry is undoubtedly research and innovation, which in fact is considered by Istat as one of the dimensions underlying the competitiveness index.[11] Figure 2.4 shows that both investments and the number of employees in R&D have increased in recent years. More specifically, in 2015 investments reached 538 million Euros which, in relation to turnover, means 2.12%, while employees in the in R&D were 4,064, or 7.05% of the total.

Furthermore, the use of IT has been significant. In fact, in 2016, 84% of companies had a website, and almost all (97.13%) a broadband connection (Figure 2.5), with 43% of employees connected to the internet. In addition, about 48% of companies used the web to buy inputs or sell their products.

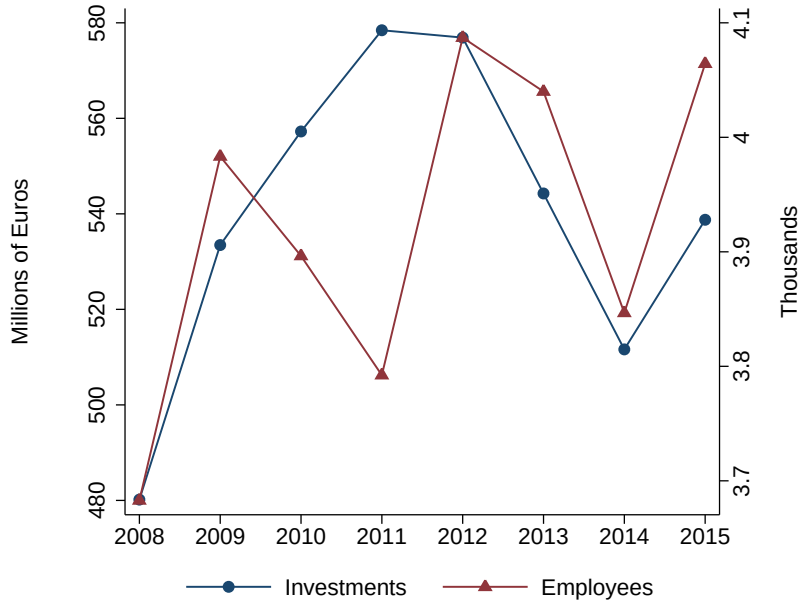
The R&D investments in the pharmaceutical industry amount to 7% of the research carried out in Italy, a value much higher than its weight in terms of turnover, and this shows the specialization of the sector in the innovation activity. In terms of R&D investments, the pharmaceutical industry is the third sector in Italy (with 13% of the manufacturing industry), after "Means of transport" and "Mechanical sector".

In terms of number of R&D employees, the pharmaceutical industry ranks third only after the same two sectors, which however have a much greater total number of employees. Therefore, R&D investments in the pharmaceutical industry are huge, both in absolute terms and in relation to the size of the sector.

Moreover, almost all companies (94%) will renew their plants in the next 3 years, giving rise to a virtuous process that will make the sector even more competitive than now. In particular, investments will be done in automation and digitalization in order to comply with the so-called "smart factory".

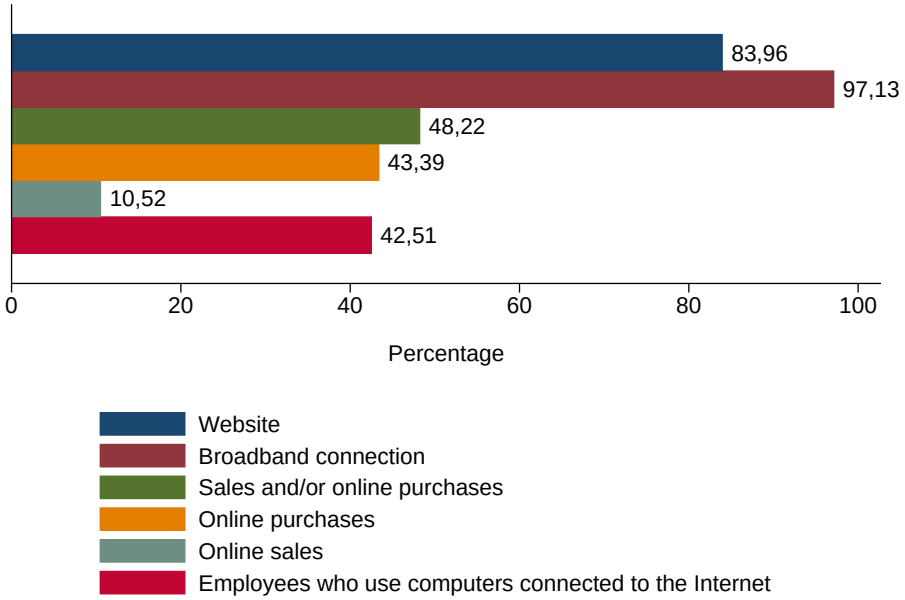
[11] See Section 2.3.1.

Figure 2.4 - Investments and employees in R&D - 2008–2015



Source: Our elaboration on Istat data.

Figure 2.5 - Percentage of firms using new technologies - Year 2016



Source: Our elaboration on Istat data.

2.3.4 Internationalization

The most evident effect of the strong competitiveness and profitability of Italian pharmaceutical companies consisted of an intense process of internationalization both in terms of participation of foreign entities in the capital and exported production.

This is evident, first of all, from the comparison of some indicators of the degree of internationalization of pharmaceutical companies compared to the average ones of the manufacturing sector, reported in Table 2.4. In 2015, pharmaceutical companies that exported part of their production accounted for 64.5% of the total, compared to an average of only 22.7% of the manufacturing sector. In the same year, pharmaceutical companies exported 73.6% of their turnover, while companies of the whole manufacturing sector exported only 36.7% of it. Sales abroad were largely a prerogative of large companies whose exports accounted for 87.3% of those of the entire pharmaceutical industry. Finally, more than half of the added-value was produced by companies controlled by foreign entities, which once again testifies the good health of pharmaceutical companies, considering that the corresponding percentage for the manufacturing sector was only 18.5%.

Table 2.4 - Internationalization - Year 2015

Index	Pharm.	Manuf.
Exporting companies (in % of companies in the sector)	64.5	22.7
Exports on turnover (%)	73.6	36.7
Exports of large companies (in % of the total sector)	87.3	50.4
Added-value of foreign-controlled companies (%)	52.7	18.5

Source: Istat (2018b).

The extraordinary performance in terms of exports by pharmaceutical companies, compared to other companies in the manufacturing sector, is nevertheless a fairly recent phenomenon. As can be seen from Figure 2.6, the overtaking has only recently occurred, but throughout the period 2012-2017 the pace of growth of the pharmaceutical sector

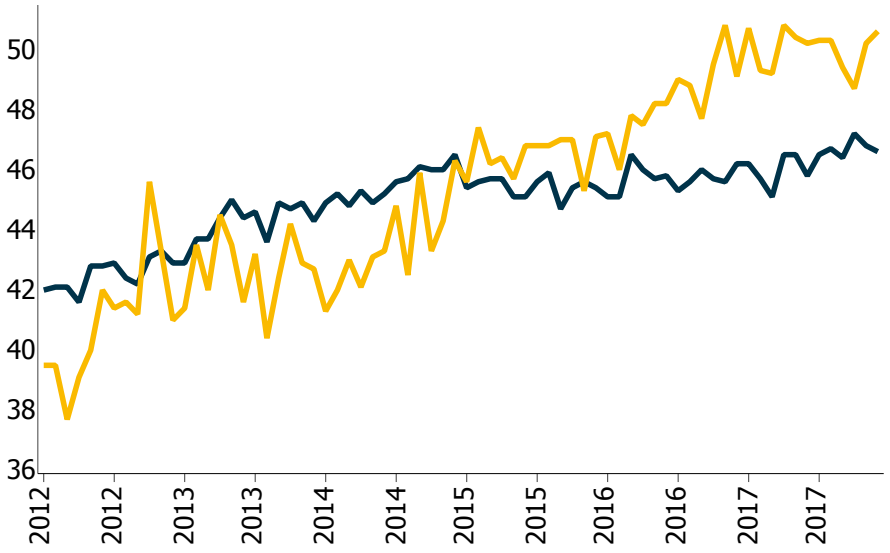
in terms of the share of exported turnover has been considerably faster.

The continent to which exports were mainly directed was Europe, and to a lesser extent Asia and America. Furthermore, while exports to European countries have grown during the period 2005-2016, those to the other two continents mentioned have remained substantially unchanged over time (Figure 2.7).

Indeed, 75% of exports and 79% of imports are related to Europe. Among the other continents, the main trading partner is America (13% of exports and 17.5% of imports). The weight of trade with Asia, which accounts for 9.4% of total exports, is also significant, while imports represent only 3.6%.

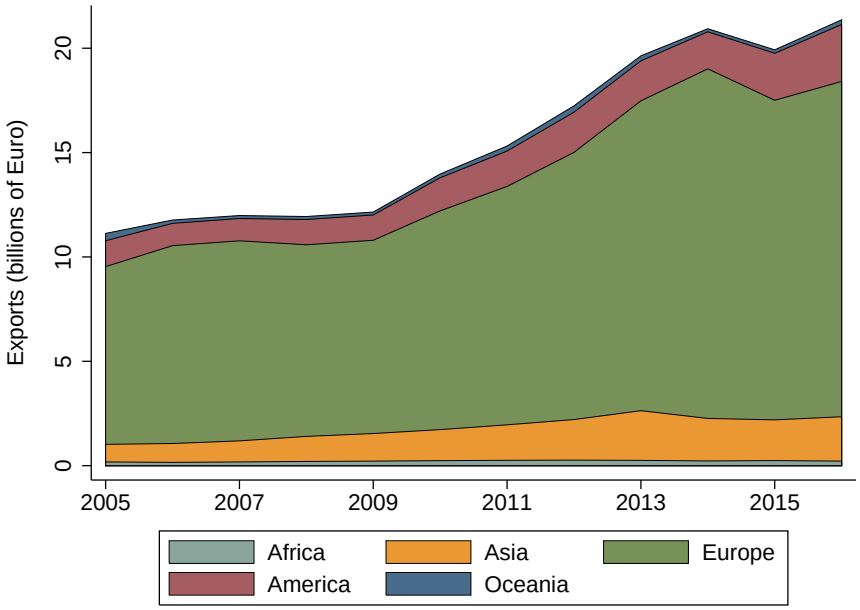
Ultimately, the internationalization process involves the pharmaceutical sector much more than the overall manufacturing industry, both due to the presence of foreign companies in Italy and exports of Italian ones abroad.

Figure 2.6 - Impact of export on turnover - Years 2012 – 2017 (in percentage, seasonally adjusted data). Manufacturing (blu) *vs* Pharmaceutical sector (yellow)



Source: Istat (2018b).

Figure 2.7 - Exports by continent of destination - 2005–2016



Source: Our elaboration on Istat data.

2.3.5 Financial constraints

The financial ed economic crisis occured in 2007-2008, in the subsequent years, led to both a strong reduction in bank credit and the possibility of accessing the capital market to finance investment projects. This has resulted in numerous bankruptcies or, at best, a reduction in the growth capacity of companies.

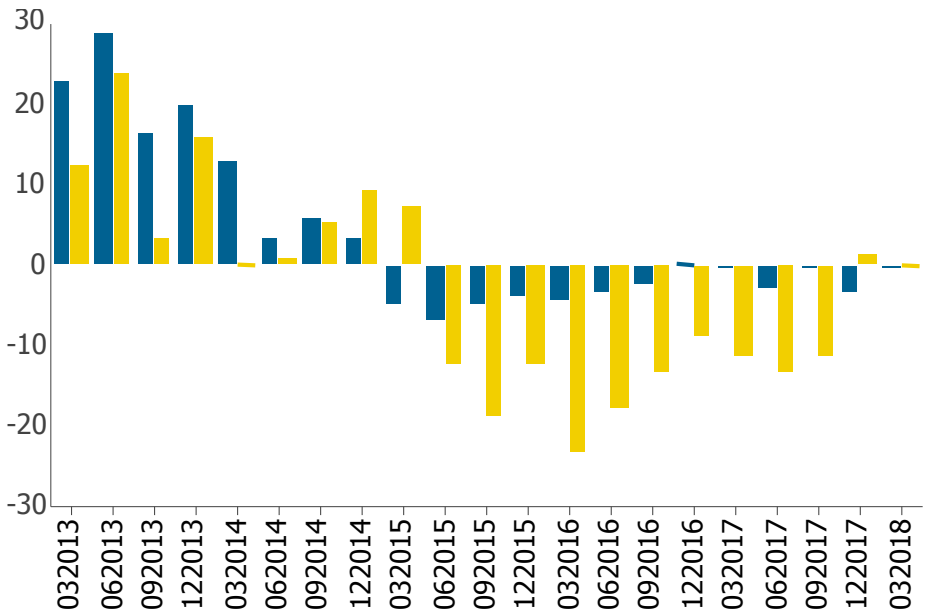
Figure 2.8 shows the trend of the "credit tension index" for the period 2013-2018, both for the pharmaceutical sector and for the manufacturing sector as a whole. The index, calculated by Istat and based on questionnaire data, is the difference between the percentage of responses which indicate less favorable conditions for access to credit and the percentage of those that indicate the most favorable conditions for access to credit. A positive value, therefore, indicates that companies which perceive to be subject to a financial constraint prevail, while a negative value indicates the perception of being able to finance investments without difficulty and at acceptable costs.

As one can see, until the last quarter of 2014, the index is positive both for the

manufacturing sector and for the pharmaceutical one. Subsequently, it becomes negative, signaling greater ease for companies to access credit. Nevertheless, the most interesting aspect is that the index has assumed a lower value for the pharmaceutical sector than the manufacturing one for the whole period considered. In other words, pharmaceutical companies have faced less financial constraints with respect to companies operating in other sectors of the economy.

This result makes the pharmaceutical sector an ideal laboratory for the study of the determinants of financial choices, since the presence of any constraint could, on the contrary, distort the optimizing behavior of companies in the choice between alternative sources of financing.

Figure 2.8 - Credit tension indicator[(a)] - 2013–2018. Manufacturing (blu) *vs* Pharmaceutical sector (yellow)



[(a)]The indicator is calculated as the difference between the percentage of responses which indicate less favorable conditions for access to credit and the percentage of those that indicate the most favorable conditions for access to credit.
Source: Istat (2018b).

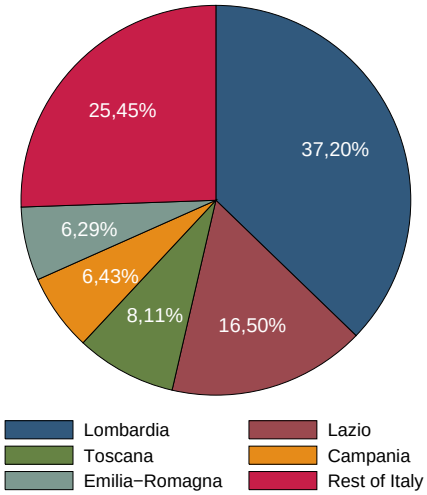
2.3.6 Localization

As it is known, there exists a strong socio-economic gap between the North and South of Italy that affects the choice of location of companies, which obviously prefer regions in which infrastructures facilitate logistic operations and it is possible to easily find qualified workers.

The pharmaceutical sector does not avoid this tendency, since, as shown in Figure 2.9, the majority of plants are located in the northern regions. More precisely, about 37% of the plants are located in Lombardy, but significant shares are also present in regions such as Tuscany and Emilia-Romagna. The only two Central-South regions in which pharmaceutical companies are present in a significant proportion are Lazio and Campania.

The gap is even more relevant if one looks at the distribution in terms of turnover (Figure 2.10). About half of the turnover is produced in Lombardy, while about a quarter in Lazio. The remaining 25% is produced for the most part, once again, in the northern regions, and only for a 6% in the other regions of Italy.

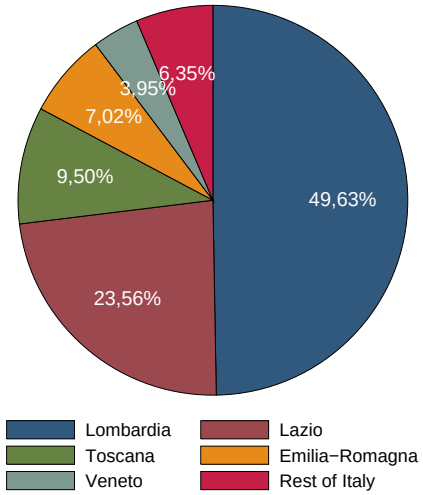
Figure 2.9 - Distribution of plants by region - Year 2015



Source: Our elaboration on Istat data.

However, in the period 2011-2015, the southern regions, and in particular Puglia,

Figure 2.10 - Distribution of turnover by region - Year 2015



Source: Our elaboration on Istat data.

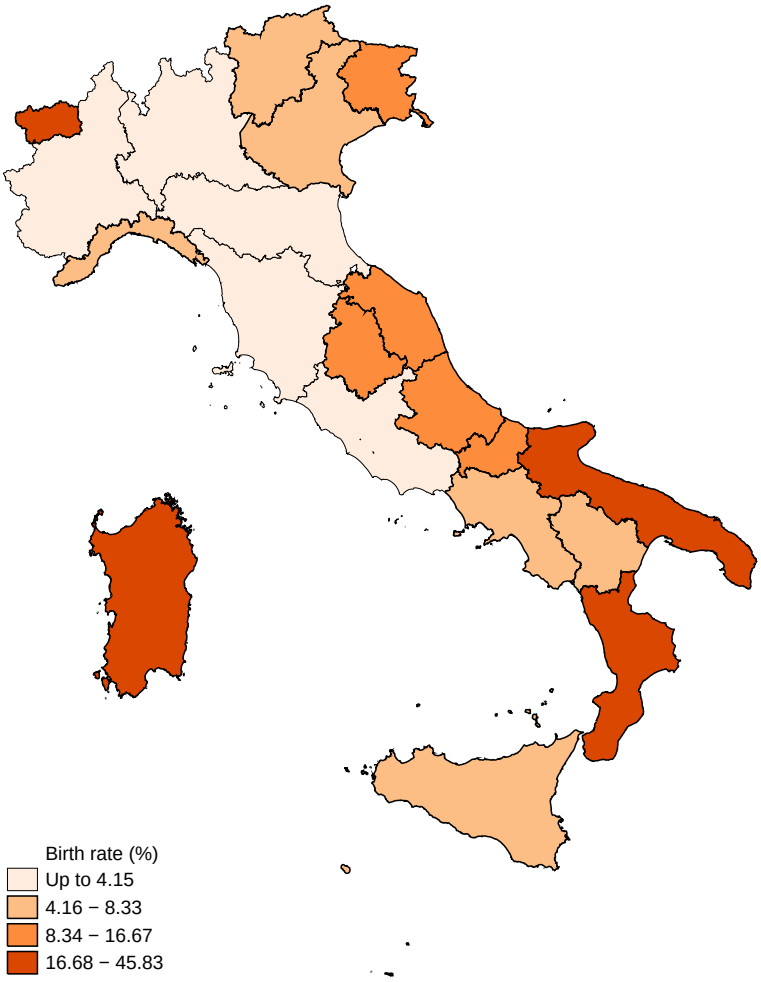
Calabria and Sardinia, have experienced birth rates of pharmaceutical companies higher than those of the northern regions (Figure 2.11). Therefore, souther regions appear to be on the good road to recover the gap in a reasonable time.

Indeed, the pharmaceutical industry is one of those driving the growth of the South of Italy. In total, around 4,000 employees work in the south-regions. Compared to the entire country, the South of Italy represents 7% of employment, 11% of investments in production and 12% of exports, with companies that export all over the world. In the last 10 years in fact, exports from the South have more than doubled, which is a better result than Germany and European average.

2.4 Comparison between Italian and European pharmaceutical industries

The pharmaceutical sector is not only one of the most developed and advanced sectors in the entire manufacturing industry, but it is also in the top positions of many European rankings.

Figure 2.11 - Firms' birth rate[(a)] by region - Years 2011–2015



[(a)]Ratio of the average number of firms born to the average number of active firms.

Source: Istat (2018b).

Indeed, Italy is second only after Germany in terms of pharmaceutical production, with a real chance to become the leader in the next years if favorable conditions are created for further investments. Then, it is first in Europe in terms of per capita production.

This is evidenced by the fact that Italy is already the leader in Europe in some segments, such as in Contract Development and Manufacturing companies (CDMO). In fact, Italy is the European country with the highest number of companies that produce for the big brands of the pharmaceutical sector. This is an organizational model that allows companies that own AIC (*Autorizzazione all'Immissione in Commercio*) to outsource production, control and pharmaceutical development activities, entrusting them to specialized companies with their own production plants and laboratories. The Italian industry of CDMO ranks first in Europe in terms of production, while Germany is second and France third.

Moreover, from 2010 to 2016 Italian pharmaceutical exports grew significantly more than the European Union's average (+ 52% compared to + 32%) and more than other big European countries, such as Germany, UK, France and Spain.

These results have been possible thanks to consistent investments, that in this industry make the difference. In particular, investments of Italian companies, which implement important growth and internationalization strategies, and investments of foreign-owned companies operating in Italy. Italy is in fact one of the principal destination country in Europe for investments of the most important multinational companies in the pharmaceutical sector. It is the leader for American and German companies and second for French and Swiss firms. Finally, for companies in the United Kingdom, Italy is a global hub for the production of vaccines.

Another aspect that distinguishes the Italian pharmaceutical industry from that of other European countries is the importance of SMEs. In fact, Italy ranks first both in terms of pharmaceutical production by SMEs and number of employees in these firms.

This aspect is in line with the structure of the Italian economy, which is characterized by a strong presence of family businesses that contribute to a large extent to the Italian GDP and employment.

It is also important to say that in Italy prices of pharmaceutical products, which are negotiated by the AIFA (Italian Medicines Agency), and the public pharmaceutical spending are lower than in other countries. In fact, the pharmaceutical spending per capita in 2016 was 29% lower than the average of the Big European countries.

Moreover, in the period 2001-2016 prices of medicines have decreased in Italy by 32.3%, while in the European Union have decreased by 12.7%. In the same period, the inflation has been more or less equal.

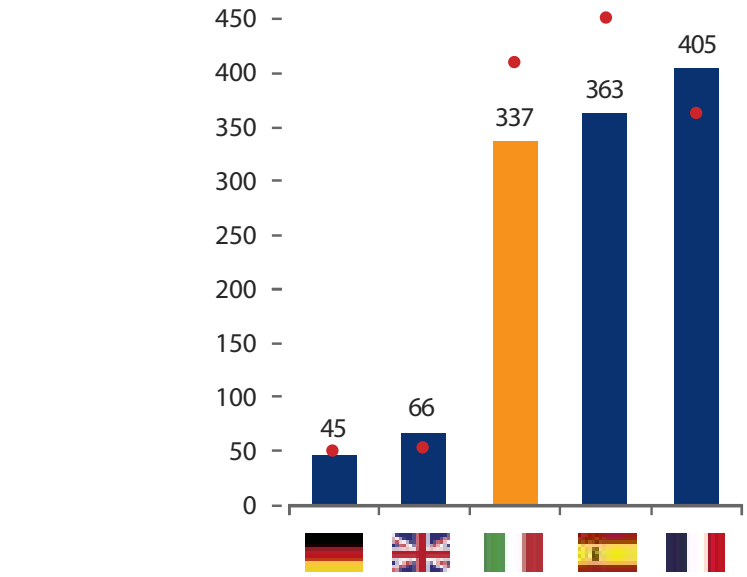
These evidences show that pharmaceutical spending in Italy needs more funding in order to keep the industry competitive in the world.

Another aspect related to the competitiveness of the Italian pharmaceutical industry and health of its population concerns the time necessary for the access of new medicines to the Italian market after the authorization of EMA (European Medicines Agency). Some data show that this time interval has been on average reduced compared to previous years. However, it remains close to 12 months, which is a large gap compared to the other major European countries, such as Germany and UK (Figure 2.12). Even because, in the great majority of cases, the time required for regional authorizations, which vary according to Regions, must be added. Therefore, bureaucratic constraints limit the access to new medicines.

2.5 Some weaknesses of the Italian system

As seen above, the pharmaceutical industry is the engine of the economic development and recovery in Italy. Companies with foreign capital have brought strong investments and transmitted a positive image of the country and those with Italian capital have not

Figure 2.12 - Access time for new products - Year 2016



Survey 2011–2014

Source: Farmindustria (2017).

relocated abroad as in the past. In short, it is a healthy sector, but with some shadows.

In fact, the positive results hide the structural weaknesses of the Italian system that must be eliminated as soon as possible because they can put the future of the industry at risk.

Indeed, a stable regulatory framework must be ensured, and also an appropriate governance for a sector undergoing a global change must be achieved, ensuring in this way the sustainability of the public pharmaceutical spending and growth of pharmaceutical firms. Nevertheless, the reform of the pharmaceutical governance is awaited by the industry and promised by the Italian government, but it does not yet appear.

One of the main problems for the industry is the payback, which is a complicated mechanism, in force since 2012, that concerns the public pharmaceutical spending. In particular, a maximum threshold is set for public pharmaceutical spending, which is therefore predetermined, but the demand and consumption of pharmaceutical products always exceeds this limit. This exceeding amount is half charged to Italian Regions and

half paid by pharmaceutical companies.[12]

Therefore, the payback is an obsolete system that forces every year pharmaceutical companies to pay back part of their turnover to Italian Regions, thus subtracting these resources from production and R&D investments. Hence, the payback makes it less convenient for multinational companies to invest in our country.

This system embodies the typical contradiction of the pharmaceutical industry, which has to make possible the coexistence between the market economy of pharmaceutical companies and the planned economy of public spending.

The limits of the payback mechanism lead to two consequences. Italian Regions put into their balance sheet a payback entity that is not guaranteed, as there are continuous disputes on these entities. Therefore, the access to these entities by Italian Regions is often blocked. Then, pharmaceutical companies have to make provisions because of the payback amounts and therefore long-term planning is impossible for them.

The complex payback mechanism should therefore be simplified. In fact, it does not ensure the certainty and correctness of data and so how much must be effectively paid back by companies to Regions. This problem gives rise to continuous litigation on the payback entities. In many cases, the current mechanism obliges companies to pay back 20% of their turnover.

Without this payback system, the liabilities of the SSN (National Health System) would be even heavier. This is why the payback is very unlikely to be abolished even in the next pharmaceutical governance.

[12]See the website http://www.sanita24.ilsole24ore.com/art/dal-governo/2018-03-28/payback-farmaceutico-riparte-stagione-contenziosi-budget-regionali-caos-183326.php?uuid=AEVkWYPE.

2.6 The challenges of the Italian pharmaceutical industry

The pharmaceutical industry, as already seen for Italy, shows considerable resistance in times of crisis at an international level. Furthermore, at the enterprise level, revenue growth rates have less fluctuations than in other sectors. These results are due to the fact that the pharmaceutical sector is characterized by a non-cyclical demand (pharmaceutical products are a basic goods whose demand does not depend on the state of the economy), has economies of scale and scope and is among the most innovative. Furthermore, the aging and consequent increase of the population suggest a growing pharmaceutical demand and production.

This is also one of the most internationalized and regulated sectors and the choices of investment location by pharmaceutical multinational companies greatly affect the GDP growth of countries.

Besides, the pharmaceutical industry must not be considered in a closed system, but a comprehensive approach should be adopted. That is, the medicine should not only be seen as a product but as part of a care and therapeutic diagnostic process. It means that, in terms of public spending, it is necessary to consider not only the costs of pharmaceutical products but also the costs they allow to avoid. For example, vaccination works as prevention and it allows to avoid treatment for sick people. Also, hospitalization and costs of care are reduced. Thus, the concept of "silos" must be overwhelmed and the costs avoided in the entire care process should be appreciated, adopting an outcome-based approach.

Moreover, the pharmaceutical sector ranks first in the world in terms of R&D. In fact, a worldwide R&D investment of approximately 900 billion Dollars is estimated over the period 2018–2022. Thus, the pharmaceutical scenario is rapidly changing.

These are global changes of great importance that may represent an opportunity

for Italy if it is able to become competitive for new products and even more attractive for investments and industrial activities. Therefore, it is fundamental that the Italian government intervenes through reforms and creates the conditions to remain among the advanced economies in this sector, which is extremely competitive at international level.

2.7 Summary

The Italian pharmaceutical sector, although it represents a small part of the manufacturing sector, in recent years has stood out for its high levels of competitiveness, as well as for its ability to innovate and establish itself on international markets. In addition, despite the financial and economic crisis that began in 2007-2008, financial constraints faced by companies have only partially influenced Italian pharmaceutical firms which continued to invest in R&D, quickly recovering pre-crisis profitability levels.

The strong concentration of pharmaceutical companies in the northern regions of Italy also suggests that territorial factors may have some role in their choices, including financial ones.

Furthermore, we have seen the important current position that the Italian pharmaceutical industry has in Europe in terms of production and exports. These results were possible thanks to consistent investments of capital coming from abroad. Despite these excellent results, Italy has recorded low public pharmaceutical spending and low prices of pharmaceutical products, as well as long times for access to new medicines on the market. This shows that there are structural weaknesses in the Italian pharmaceutical system that should be eliminated through a reform of the governance and payback system. These structural weaknesses, as well as some future challenges for the sector, will be fundamental to the success or failure of the Italian pharmaceutical industry, which aims to maintain its position of prestige and gain competitive advantages over Europe.

For these reasons, the pharmaceutical industry is of particular interest for the study of the determinants of the financial choices of companies and to test the validity of the theories discussed in Chapter 1.

Chapter 3

An empirical analysis on the determinants of the financial structure of Italian pharmaceutical companies

3.1 Introduction

This chapter presents the results of an econometric analysis aimed at identifying the determinants of the financial structure of Italian pharmaceutical companies.

The empirical literature discussed in Chapter 1 considers the characteristics of the company (size, profitability and liquidity) as the main determinants of leverage. However, recent studies have shown that the financial structure of companies can also depend on the territorial context in which the firm operates and in particular on the characteristics of banking markets.

As is known from economic theory, the relationship between firms and banks is characterized by the presence of strong information asymmetries that induce the latter to perform a screening activity of investment projects. This screening activity becomes particularly severe when it deals with companies operating in innovative and risky

sectors, such as the pharmaceutical one. Indeed, companies operating in such a sector must face rather stringent financial constraints, since they perform a high-risk activity due the uncertainty about the results of pharmaceutical research.

Moreover, in a country like Italy, where external financing sources come mainly from the banking sector rather than the financial one (for example through bonds), the financial structure of companies, not just pharmaceutical ones, depends crucially on the relationship established with credit institutions.

More generally, a study based on Italian companies can not ignore the well-known socioeconomic gap between the North and South of the country, which affects the characteristics and results of any economic activity. It is not by chance that, as will be clear from the descriptive analysis of Section 3.5, most Italian pharmaceutical companies are concentrated in the central-northern part of Italy.

Thus the econometric model presented in this chapter considers both firm and territorial factors as potential determinants of the financial structure of the Italian pharmaceutical companies. The model has been estimated using a panel of 318 firms observed during the period 2008-2016.

The chapter is organized as follows. Section 3.2 contains a discussion of the econometric methodology for panel data, which will be used for estimating and verifying the model presented in the following section. Section 3.4 discusses the theoretical reasons why concentration in banking markets can affect the financial structure of companies and some data on the consolidation process of the banking sector that took place in Italy over the past two decades. Section 3.5 contains a descriptive analysis of the available data, while the subsequent section reports and discusses the results of the econometric analysis.

3.2 Econometric methodology

When repeated observations over time are available on the same statistical unit, the data take on a so-called panel structure.

This allows us to estimate more realistic models than it would be possible if a single cross-section or time series was available. In particular, it is possible to take into account the unobserved heterogeneity among the statistical units, that is, factors not captured by the independent variables and which however imply a different relationship between the dependent variable and the covariates depending on the statistical unit considered.

This is possible thanks to the introduction in the model of the so-called "individual effects", that is a constant for each statistical unit. These effects can be considered as further parameters to be estimated or as draws from a random variable. In the first case we speak of "fixed effects", while in the second case of "random effects".

In this section, therefore, we review estimation and testing methods in the context of static linear models for panel data.[13]

3.2.1 The fixed effects model

The fixed effects model can be written as:

$$y_{it} = \alpha_i + \boldsymbol{x}'_{it}\boldsymbol{\beta} + \varepsilon_{it}, \tag{3.1}$$

where $i = 1, \ldots, N$ and $t = 1, \ldots, T$ index cross-sectional units and time, respectively, $\varepsilon_{it} \sim IID(0, \sigma^2_\alpha)$ and α_i is an individual intercept, which does not vary over time, $\boldsymbol{x}_{it}$ is a vector of covariates and $\boldsymbol{\beta}$ is the corresponding parameter vector. Thus, equation (3.1) can be thought as a linear regression model containing a dummy variable for each

[13] This section is mainly based on Verbeek (2004, Chapter 10).

unit i, that is it can be also written as:

$$y_{it} = \sum_{i=1}^{N} \alpha_j d_{ij} + \boldsymbol{x}'_{it}\boldsymbol{\beta} + \varepsilon_{it}, \tag{3.2}$$

where $d_{ij} = 1$ if $i = j$ and 0 otherwise. Then, the parameters $\alpha_1, \ldots, \alpha_N$ and $\boldsymbol{\beta}$ can be estimated by OLS; the implied estimator is known as Least Squares Dummy Variable (LSDV) estimator. However, when N is large, this estimator is difficult to compute, so that it is preferable first to eliminate the individual effects by means of the within transformation, that is considering the model in deviation from individual means:

$$y_{it} - \bar{y}_i = (\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)'\boldsymbol{\beta} + (\varepsilon_{it} - \bar{\varepsilon}_i). \tag{3.3}$$

The OLS estimator applied to equation (3.3) is called the "within estimator" or "fixed effects estimator" and is numerically equivalent to the LSDV one. Formally:

$$\hat{\boldsymbol{\beta}}_{FE} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)'\right]^{-1} \sum_{i=1}^{N}\sum_{t=1}^{T}(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)(y_{it} - \bar{y}_i). \tag{3.4}$$

Standard assumptions of the linear regression model ensure that this estimator has desiderable properties. More precisely, if all x_{it} are independent of all ε_{it}, the fixed effect estimator, $\hat{\boldsymbol{\beta}}_{FE}$, is unbiased, while if $\mathrm{E}(x_{it}\varepsilon_{is}) = 0, \forall s, t$, that is if covariates are "strictly exogenous", then it is consistent.[14] Unbiased estimates of the individual effects can be obtained as:

$$\hat{\alpha}_i = \hat{y}_i - \hat{\boldsymbol{x}}'_i\hat{\boldsymbol{\beta}}_{FE}, \qquad i = 1, \ldots, N. \tag{3.5}$$

Provided that T goes to infinity, the estimator (3.5) is consistent as well.

[14] As N goes to infinity.

3.2.2 The random effects model

In the random effects model, the α_i are assumed to be random, independently and identically distributed over individuals. Formally:

$$y_{it} = \mu + \boldsymbol{x}'_{it}\boldsymbol{\beta} + \alpha_i + \varepsilon_{it}, \tag{3.6}$$

where $\alpha_i \sim IID(0, \sigma^2_\alpha)$ and $\varepsilon_{it} \sim IID(0, \sigma^2_\varepsilon)$, with the ε_{it} uncorrelated over time. It is also assumed that α_i and ε_{it} are mutually independent and independent of $x_{js}, \forall j, s$, which ensures that the OLS estimator of $\boldsymbol{\beta}$ is unbiased and consistent.

However, since the variance-covariance matrix of the composite error term $\alpha_i + \varepsilon_{it}$ is not diagonal, more efficient estimates can be obtained through Generalized Least Squares (GLS). For the i-th unit, this matrix can be written as:

$$\boldsymbol{\Omega} = \sigma^2_\alpha \boldsymbol{\imath}_T \boldsymbol{\imath}'_T + \sigma^2_\varepsilon \boldsymbol{I}_T, \tag{3.7}$$

where $\boldsymbol{\imath}_T$ and $\boldsymbol{I}_T$ are the unit vector and the identity matrix, respectively, both of dimension T. The inverse of $\boldsymbol{\Omega}$ is:

$$\boldsymbol{\Omega}^{-1} = \sigma_\varepsilon^{-2}\left[\left(\boldsymbol{I}_T - \frac{1}{T}\boldsymbol{\imath}_T\boldsymbol{\imath}'_T\right) + \psi\frac{1}{T}\boldsymbol{\imath}_T\boldsymbol{\imath}'_T\right], \tag{3.8}$$

where

$$\psi = \frac{\sigma^2_\varepsilon}{\sigma^2_\varepsilon + T\sigma^2_\alpha}. \tag{3.9}$$

Then, the GLS estimator is:

$$\begin{aligned}\hat{\boldsymbol{\beta}}_{GLS} = &\left[\sum_{i=1}^{N}\sum_{t=1}^{T}(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)' + \psi T\sum_{i=1}^{N}(\bar{\boldsymbol{x}}_i - \bar{\boldsymbol{x}})(\bar{\boldsymbol{x}}_i - \bar{\boldsymbol{x}})'\right]^{-1} \\ &\times \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)(y_{it} - \bar{y}_i) + \psi T\sum_{i=1}^{N}(\bar{\boldsymbol{x}}_i - \bar{\boldsymbol{x}})(\bar{y}_i - \bar{y})\right].\end{aligned} \tag{3.10}$$

For large T ($T \to \infty$), $\psi \to 0$ and then the GLS estimator is equivalent to the fixed effects one,[15] while if $\psi = 1$, one gets the OLS estimator. Furthermore, it can be shown that:

$$\hat{\boldsymbol{\beta}}_{GLS} = \boldsymbol{\Delta}\hat{\boldsymbol{\beta}}_B + (\boldsymbol{I}_k - \boldsymbol{\Delta})\hat{\boldsymbol{\beta}}_{FE}, \tag{3.11}$$

where

$$\hat{\boldsymbol{\beta}}_B = \left[\sum_{i=1}^{N}(\boldsymbol{x}_i - \bar{\boldsymbol{x}})(\boldsymbol{x}_i - \bar{\boldsymbol{x}})'\right]^{-1} \sum_{i=1}^{N}(\boldsymbol{x}_i - \bar{\boldsymbol{x}})(\bar{y}_i - \bar{y}) \tag{3.12}$$

is the so-called "between estimator"[16] and $\boldsymbol{\Delta}$ is proportional to the inverse of the variance-covariance matrix of $\hat{\boldsymbol{\beta}}_B$. In other words, the GLS estimator is a weighted average of the between and within estimators, then conditions for its consistency are more stringent than those for the fixed effects estimator; in particular, it is required that $\mathrm{E}(\bar{x}_i\alpha_i) = 0$.

The GLS estimator can be obtained estimating by OLS the following trasformed model:

$$(y_{it} - \theta\bar{y}_i) = \mu(1-\theta) + (\boldsymbol{x}_{it} - \theta\bar{\boldsymbol{x}}_i)'\boldsymbol{\beta} + u_{it}, \tag{3.13}$$

where $\theta = 1 - \psi^{1/2}$ and $0 \leq \theta \leq 1$. The consistent estimates of the variance components,

[15] See (3.4).

[16] As one can see from (3.12), the between estimator is the OLS one in the model:

$$\bar{y}_i = \mu + \bar{x}_i'\boldsymbol{\beta} + \bar{\varepsilon}_i, \quad i = 1, \ldots, N$$

σ_ε^2 and σ_α^2, needed to make this estimator feasible, can be computed as:

$$\begin{aligned}\hat{\sigma}_\varepsilon^2 &= \frac{1}{N(T-1)}\sum_{i=1}^{N}\sum_{t=1}^{T}(y_{it}-\hat{\alpha}_i-\boldsymbol{x}_{it}'\hat{\boldsymbol{\beta}}_{FE})^2 \\ &= \frac{1}{N(T-1)}\sum_{i=1}^{N}\sum_{t=1}^{T}[y_{it}-\bar{y}_i-(\boldsymbol{x}_{it}-\bar{\boldsymbol{x}}_i)'\hat{\boldsymbol{\beta}}_{FE}]^2\end{aligned} \tag{3.14}$$

and

$$\hat{\sigma}_\alpha^2 = \hat{\sigma}_B^2 - \frac{1}{T}\hat{\sigma}_\varepsilon^2, \tag{3.15}$$

where

$$\hat{\sigma}_B^2 = \frac{1}{N}\sum_{i=1}^{N}(\bar{y}_i-\hat{\mu}_B-\bar{\boldsymbol{x}}_i'\hat{\boldsymbol{\beta}}_B)^2. \tag{3.16}$$

3.2.3 Hypothesis testing in panel data models

In order to choose among alternative panel data estimators, some tests are available. First, one could test the joint significance of the individual effects in model (3.2), that is $H_0 : \alpha_1 = \alpha_2 = \cdots = \alpha_{N-1} = 0$, by performing the following F-test:[17]

$$F = \frac{(RRSS - URSS)/(N-1)}{URSS/(NT-N-K)}, \tag{3.17}$$

where $RRSS$ is the residual sums of squares from the OLS on the pooled model, $URSS$ is the residual sums of squares from the fixed effects model and K is the number of regressors (excluding the constant). Under the null hypothesis, the test statistic (3.17) is distributed as an F with $N-1$ and $NT-N-K$ degrees of freedom.

The random effects model can be tested against the classical linear model by means

[17] See Baltagi (2005, p. 13).

of the Breusch-Pagan Lagrange multiplier test, whose system of hypothesis is:[18]

$$H_0 : \sigma_\alpha^2 = 0$$
$$H_1 : \sigma_\alpha^2 \neq 0.$$

The test statistic is:

$$LM = \frac{NT}{2(T-1)} \left[\frac{\sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{\varepsilon}_{it} \right)^2}{\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{\varepsilon}_{it}^2} - 1 \right], \tag{3.18}$$

where $\hat{\varepsilon}_{it}$ are the OLS residuals. Under the null hypothesis, the limiting distribution of LM is Chi-squared with one degree of freedom.

Finally, the choice between fixed and random effects can be based on the Hausman specification test.[19] The latter compares two estimators, one which is consistent under both the null and alternative hypothesis and one which is consistent (and typically efficient) under the null hypothesis only. A significant difference between the two estimators indicates that the null hypothesis is unlikely to hold. In a panel data context, the null hypothesis is that $\boldsymbol{x}_{it}$ and α_i are uncorrelated, so that $\hat{\boldsymbol{\beta}}_{RE}$ is consistent and efficient only under the null, while $\hat{\boldsymbol{\beta}}_{FE}$ is always consistent. The test consists in evaluating the significance of the difference $\hat{\boldsymbol{\beta}}_{FE} - \hat{\boldsymbol{\beta}}_{RE}$ and then its statistic is:

$$H = (\hat{\boldsymbol{\beta}}_{FE} - \hat{\boldsymbol{\beta}}_{RE})' [\hat{V}_{\hat{\boldsymbol{\beta}}_{FE}} - \hat{V}_{\hat{\boldsymbol{\beta}}_{RE}}]^{-1} (\hat{\boldsymbol{\beta}}_{FE} - \hat{\boldsymbol{\beta}}_{RE}), \tag{3.19}$$

where $\hat{V}$ denotes the estimated variance-covariance matrix of the corresponding estimator. Under the null, H has an asymptotic Chi-squared distribution with degrees of freedom equal to the number of elements in $\boldsymbol{\beta}$.

So far it has been assumed that the panel is "balanced", that is for each of the N individuals exactly T observations are available for the same period of time. However,

[18] See Greene (2012, p. 376).
[19] See Verbeek (2004, p. 351).

it is not uncommon that the panel is "incomplete" (or "unbalanced"), in the sense that for some statistical units one has a number of observations less than T. If the lack of such observations is random, estimation methods and tests discussed previously remain valid although formulas require some adjustment.[20]

3.3 The econometric model

In order to identify the determinants of the financial structure of Italian pharmaceutical companies, we estimate the following econometric model for panel data:

$$\begin{aligned} Y_{it} = \alpha_i + \beta_1 TANFIX_{it} + \beta_2 \ln SIZE_{it} + \beta_3 GROWTH_{it} + \beta_4 PROF_{it} \\ + \beta_5 LIQU_{it} + \beta_6 CONC_{it} + \beta_7 SOUTH_i + \varepsilon_{it} \end{aligned} \tag{3.20}$$

where i and t index company and time, respectively, α_i is a firm-specific component and $\varepsilon_{ij} \sim IID(0, \sigma_\varepsilon^2)$ is an error term uncorrelated over time. The dependent variable, Y, is either the Debt-to-Equity ratio ($DEBEQU$) or the Debt-to-Capital ratio ($DEBCAP$).

The independent variables are defined as follows:

- $TANFIX$, that is the ratio between tangible assets and total assets. Companies with a greater share of tangible assets should have a greater ability to issue debt because in the event of bankruptcy these assets, unlike the intangible ones, retain their value and can be used to satisfy creditors, who should therefore be more willing to finance the company (Harris and Raviv, 1991). Moreover, as argued by Rajan and Zingales (1995), the guarantee offered by this type of assets implies a less risk and agency costs associated with debt incurred by the creditors, and then the company's leverage should be higher. Therefore, there is a positive relationship between tangible assets and financial leverage.

  Conversely, and according to Grossman and Hart (1982), the monitoring costs of

[20] See Verbeek (2004, Section 10.8). If, on the other hand, some individuals are observed incompletely for an endogenous reason then this can lead to distorted estimators and invalid tests (selection bias).

the agency relationship between shareholders and managers are higher in firms with lower assets' tangibility. In order to reduce the opportunistic behaviour of managers, some firms may choose higher debt levels. In other words, firms with less collateralizable assets (that is with a lower share of tangible assets) may choose higher debt levels to limit their managers' consumption of perquisites. Then, the relationship between the assets' tangibility and financial leverage should be negative. In sum, the sign of $TANFIX$'s impact on the debt ratio is not determinable a priori;

- $\ln SIZE$, that is the natural logarithm of assets.[21] Larger companies are more diversified in terms of activities, thus less risky and more able to issue debt. For this reason, many authors (Rajan and Zingales, 1995; Booth et al., 2001; Frank and Goyal, 2003) argue that the relationship between size and leverage must be positive. On the other hand, for larger companies there are fewer information asymmetries between insiders and investors in the capital markets. Large firms should thus be more able to issue informationally sensitive securities like equity, and should have less debt;
- $GROWTH$, that is the growth rate of sales. According to Jensen and Meckling (1976), a firm's growth opportunities are a proxy for the agency cost of debt. Indeed, when a firm grows there should be sufficient internal funds available for its investments and then it reduces leverage. However, if these funds are not sufficient, the company must resort to debt with the consequence that the leverage could also increase;
- $PROF$, which is profitability measured as the ratio between EBITDA[22] and assets.

[21] The use of the logarithm allows to take into account any non-linearity of the relationship between leverage and size and in any case represents a consolidated practice in the literature.

[22] EBITDA stands for "Earnings Before Interest, Taxes, Depreciation and Amortization" and therefore corresponds to the Operating Result gross of depreciation. The $PROF$ variable, therefore, is a measure very close to the most common ROI. An alternative measure of profitability is ROE, but this is in turn influenced by the interest on the debt and therefore by the financial choices of the company; its use instead of the measure of profitability adopted here would therefore generate, from an econometric

The sign of its impact on financial leverage could be both positive or negative. Higher profitability makes the use of debt more attractive due to tax reductions and, at the same time, increases the company's ability to pay interests and thus reduces its likelihood of bankruptcy. Moreover, higher profits mean greater liquid resources disposable to management, so if the theory of "free" cash flows is valid, this implies higher agency costs of equity[23] with the result that the firm needs to increase the debt to regulate managers. Therefore, profitability could have a positive impact on financial leverage. On the other hand, the sign could be negative by virtue of the pecking-order theory: more profitable companies have a greater capacity to finance investments with internal resources and therefore they are less in debt;

- $LIQU$, that is the liquidity index, calculated as the fraction of the assets consisting of cash, cash equivalents (bank accounts) and financial assets that can be promptly liquidated without costs. In this case, the expected sign is negative as greater liquidity indicates a higher capacity of self-financing and so less debt. Nevertheless, in presence of greater liquid resources the liquidation value in the event of bankruptcy is greater (Shleifer and Vishny, 1992) and thus the firm is more likely to get debt financing from credit institutions. Therefore, according to this different kind of reasoning, this variable should positively impact on the leverage. However, Weiss and Wruck (1998) argue that asset liquidity is a factor reducing, not increasing, the firm's ability to issue debt securities;[24]
- $CONC$, that is the concentration index in the banking market, computed at a provincial level. From a theoretical point of view, the impact of this variable on the leverage can be either positive or negative;[25]

point of view, a problem of endogeneity. SeeVerbeek (2004, p. 110).

[23] See Section 1.7.

[24] See also Morellec (2001).

[25] For a more in depth discussion on this point, see Section 3.4.

- *SOUTH*, that is a dummy variable equal to 1 if the company's registered office is in a region of the South or the Islands[26] and 0 otherwise. The purpose is to verify if there is a significant difference in terms of leverage between southern companies and those operating in other parts of the country. In fact, it may be that the well-known socio-economic gap between the two areas also has an impact on the financial choices of companies.

Ultimately, for all the independent variables included in the model, the expected sign of their impact on leverage is difficult to determine, as it depends on the theory by which it is analyzed. This, on the one hand, shows a non-univocity of the theory on the determinants of indebtedness and, on the other hand, it requires a considerable and continuous effort of empirical research in order to find those regularities that the theory can not provide.

3.4 Bank concentration and financial structure

3.4.1 Theoretical considerations

From a theoretical point of view, the effects of concentration in banking markets on corporate leverage depend crucially on the hypothesis about the degree of information asymmetry characterizing these markets. Depending on this hypothesis, the effect of concentration on the financial structure may be either positive or negative.

When there are no information asymmetries, that is when both companies and banks know the quality of investment projects and the effort that the latter will exert to ensure their success, then the so-called Structure-Conduct-Performance (SCP) paradigm should hold.[27]

According to this theory, there exists a positive relationship between price or profits

[26] According to the ISTAT's classification, the southern or insular regions are:Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicily, Sardinia.

[27] See, among others, Mason (1939) and Bain (1951).

and the level of market concentration. Therefore, in the case of banking markets, the higher the market concentration the higher interest rates on loans. Although the SCP paradigm has been criticized by more recent theories, it still represents the reference of many antitrust authorities in the world, who use the Herfindahl-Hirschman Index (HHI)[28] to assess any anti-competitive effect of merger and acquisition (M&A) operations.

Following this argument, a negative relation might be expected between concentration in banking and firm's leverage, because of the higher interest rates on loans caused by the increased concentration. In fact, studies like those by D'Auria et al. (1999) and Degryse and Ongena (2005) show that, in Italy and Belgium respectively, a higher concentration implies a higher cost of fund for firms who finance themselves through the credit market.

However, the hypothesis of symmetric information in banking markets is hardly reflected in reality. The attempt to explain why banks specialize in lending, that is, in activities that are difficult to negotiate and therefore strongly illiquid, led to the birth of a strand of literature based on the so-called "lemons principle" of Akerlof (1970).

In particular, the latter shows that when the characteristics of the good being traded are not observable by buyers, and therefore when ex-ante (that is before the conclusion of the contract) information asymmetries exist, an "adverse selection problem" arises: prices reflect the average quality of the good, so that the bidders of the best quality goods apply higher prices, but customers can not observe goods' characteristics and quality. Therefore, the bidders of the best quality goods come out of the market and the supply of the good decreases until the market disappears.

A similar phenomenon could occur in the credit market: the characteristics of the investment projects of borrowers are not fully observable by banks, which therefore

[28]The HHI index is defined as the sum of the squared market shares of the firms operating in market. For more details, see below.

charge the rate and other conditions of the loan contract on the basis of the average quality of these projects. This induces companies with the best projects to exit the credit market with a consequent deterioration of the average quality of the remaining projects. Banks try to mitigate this problem through the collection of information on the potential borrower and its project (screening) before concluding the contract.

In the presence of ex-post (that is after the conclusion of the contract) information asymmetries, a problem of "moral hazard" may arise. As the agency theory shows, this phenomenon occurs in the context of a contractual relationship between a principal and and an agent having conflicting preferences. In order to get private benefits, the agent could reduce the effort in realizing the agreed performance ("hidden action") or lying about the state of the world ("hidden information"). To solve this problem, the principal will have to offer a contract such that it induces the agent to act in accordance with his own interests, or to carry out a control activity (monitoring) of his behavior. With reference to the credit market, the borrower (agent) could reduce its effort in managing the funded project, especially if he is protected by limited liability, or lying about the results of his business in order to avoid paying the debt or reducing its amount through, for example, a renegotiation.

Adverse selection and moral hazard lead to the establishment of long-term relationships between banks and borrowers ("relationship banking") (Booth et al., 2001; Dell'Ariccia and Marquez, 2004). Indeed, the firm prefers a multi-period contract with payments in favor of the bank related to the results of the project, rather than a sequence of uniperiodal debt contracts. The fact that the firm achieved good results in the past allows the bank to save on monitoring costs and then it can charge a lower interest rate on loans.

Therefore, if a higher concentration in the banking markets favors relationship banking, the availability of credit increases, thereby reducing fir's financial constraints and increasing leverage. Thus, we must expect a positive relationship between banking

markets' concentration and financial leverage. However, the empirical evidence on the impact of concentration on relationship banking and thus on leverage is mixed.

For example, the works by Petersen and Rajan (1994, 1995) show that in more concentrated markets banks are willing to lend more, since they can get higher profits establishing a longstanding relationship with companies and amortize the initial costs necessary to evaluate their creditworthiness. Conversely, in less concentrated markets the asymmetric information problem is resolved by charging higher interest rates. Also Berlin and Mester (1999) find that the financial constraints faced by firms are less stringent in more concentrated banking markets, while Cetorelli and Gambera (2001) find that bank concentration promotes growth of industrial sectors that are more in need of external financing by facilitating credit access for younger firms.

On the other hand, as discussed by Boot and Thakor (2000) and Yafeh and Yosha (2001), in less concentrated, and thus more competitive markets, banks could invest more heavily in relationship banking in order to lock in their clients and alleviate the competitive pressure of other banks.

3.4.2 Consolidation process and concentration in the Italian banking system

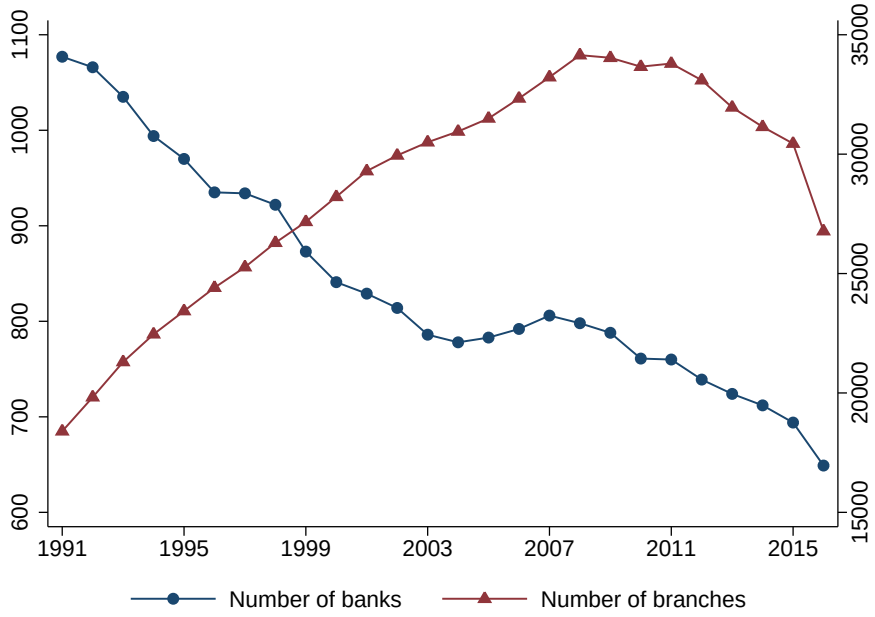
The issue of the effect of concentration in banking markets on leverage in Italy is even more interesting due to the fact that our banking system has been affected by an intense consolidation process over the last twenty-five years.

In fact, due to the privatization of large public banks and the liberalization of the opening of branches in the early '90s, as well as an increasingly intense competition from foreign banks following the implementation of the European Monetary Union, the profit margins of banks were eroded and the they tried to recover profitability through acquisitions and mergers. As a result, concentration levels in banking markets have

undergone significant changes.

As it is evident from Figure 3.1, in the period 1991-2016, the number of banks decreased, mainly because of M&A operations. Conversely, the number of branches increased markedly at least until 2008; afterward it reduced, maybe as an effect of the economic and financial crisis. Nevertheless, over the period under study the branch network grew by 24%. Assuming 1990 as the reference year, when the number of branches was 17,721[29], this figure increases by 71%.

Figure 3.1 - Number of banks and branches in Italy - Years 1991–2016



Source: Our elaboration on Bank of Italy data.

Market concentration is usually measured through either the CR_k index or the Herfindahl-Hirschman index (HHI) (Pepall et al., 2009, p. 41). The former is defined as the sum of the market shares of the k largest firms, while the latter is the sum of the squared market shares of the firms operating in the market. Particularly, the HHI index ranges between 0 (perfect competition) and 1 (monopoly), or 0 and 10,000 if market shares are measured in percentage.

[29] Bank of Italy, *Annual Report on 1990*, p. 302.

For the purpose of our study, we used the HHI index, since it, unlike the CR_k one, takes into account all the firms operating in the market. In principle, the concentration index should be calculated using deposits or loans of banks. However, since these data are not available at a local level, we resort to geographical distribution of banks' branches.[30] Formally, the HHI index of province j in year t has been computed as:

$$HHI_{jt} = \sum_{i=1}^{N} \left(\frac{b_{ijt}}{\sum_{i=1}^{N} b_{ijt}} \right)^2$$

where i, j and t index banks, provinces and years respectively, N is the number of banks in province j and year t, and b denotes the number of branches. In other words, the index is the sum of the squared market shares, where the market share of bank i (for each province and year) is computed as the ratio between the number of its branches and the total number of branches in the province. The results of this calculation, for year 2016, are reported in Figure 3.2.

3.5 Data and variables

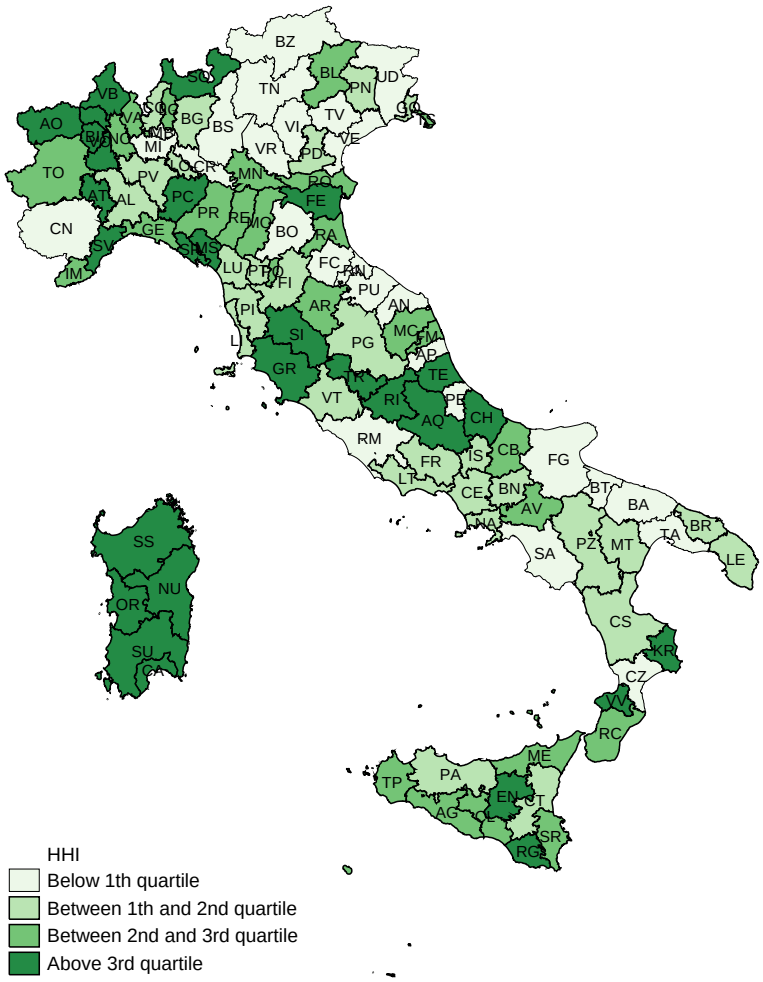
3.5.1 Sample selection

The sample of Italian pharmaceutical companies used to estimate the econometric model (3.20) comes from the database called AIDA, managed by Bureau van Dijk, which contains the financial statements of Italian firms.

From this database we extracted data on companies belonging to the ATECO categories "Manufacture of basic pharmaceutical products" (*Fabbricazione di prodotti farmaceutici di base*, code 21.10.00) and "Manufacture of medicines and other pharmaceutical preparations" (*Fabbricazione di medicinali ed altri preparati farmaceutici*, code 21.20.09), for the the period 2007-2016.

[30] Like, for example, Degryse and Ongena (2005).

Figure 3.2 - Distribution of provinces by HHI - Year 2016



Source: Our elaboration on Bank of Italy data.

Before to proceed with the estimation of the model, the available data have been suitably filtered. First of all, the companies that by 2016 were found to be bankrupt or subjected to another bankruptcy procedure were eliminated. Some of the remaining firms had an unreasonably low asset value, probably due to the fact that the current legislation makes it possible to set up a company also with an extremely limited social capital (at most one euro). A second selection is therefore consisted in eliminating companies with asset value less than 1,000 Euros. Thirdly, the observations for which the equity was negative were eliminated. After the application of these filters, the initial number of companies decreased to 368.

A further selection was made after calculating the variables to be included in the model. In fact, some of them, namely $DEBCAP$, $TANFIX$ and $LIQU$ should vary between 0 and 1, extremes included. Therefore, the observations for which the above variables fell outside this range were eliminated.

For the remaining variables, we checked for the presence of outliers. Observations for which these variables were lower than the 1^{st} centile or larger than the 99^{th} centile were dropped. Finally, we excluded companies for which less than three observations were available.

The final sample consists of 2,492 observations on 318 firms and covers the period 2008-2016.[31] Since, according to ISTAT data, in 2015[32] the pharmaceutical sector was made up of 453 companies, our sample includes about 70% of the whole sector and therefore is very representative of the population. The panel is unbalanced, and includes about 8 observations for each firm. Table 3.1 provides some descriptive statistics of the sample.

[31] Although the original data also included 2007, this year was lost due to the calculation of the $GROWTH$ variable.

[32] See Table 2.1.

Table 3.1 - Summary statistics of variables

Variable	Mean	Std. Dev.	Min.	1st Quart.	Median	3rd Quart.	Max.
$DEBEQU$	2.406	2.736	0.057	0.653	1.463	2.963	16.347
$DEBCAP$[a]	0.568	0.223	0.054	0.395	0.594	0.748	0.942
$TANFIX$[a]	0.213	0.195	0.000	0.040	0.163	0.337	0.843
$SIZE$[b]	57.801	124.035	0.048	2.798	13.301	51.284	840.973
$GROWTH$[c]	0.072	0.292	-0.646	-0.045	0.033	0.130	3.688
$PROF$	0.126	0.100	-0.268	0.065	0.110	0.176	0.468
$LIQU$[a]	0.153	0.185	0.000	0.014	0.074	0.230	0.860
$CONC$[d]	0.091	0.033	0.035	0.070	0.082	0.104	0.357
$SOUTH$[e]	0.099	0.299	0.000	0.000	0.000	0.000	1.000
Observations	2492						

[a] Fraction
[b] Millions of Euros
[c] Variation rate
[d] Index in 0–1
[e] Dummy

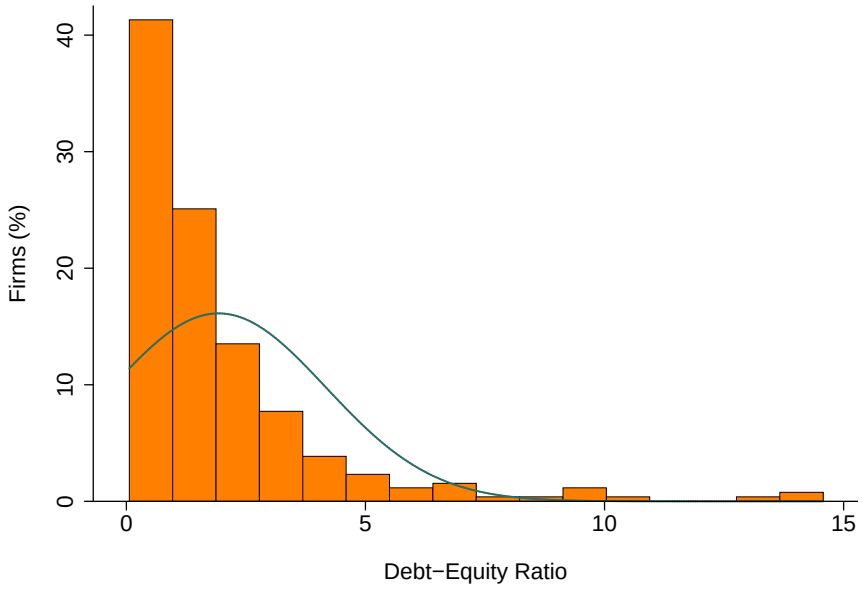
3.5.2 Descriptive analysis of the sample

This section presents the distributions, as well as some statistics of the key variables included in the econometric model, in order to complete the analysis of the fundamental characteristics of the Italian pharmaceutical sector presented in Chapter 2. In particular, the distributions presented here are based on data from the last year available, namely 2016.

Figure 3.3 shows the distribution of our first dependent variable, that is the Debt-Equity Ratio ($DEBEQU$). As can be seen, about 65% of the observations are characterized by a level of indebtedness that does not exceed twice the equity. For a much smaller percentage of firms the ratio stands between 2 and 5, and only a very small fraction has even higher ratios, resulting in a positive asymmetric distribution.

The distribution of the alternative measure of leverage, that is Debt-Capital Ratio ($DEBCAP$), used to evaluate the robustness of results, is reported in Figure 3.4. In this case, the leverage assumes values between 0 and 1 and the observations are much more evenly distributed among the various classes, albeit with a certain prevalence of

Figure 3.3 - Distribution of firms in the sample by Debt-Equity Ratio - Year 2016



Source: Our elaboration on AIDA data.

the higher values, and therefore with a slight negative asymmetry.

From this distribution, more than from that of the previous figure, we can have a more precise idea of the degree of leverage of Italian pharmaceutical companies, as the the Debt-Capital ratio is limited above.[33] Its mean is 0.57, while the median is 0.6,[34] which implies that, on average, companies are financed in almost equal parts with external and internal funds. Based on this result, it is difficult to say whether the level of indebtedness is high or low, since according to our best knowledge, statistics on the average leverage of the various economic sectors are not available.

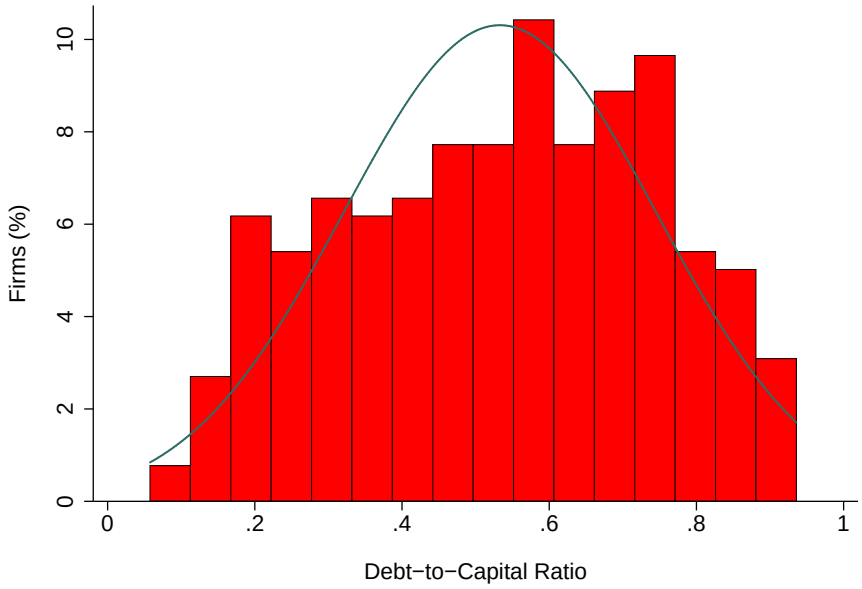
Regarding the size of the firms in the sample, we report the distributions of two variables commonly used to evaluate this feature of the companies, that is the number of employees (Figure 3.5) and the value of total assets (Figure 3.6).

The first distribution was constructed using the same classes as in Table 2.2, so that we can make a comparison with the analogous distribution coming from ISTAT

[33]Conversely, $DEBEQU$ has a lower limit of 0 but it has no an upper limit.

[34]See Table 3.1. The almost equality of the mean and the median confirms the almost symmetry of the distribution.

Figure 3.4 - Distribution of firms in the sample by Debt-Capital Ratio - Year 2016

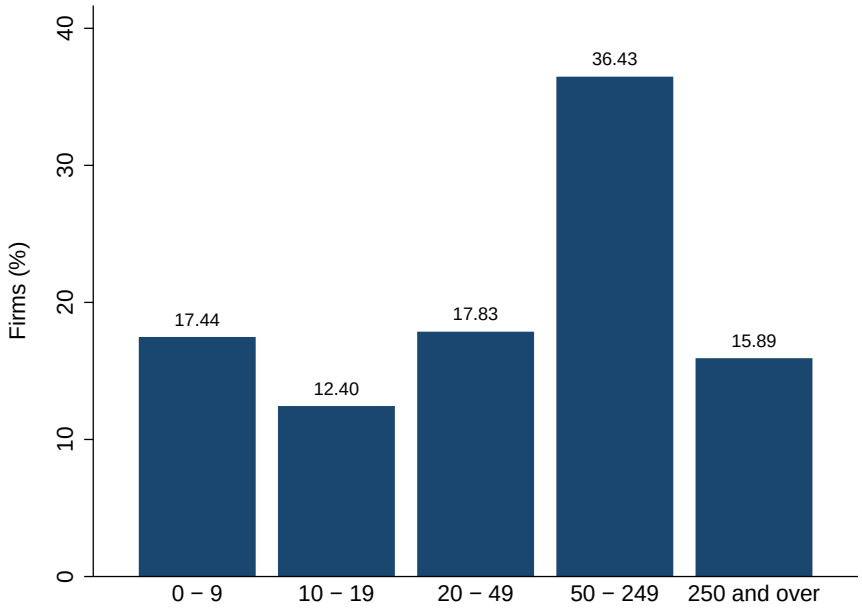


Source: Our elaboration on AIDA data.

and evaluate the representativeness of our sample in terms of the number of employees. As one can see, about 18% of the sample consists of companies with fewer than 10 employees, while the corresponding percentage in the population is 36%. The most represented category is that of companies with a number of employees between 50 and 249, which amount to 36.4%, while in the ISTAT distribution it represents 27% of the total. Thus, small businesses are underrepresented, but on the whole, the distribution by the number of employees reproduces almost exactly the same distribution in the population, and therefore in this respect our sample is quite representative.

Another variable commonly used to assess the size of companies is the value of assets. Figure 3.6 shows that the distribution of this variable in the sample is positively-skewed, that is, most companies are characterized by a low value of assets. In fact, the median of the distribution amounts to 13.3, the mean amount to 57.8 million Euros, while the 75^{th} centile is about 51.2. Some firms, however, have assets whose value is higher than half billion Euros, confirming that the sector is characterized by companies that are

Figure 3.5 - Distribution of firms in the sample by Employees - Year 2016



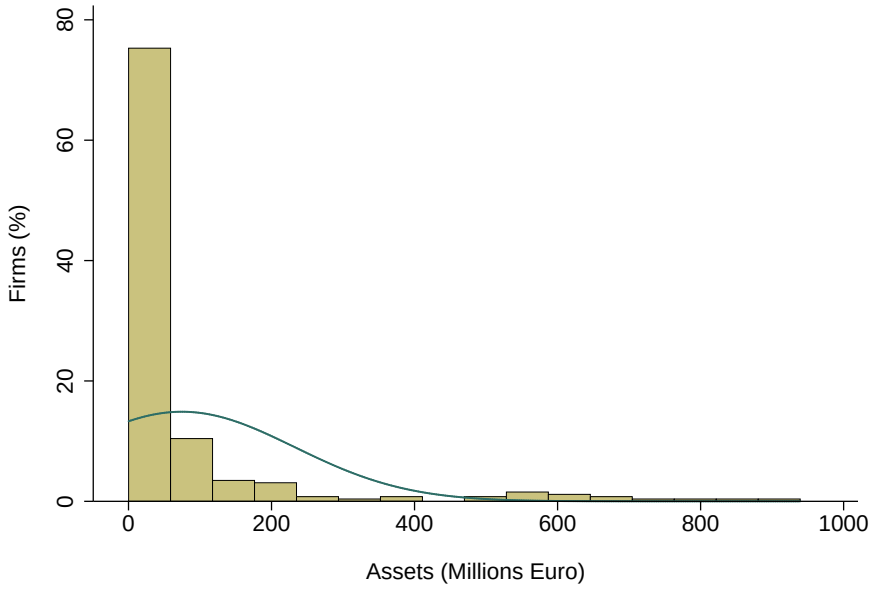
Source: Our elaboration on AIDA data.

either very small or very large.

In contrast, the distribution of the *ROE* (Figure 3.7) is negatively-skewed, which means that more than half of the companies in the sample are profitable. The 25th percentile of the distribution is in fact equal to 0.92%, while the median exceeds 8.5%. This confirms what we have already observed in the previous chapter, namely that the pharmaceutical sector is particularly profitable. With regard to loss-making companies, this result is probably due to excessive debt and therefore to financial charges which, in the profitability index calculated by Istat, based on the operating result, are not taken into consideration.

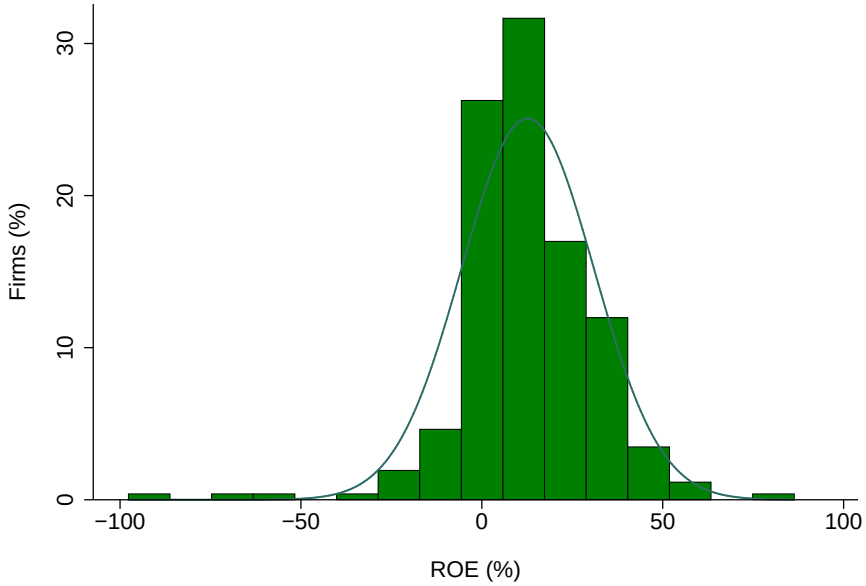
The latter conclusion is also evident from Figure 3.8 that shows the distribution of the *PROF* variable which, being calculated as the ratio between EBITDA and total assets, is gross of financial costs. In fact, as on can see, the percentage of companies that has a negative value of this indicator is extremely low: the 25th percentile is equal to 6.5% while the median reaches 17.6%. Therefore, pharmaceutical companies have a

Figure 3.6 - Distribution of firms in the sample by Assets - Year 2016



Source: Our elaboration on AIDA data.

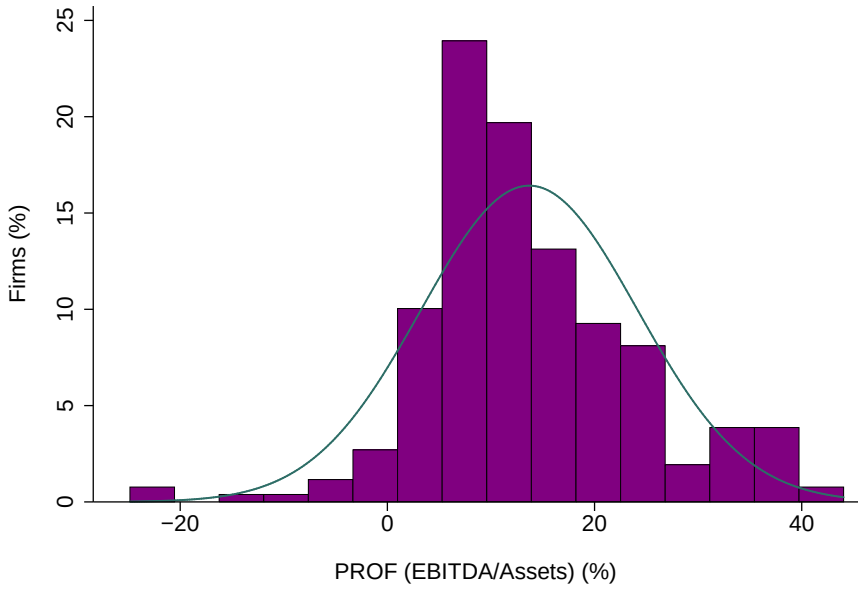
Figure 3.7 - Distribution of firms in the sample by ROE - Year 2016



Source: Our elaboration on AIDA data.

high profitability when looking at their core business, which however is reduced due to the financial costs associated with debt, signaling a negative effect of the leverage on the overall profitability (ROE).[35]

Figure 3.8 - Distribution of firms in the sample by PROF - Year 2016

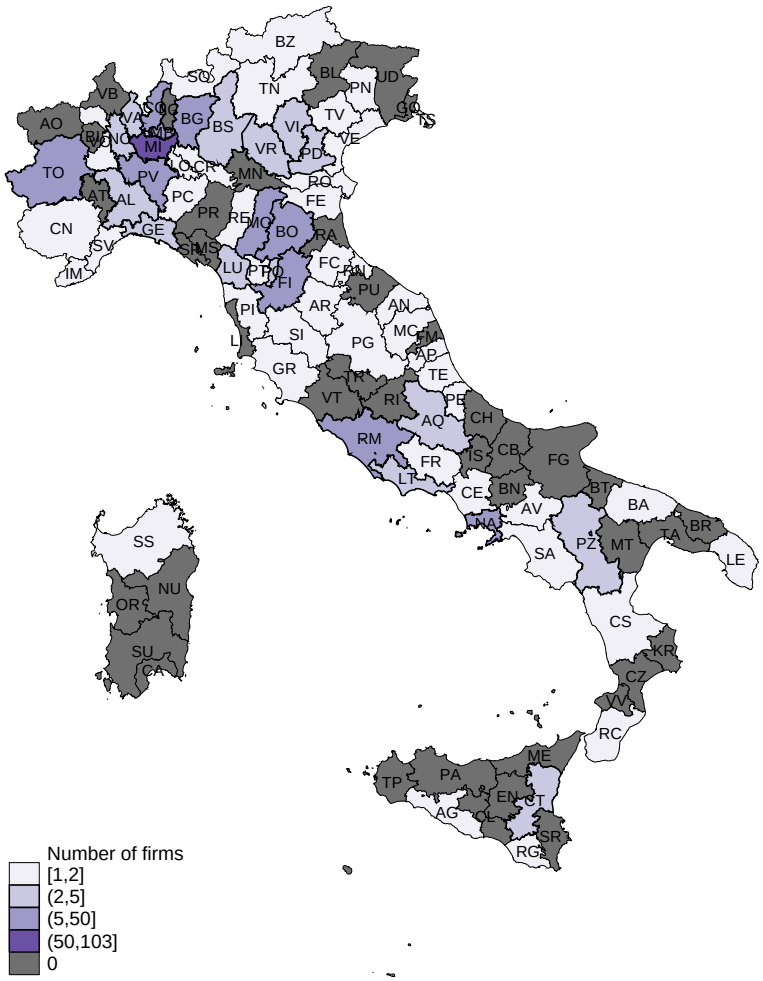


Source: Our elaboration on AIDA data.

Finally, the Figure 3.9 reports the geographical distribution by province of the sample. Except for the province of Rome and some other provinces in the South, the majority of pharmaceutical companies are concentrated in the North-West of the country, with Milan presenting the highest concentration (103 companies). This figure has already emerged in the analysis of Chapter 2,[36] and suggests that the economic gap between the two parts of the country has some relevance in explaining also the location choices of the Italian pharmaceutical companies. The $SOUTH$ variable included in the econometric model is precisely aimed at capturing this aspect of the phenomenon.

[35] See the discussion in Section 1.2.
[36] See Figures 2.9-2.10.

Figure 3.9 - Distribution of firms in the sample by province



Source: Our elaboration on AIDA data.

3.6 Discussion of results

Estimation results of model (3.20) are reported in Table 3.2. For both the dependent variables measuring the leverage of Italian pharmaceutical companies ($DEBEQU$ and $DEBCAP$) we estimated a fixed (FE) and random effects (RE) model. In the FE specification, the variable named SOUTH was dropped since it is time-invariant. Indeed, the within estimator (3.4) leads to the elimination from the estimates of the variables that do not change over time and whose average therefore corresponds to the value assumed in the single observation.

When the dependent variable is the Debt-to-Equity Ratio ($DEBEQU$), the Breusch-Pagan LM test suggests that the RE model should be preferred to the pooled OLS, since it rejects the null hypothesis that the variance of individual effects is equal to zero. Moreover the Hausman test does not reject the null, so that the RE model should be prefereed to the FE one. Therefore, the following discussion is based on the third column of the table.

Most of the parameters are statistically significant at the 1% level. The coefficient of $TANFIX$ is statistically significant and negative, which means that companies with a larger share of tangible assets in total assets have a lower leverage. Therefore, between the two alternative interpretations about the impact of tangible assets on the degree of indebtedness discussed in Section 3.3, in our sample seems to prevail that proposed by Grossman and Hart (1982). According to them the monitoring costs of the agency relationship between shareholders and managers are higher in firms with lower assets tangibility. In order to reduce the opportunistic behaviour of managers, some firms may choose higher debt levels. In other words, firms with less collateralizable assets (that is with a lower share of tangible assets) may choose higher debt levels to limit their managers' consumption of perquisites. Moreover, since our econometric model is linear, each parameter can be interpreted as the marginal effect of the corresponding

independent variable on the dependent one. In this case, the estimate is equal to about -1.79, which implies that an increase of 0.1 (that is, of 10 percentage points) in $TANFIX$ leads to a decrease of 0.179 of the Debt-Equity Ratio.

The coefficient of $\ln SIZE$ is significant and negative as well. Thus, according to our estimates, as the size of the company increases, leverage decreases. This probably happens because larger companies are less opaque in terms of information and therefore can more easily access to the capital market and issue new shares at advantageous prices. This effect seems to prevail over that associated with diversification which, instead, implying a lower risk should allow the company to get into debt more easily. Since the size is measured in logarithm and the independent one is in level, the coefficient can be interpreted as semi-elasticity, that is the percentage increase in the dependent variable when the independent one increases by 1. Thus, according to our estimates, if the size increases by one million Euros, the Debt-Equity Ratio decreases by about 14%.

Firm's sales growth ($GROWTH$) impacts positively on leverage, which means that the investments needed to sustain growth are financed mainly with external resources and so debt, although growth normally also leads to a greater availability of internal funds. However, this impact is very small in magnitude. Indeed, the corresponding coefficient amounts to about 0.46, then an increase in sales growth of 10 percentage points would lead to an increase in $DEBEQU$ of only 0.046.

Conversely, the parameter associated to profitability ($PROF$) is negative, and then when profitability increases, the leverage decreases. This implies that the pecking-order theory, according to which more profitable companies have a greater capacity to finance investments with internal resources and therefore are less in debt, is confirmed by our estimates. The fiscal advantages that could derive from a greater recourse to debt and the need to regulate managers in the presence of high profits therefore seem to have little effect on the financial decisions of pharmaceutical companies. The (negative) impact of profitability on leverage is strong. The corresponding parameter allows to

conclude, in fact, that if profitability increases by one percentage point, the Debt-Equity Ratio is reduced by 0.046, which represents a higher impact than that associated with $TANFIX$.

Finally, the liquidity index ($LIQU$) leads to a lower leverage, since the sign of the corresponding parameter is negative. In terms of magnitude, the impact is similar to that of $TANFIX$. This result is consistent with those of Weiss and Wruck (1998) and Morellec (2001), but it is somewhat counterintuitive because a greater liquidity implies a higher liquidation value in the event of bankruptcy and thus easier access to debt financing, so that this variable should positively impact on the leverage. Nevertheless, our result shows that a greater liquidity indicates a higher capacity of self-financing and so less debt.

Since neither $CONC$ nor $SOUTH$ variables are statistically significant, the fact that a firm is located in more concentrated banking markets or in a southern region of Italy has no effects on leverage. However, the coefficient of the first variable is positive and so is consistent with the idea that concentration favors the establishment and preservation of longstanding relationships between banks and firms, so that the latter can more easily access bank credit and increase their leverage. On the other hand, the parameter associated with the $SOUTH$ variable is negative, indicating that companies operating in the South of Italy are on average less indebted than those operating in other areas of Italy.

These results are largely confirmed by the model that considers the Debt-Capital Ratio ($DEBCAP$) as dependent variable. In this case, the test results lead to preferring the FE model (fourth column of Table 3.2) over both the RE model and the pooled OLS.

The only two differences with respect to the model with $DEBEQ$ as the dependent variable are:

1) the non-significance of $TANFIX$, meaning that the share of tangible assets has

no impact on leverage;

2) the positive sign of the coefficient associated to $\ln SIZE$, which leads to the assertion that larger companies are more indebted. This result is explained by the fact that, being more diversified, larger companies are less risky and therefore are considered more creditworthy by potential lenders.

In all other cases, the parameters of the independent variables are highly significant as in the first model, but present different values simply because the dependent variable has a different scale.[37]

3.7 Summary and conclusions

This chapter presented the results of an econometric model for panel data aimed at explaining the leverage of Italian pharmaceutical companies. It includes both variables traditionally considered in this type of analysis, namely the economic and financial characteristics of the companies, as expressed by some fundamental balance sheet indicators, and territorial variables such as the level of concentration in local banking markets and the geographical location of the company.

The model was estimated on the basis of a sample of 318 companies observed for the period 2008-2016. The related data have been extracted from the AIDA database and the corresponding distributions accurately resemble those derived from the population data by ISTAT, thus ensuring a strong representativeness of the analyzed sample.

According to our estimates, the leverage of pharmaceutical companies is significantly and positively affected by the growth rate of sales and it is negatively correlated to the share of tangible assets, size, profitability and the degree of liquidity of assets. On the other hand, neither concentration in the banking markets nor the different degree of economic development between the North and South of Italy seems to have an impact

[37] See Table 3.1.

Table 3.2 - Estimation results

Variable	$DEBEQU$		$DEBCAP$	
	Fixed	Random	Fixed	Random
Constant	2.1575***	4.3040***	0.5570***	0.6913***
	(0.5191)	(0.3511)	(0.0332)	(0.0250)
$TANFIX$	-1.9604***	-1.7886***	0.0278	0.0019
	(0.4984)	(0.4023)	(0.0318)	(0.0275)
$\ln SIZE$	0.5297***	-0.1384***	0.0389***	-0.0070*
	(0.1245)	(0.0532)	(0.0080)	(0.0040)
$GROWTH$	0.4011***	0.4638***	0.0487***	0.0507***
	(0.1173)	(0.1174)	(0.0075)	(0.0076)
$PROF$	-4.3753***	-4.6240***	-0.3327***	-0.3466***
	(0.5061)	(0.4878)	(0.0323)	(0.0318)
$LIQU$	-1.4976***	-1.7996***	-0.2055***	-0.2393***
	(0.3336)	(0.3102)	(0.0213)	(0.0204)
$CONC$	6.3488	1.8953	0.1489	0.0509
	(4.3981)	(2.9937)	(0.2810)	(0.2114)
$SOUTH$		-0.4594		-0.0241
		(0.4196)		(0.0324)
Hausman test	-	19.88	-	104.97
	-	(0.1341)	-	(0.0000)
Breusch-Pagan LM test		2697.09		4243.47
		(0.0000)		(0.0000)
F test for $\alpha_i = 0$	15.29	-	24.30	-
	(0.0000)		(0.0000)	
R^2 within	0.0932	0.0800	0.1681	0.1541
R^2 between	0.0041	0.2013	0.0061	0.3040
R^2 overall	0.0008	0.1511	0.0213	0.2468
N. of obs.	2,492	2,492	2,492	2,492
N. of firms	318	318	318	318

Significant at: *** = 1% level; ** = 5% level; * = 10% level. Standard errors of the parameters and p-values of the tests in parentheses. Yearly dummies included but not reported.

on the financial choices of these companies.

Conclusions

The study of the determinants of the financial structure of companies is an argument widely studied and debated both from a theoretical and empirical point of view. As discussed in Chapter 1, after the fundamental contribution of Modigliani and Miller (1958, 1963), numerous theories have been developed to explain the financial decisions of companies with regard to the relationship between internal and external sources.

However, the choice process supported by these theories is different, as it goes from the optimizing behavior of the trade-off theory to the hierarchical choice of the funding sources highlighted by the pecking-order theory and to the conclusion that financial choices depend on external factors, that is the performance of financial markets, as advocated by the market-timing theory.

The comparison between the different positions has then moved on the empirical ground. In this case, the works of several authors have made it possible to identify a series of characteristics of the company (size, growth, profitability, liquidity) as fundamental determinants of leverage. In addition, more recent contributions have highlighted the importance also of institutional factors in the country in which the company operates, as well as the characteristics of the banking markets to which the company resorts to finance its projects. Finally, the specific characteristics of the sector in which the company operates could also play a role. It follows the need, from the empirical point of view, to focus on a homogeneous sample of companies, operating in a specific country and a specific sector.

Following this principle, in this thesis, the determinants of the financial structure of the Italian companies operating in the pharmaceutical industry have been studied through an econometric model for panel data.

The choice of the pharmaceutical sector was not accidental, since, as shown in Chapter 2, during the last years it represented one of the sectors driving the recovery of the Italian economy after the 2007-2008 crisis. In fact, it is a sector characterized by a high degree of innovation, strongly internationalized and therefore very competitive. For these reasons, companies were able to access both external financing from the banking sector and internal financing through the equity markets. Then, the lack of financial constraints makes the pharmaceutical sector particularly suitable for the study of the determinants of leverage.

The econometric model, whose results have been presented and discussed in Chapter 3, has been estimated on the basis of data taken from the AIDA database. In particular, the sample consists of 318 pharmaceutical companies observed during the period 2007-2016.

The dependent variable of the model is the leverage, measured both as the Debt-Equity ratio and the Debt-Capital ratio. Among the independent variables were considered the characteristics of companies in terms of size, growth, profitability and liquidity, and two territorial variables, that is, the degree of concentration in local banking markets and a dummy variable aimed at capturing the impact on the leverage of the well-known socio-economic gap between the North and South of Italy.

The results of the econometric model show that the financial leverage of Italian pharmaceutical companies is significantly and positively correlated with the growth rate of sales and negatively influenced by the share of tangible assets, size, profitability and the degree of liquidity of assets.

On the other hand, there is no evidence of any impact of banking concentration on financial leverage, nor of a statistically significant difference in terms of leverage between

companies operating in the northern provinces of the country and those operating in the South. The results are robust with respect to the two ways of measuring the leverage.

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SUMMARY

The financial crisis originated in the United States in 2007, following the collapse of the subprime mortgage market, and subsequently spread all over the world, showed that in modern economic systems the financial fragility of companies, both in banking and non-banking sectors, should be one of the main concern of policy-makers.

It is obvious, in fact, that any macroeconomic shock produces effects that are more severe when companies are characterized by a high level of leverage, as in this case the propagating effect of bankruptcies from one company to another is much more likely.

It follows that the determinants of the financial structure of companies are a highly topical field of study and can help to identify the most appropriate tools to prevent, or at least mitigate, the effects of financial shocks.

Starting from the seminal contribution by Modigliani and Miller, the theory of corporate finance has made considerable progress in the study of the factors that affect the financial choices of companies. Numerous other theories have been formulated, thanks also to the developments of the theory of contracts and information asymmetries. However, while there is a substantial agreement on what are the characteristics of the companies (size, profitability, liquidity) that lead them to choose their own financial structure, there are contradictory conclusions about the sign (positive or negative) of their impact on leverage.

Moreover, the most recent contributions have shown that in addition to variables at the firm level, also the institutional and geographical factors, as well as the characteristics of the financial and banking systems, and then factors at the macro level, play a significant role in determining the financial structure of companies.

Faced with the non-univocal nature of the theory's predictions, empirical studies have assumed a fundamental importance in the search for factors affecting the financial structure. In this thesis we offer a contribution in this sense, proposing a econometric model based on panel data that tries to identify the determinants of the financial structure of Italian pharmaceutical companies. The object of the investigation has been deliberately limited to a specific sector and to a specific country in order to favor as much as possible the homogeneity of the analyzed sample, avoiding in this way the effect of heterogeneity among economic sectors and/or countries.

In Chapter 1 we first discuss the relationship between ROE and leverage, in order to show how the use of debt impacts on the profitability, and therefore that the study of the determinants of the financial structure also allows to identify some of the factors affecting the companies' performance.

Since leverage is the dependent variable of the econometric model presented in Chapter 3, we also illustrate the alternative ways in which this variable can be defined.

Subsequently, theories on the financial structure and studies that tried to demonstrate their validity on an empirical ground are reviewed. Indeed, in the literature it is possible to identify five main theories on the choice of the financial structure: i) the theory of Modigliani and Miller (1958, 1963); ii) the trade-off theory; iii) the theory of the order of choice (pecking-order hypothesis); iv) the theory of market timing; v) the theory based on agency costs.[1]

As it is well known, one of the key performance indicator of a company is the Return on Equity (ROE) which is defined as:[2]

$$ROE = \frac{\text{Net income}}{\text{Book Value of Equity}} \tag{1}$$

Since Net Income is a flow variable, sometimes as denominator of formula (1) we consider the average of the book value of equity at the beginning and at the end of the year which Net Income refers to.

Basically, the ROE explains the overall profitability of the company on behalf of shareholders. Therefore, it is a measure of the return that shareholders (or owners) have achieved on the capital invested in the enterprise. While the ROE represents a basic measure of profitability, the Return on Common Equity (ROCE) is instead used by analysts. The difference is in the numerator where the Total Comprehensive Income is used. We will use the basic version of profitability for our purposes because the ROCE focuses on the total income realized, even the portion that cannot be distributed.

The ROE can be further decomposed as follows:

$$ROE = \underbrace{\frac{\text{Net income}}{\text{Sales}}}_{\text{Net Profit Margin}} \times \underbrace{\frac{\text{Sales}}{\text{Total Assets}}}_{\text{Asset Turnover}} \times \underbrace{\frac{\text{Total Assets}}{\text{Book Value of Equity}}}_{\text{Equity Multiplier}} \tag{2}$$

[1] For an extensive review of these theories see Prasade et al. (2005) and Frank and Goyal (2008).

[2] See Berk and De Marzo (2014, p. 42).

Formula (2) shows that the ROE depends on the following three terms: 1) Net Profit Margin, that is the portion of sales translated into profits, which is a measure of efficiency and profitability; 2) Asset Turnover, which is a measure of effectiveness, since it shows the ability of the company to generate sales from its assets; 3) Equity Multiplier, which is a measure of leverage: the higher this ratio, the lower is the amount of the company's assets that are financed by its shareholders or, equivalently, the higher is the portion of assets that are financed by debt.

Since the ROE is a measure of profitability of the company and depends on the leverage (debt-equity relationship), as is visible by the Equity Multiplier, this implies that studying the determinants of the financial structure is equivalent to study also some of the determinants of the overall profitability of companies.

From formula (2) it may seem that the ROE increases as the leverage, and so the third term, increases. However, such a conclusion would be wrong as the equation does not explicitly take into account the role of interest on debt. To this end, we break down the Net Profit Margin in two parts as follows:[3]

$$\begin{aligned}\text{Net Profit Margin} = &\frac{\text{After-tax Interest} + \text{Net Income}}{\text{Sales}} \\ &\times \frac{\text{Net income}}{\text{After-tax Interest} + \text{Net Income}}\end{aligned} \tag{3}$$

where After-tax Interest $= (1-t)I$, being t the tax rate and $I = iD$ the gross interest paid on debt. Rewriting equation (2) in the light of (3), we obtain:

$$\begin{aligned}ROE = &\underbrace{\frac{\text{After-tax Interest} + \text{Net Income}}{\text{Sales}}}_{\text{Operating Profit Margin}} \\ &\times \underbrace{\frac{\text{Net income}}{\text{After-tax Interest} + \text{Net Income}}}_{\text{Debt Burden}} \\ &\times \underbrace{\frac{\text{Sales}}{\text{Total Assets}}}_{\text{Asset Turnover}} \times \underbrace{\frac{\text{Total Assets}}{\text{Book Value of Equity}}}_{\text{Equity Multiplier}}\end{aligned} \tag{4}$$

In the last equation, the first term is the Operating Profit Margin[4], which is the portion of Sales that translates into Operating Profit. In particular, the numerator of the first term represents the Net Operating Profit after Taxes (NOPAT).[5] In this case, it is computed with the bottom-up tax allocation method, that is starting from Net Income, adding financial expenses and subtracting the tax benefit (After-Tax Interest).

The product between the first term and the third one is the Return on Assets (ROA), which is an indicator of how much profitable a company is relative to its total assets. Since the numerator is represented by After-Tax Interest plus Net Income (NOPAT) and the denominator is Total Assets, the ROA explains the profitability of operating activities, without considering financial activities. Therefore, the ROA, sometimes referred to as Return on Investments (ROI) depends on the business capabilities of the company but is not influenced by the financial structure.

Conversely, the second and fourth term depend on the debt-equity mix. The former, defined as Debt Burden, measures the portion of the Operating Profit which translates into Net Income and it decreases as debt, and therefore interest, increases. While the relationship between debt and Debt Burden is negative, the relationship between debt and the Equity Multiplier is instead positive.

If the company was entirely financed by equity (zero debt), both the Debt Burden and the Equity Multiplier would be equal to 1. In this case ROA, that is the product between the first and third therm of formula (4), would be equal to ROE.

However, if the company has debt, the Debt Burden is less than 1, while the Equity Multiplier is greater than 1. As debt increases, the former decreases and the latter increases, which means that leverage can either increase or decrease ROE. This result shows the fundamental relationship between ROE and leverage.

This relationship, and so the effect of the financial structure on the overall profitability of the company, can also be explained by the following formula:

$$ROE = ROI + (ROI - i) \times \frac{D}{E} \times (1-t), \tag{5}$$

where i is the average interest rate paid by the company for its financial debt (cost of debt) and t is the tax rate. This formula allows to compute the ROE after taxes and can be divided in two parts. The first part relates to the operating activities (ROI), while the second part relates to the financial structure.

[3] See Brealey et al. (2011, p. 718).
[4] Sometimes also defined as Return on Sales (ROS) when the numerator is represented by the EBIT.
[5] See Magnanelli et al. (2016).

As it is easily observable, the effect of leverage (D/E) on the ROE can be positive or negative depending on (ROI – i), called spread.[6]

If $(ROI - i) > 0$, the effect of leverage (D/E) on the ROE is positive and it is convenient for the company to borrow from external lenders. In this case, there is a positive financial leverage, indeed the remuneration of capital invested in operating activities (ROI) is higher than the cost of that capital (i).

If $(ROI - i) < 0$, the effect of leverage (D/E) on the ROE is negative, and so it is not convenient for the company to increase financial debt. Then, there is a negative financial leverage and the company should finance itself through capital contributions of its shareholders.

The definitions of leverage used in equations (4) and (5) are different but they both highlight that leverage acts as a ROE amplification factor. Indeed, leverage is also called multiplier because it can either enlarge or reduce the effect on the overall profitability. This effect depends on whether the spread $(ROI - i)$ is positive or negative.

If in formula (4) the book values of assets and equity are substituted by the corresponding market values, that is the Equity Multiplier is calculated as Enterprise Value/Market Value of Equity, we get an index measuring the financial risk caused by leverage from a shareholders' point of view rather than a firm's one. From a mathematical point of view this definition of leverage is equal to 1 for an unlevered firm and greater than 1 for a levered one.

Moreover, leverage is often measured by means of the debt-equity ratio, defined as the ratio between the amount of debt (both short and long-term) and equity:

$$\text{Debt-Equity Ratio} = \frac{\text{Total Debt}}{\text{Total Equity}} \tag{6}$$

It is worth noting that only financial debt must be considered and not also operating liabilities.

However, as in the case of the Equity Multiplier, it may be preferable to consider the market value of equity rather than the book value. In fact, as it is known, the book-value of equity does not correctly reflect the value of the company and can sometimes even be negative, making the index under consideration meaningless.

The Debt-Equity Ratio is equal to zero if the firm is unlevered and greater than zero if it has debt. A value greater than 1 points out that the company finances itself more with debt than with its own resources.

Another alternative definition of leverage is the portion of total assets financed by debt, known as the debt-to-capital ratio, that is:

$$\text{Debt-to-Capital Ratio} = \frac{\text{Total Debt}}{\text{Total Equity} + \text{Total Debt}} \tag{7}$$

Even in this case, the index can be computed by using both book or market values. It ranges between zero (in the case of an unlevered firm) and 1 (if the firm is financed entirely by debt).

The risk of bankruptcy increases with increasing leverage. However, with the same amount of debt, this risk is lower for a company that has more liquid resources or assets that can be readily liquidated without costs. Therefore, in analyzing the financial structure of a company, it is useful to calculate also its Net Debt, that is the debt in excess of its cash reserves:

$$\text{Net Debt} = \text{Total Debt} - \text{Cash \& Short-term Investments} \tag{8}$$

In turn, the Net Debt can be used to calculate an index similar to the debt-to-capital ratio, known as the firm's debt-to-enterprise value ratio:

$$\begin{aligned} \text{Debt-to-Enterprise Value Ratio} &= \frac{\text{Net Debt}}{\text{Market Value of Equity} + \text{Net Debt}} \\ &= \frac{\text{Net Debt}}{\text{Enterprise Value}} \end{aligned} \tag{9}$$

Among the alternative definitions of leverage, the most widely used and easily understandable is the Debt-Equity Ratio. In effect, this definition emphasizes the most important financing methods of a company and directly compares them.

One of the first theories dealing with the problem of the optimal financial structure of a company was that proposed by Modigliani and Miller (1958, 1963) (MM). The main result of this theory is that the value of a company does not depend on its financial structure. This means that it does not matter if the company raises its capital through the issuance of shares or debt.

The theorem consists of two distinct propositions, both valid under very shirinking constraints imposed by the fundamental assumption. Indeed, the key assumption which this theorem is based on is that of "perfect capital markets", which in turn means that:

1) all economic agents, whether they are investors or companies, can buy and sell the same securities at the market price, the latter defined as the present value of future cash flows that the security produces. Therefore, investors and companies can borrow at the same rate because there are not information asymmetries.

[6] See Magnanelli et al. (2016).

2) absence of taxes and transaction costs associated with security trading;
3) the cash flows of firms' investment projects are independent of their financial decisions and these do not reveal additional information about the profitability of the projects themselves.

As shown by MM, if these hypotheses are valid, the firm's decisions about its financial structure do not affect its value. The latter will correspond to the market value of cash flows generated by its assets. Intuitively, this result is explained by the fact that, in the absence of taxes and transaction costs (assumption 2), cash flows paid to shareholders and creditors of the company are equal to the cash flows generated by its assets. The equality of the cash flows implies in turn the equality between the value of firm's securities and the value of its assets (since value depends on future cash flows - assumption 1). In other words, the financial structure has no effect on the value of the company, provided that it does not lead to a change in the cash flows associated with the investment projects (assumption 3).

The same conclusion applies even if investors have different preferences with respect to the financial structure chosen by the company in which they invest. In fact, given that they can borrow and lend at the same rate as the company, they will be able to achieve the desired level of leverage for their portfolio. For example, if an investor believes that the leverage level chosen by the company is too low, he or she can borrow and build a portfolio characterized by a higher level of debt. In other words, the so-called "homemade" leverage is a perfect substitute of the leverage used by the firm.

Formally, the first proposition of the MM's theorem can be written as:

$$E + D = U = A \tag{10}$$

where E, D, U, A are the market values of equity of a levered firm, debt, equity of an unlevered firm, and assets respectively. In other words, the market value of a company is equal to the value of its assets regardless of whether or not it is indebted.

The first equality in formula (10) can be reinterpreted in terms of returns. That is, the return on a portfolio consisting of securities representing equity and debt of a levered company must be equal to the return on a portfolio of securities of an unlevered one:

$$\frac{E}{E+D}R_E + \frac{D}{E+D}R_D = R_U \tag{11}$$

Solving for R_E, one gets the second proposition of the MM's theorem:

$$R_E = \underbrace{R_U}_{\substack{\text{Risk without} \\ \text{leverage}}} + \underbrace{\frac{D}{E}(R_U - R_D)}_{\substack{\text{Risk due to} \\ \text{additional leverage}}} \tag{12}$$

The second proposition expresses that the levered return (R_E) is the sum of the unlevered return (R_U) and an extra component which is proportional to the debt-equity ratio D/E (leverage). This means that a shareholder investing in a levered company will require a higher return than a shareholder investing in a company without debt.

The reason is that in case of debt (levered firm) the risk of bankruptcy exists and therefore the equity cost of capital (R_E) increases. In other words, a higher leverage implies a higher cost of equity because equity-holders demand a higher return due to the increased risk of default. Similarly, the cost of debt (R_D) increases as leverage increases because a more indebted company runs a greater risk of bankruptcy and therefore its creditors demand a higher remuneration.

The second proposition of MM also involves that, in case of perfect capital markets, the Weighted Average Cost of Capital ($WACC$) of the firm is independent of its capital structure and is equal to its equity cost of capital if it is unlevered, which in turn is equal to the cost of capital of its assets.

As the fraction of the firm financed by debt increases, both the equity and debt become riskier and their cost of capital rises. However, since the weight of debt in the financial structure increases and R_D is generally lower than R_E, the $WACC$ remains constant. In other words, the $WACC$ does not change with a changing leverage.

The MM's theorem might seem negligible because both propositions are based on assumptions that are not met in the real world. Actually, the theorem is of great importance because it demonstrates that the financial structure matters. Indeed, it influences the value of the company exactly because one or more fundamental assumptions are violated in the real markets. Hence, the theorem is a cornerstone of corporate finance even if it is not applicable to the real world.

In light of the MM's result, the theme of the optimal financial structure has given raise to the "trade-off theory". As argued by Kraus and Litzenberger (1973), companies choose the financial structure that maximizes their value and, in doing so, they must seek a compromise between benefits and costs. Benefits are represented by the tax deductibility of interest, also referred as the tax benefits of debt. On the other hand, costs are due to the fact that a higher leverage leads to an increase in the probability of bankruptcy. Thus, the optimal ratio between debt and equity is that for which marginal benefits and marginal costs are equal.

Another example of the cost of debt is the so-called "debt overhang", highlighted by Myers (1977), which means that indebted companies may not undertake investment projects with positive net present value since part of the

cash flows would benefit company's creditors and not shareholders. The consequence is that the optimal debt-equity ratio is lower than that would result from the model of Modigliani and Miller (1963).

After MM's seminal contribution, a flourishing economic literature has emerged. In fact, alternative theories on the financial structure have been elaborated, which try to avoid the constraints given by the MM's initial hypotheses. The pecking-order theory was originally developed by Myers (1984) and Myers and Majluf (1984). They, without coming to affirm that financial decisions are irrelevant to the value of the company, as stated by the MM's theorem, argue that companies do not have an optimal capital structure.

Indeed, due to information asymmetries between shareholders and managers on the one hand, and potentials external lenders on the other hand, companies tend to adopt a perfect hierarchical order of funding: first, they use internal funds, that is retained earnings; if external financing is needed, they issue low risk debt; only in the last resort, when the ability to issue high quality debt is exhausted, the company issues new shares.

Therefore, the pecking order theory, unlike the MM theory, is based on the information asymmetries. Indeed, managers have more information about their company than external potential investors. Hence, lenders and investors will require a higher return because of the higher risk. Moreover, the company has to incur other costs to issue debt and shares. For all these reasons, internal financing is better and cheaper than external financing. If retained profits are not sufficient, then the company will use external financing. In this case, managers prefer debt over equity because the cost of debt is lower than the cost of equity. However, at a certain point, the company will shift to equity as a too high leverage can be really risky.

Another reason why it is preferable to use self-financing is to avoid sharing profits with external lenders. If internal sources are not enough to finance the project, it is better to issue low-risk debt, thus paying a reduced and fixed fee to lenders and withholding the residual profits to benefit shareholders. The issuance of shares is the least advantageous solution since, by increasing the shareholder base, it reduces profits for the original shareholders.

Ultimately, leverage at a given time simply reflects external financing needs, without the tendency to converge towards a particular optimal level.

The non-existence of an optimal financial structure is also stated by the market timing theory (Stein, 1996; Baker et al., 2003) which, going further, argue that financial decisions of companies are completely determined by the often non-rational behavior of financial markets.

When the price of the company's shares is high, it prefers to issue new equity rather than debt to finance its investment projects. In fact, in this case, the firm can collect the necessary resources by issuing a limited number of new shares and thus diluting to a less extent the participation of the original shareholders. On the other hand, the firm will resort to the debt or postpone the investment when the market in general, or its own shares in particular, is falling. Therefore, this theory states that companies choose the cheaper form of financing at the time of the investment project without paying attention to their current level of internal resources, equity and debt.

Ultimately, according to the market- timing theory there is not an optimal financial structure, and leverage at a given time is nothing but the result of factors external to the company, rather than its optimizing decisions.

On the other hand, the agency theory (Jensen and Meckling, 1976) states that the optimal financial structure is the one that reconciles the needs of shareholders and managers with those of the company's creditors. In this case too, therefore, it is a matter of finding an optimal trade-off between conflicting forces, although benefits and costs are of a different nature from those highlighted by the previous theories.

More precisely, agency costs associated with the shareholders-manager[7] relationship (agency costs of equity) decrease as leverage increases, since in this case investments are financed more and more with creditors' and not shareholders' resources. Indeed, as leverage increases, equity-holders are less interested in the undertaken projects and so they support less costs to control their managers.

On the other hand, the agency costs associated with the creditors-shareholders relationship (agency costs of debt) increase with increasing leverage; in fact, as shareholders are protected by limited liability, they will tend to implement risky projects, with the consequence that creditors will demand a greater interest rate.

The optimal level of leverage is therefore the one that minimizes the sum of the two types of agency costs.

Another contribution to the agency theory is that of Jensen (1986), who argues that the agency costs characterizing shareholders and managers increase as "free" cash flows increase. These are the cash flows that managers could use for non-productive expenses and thus shareholders seek to minimize them. In this perspective, a higher debt entails a reduction in agency costs because it involves a payment of a fixed amount of money (interests) that reduces "free" cash flows available to management.

As a summary, there is a negative relationship that can be exploited between the leverage and agency costs.

In Chapter 2 we analyze the characteristics and trends of the Italian pharmaceutical industry. The analysis is conducted on the entire population of pharmaceutical companies in relation to the manufacturing sector as a whole. The aspects under study are therefore of a "macro" type and concern the degree of competitiveness, research and innovation, internationalization and localization. Afterwards, there is an analysis concerning the comparison between the Italian and European pharmaceutical industries. At the end of the chapter, some weaknesses of the Italian pharmaceutical industry and its challenges for the future are discussed. The analysis at a firm level is

[7] Principal and agent of the agency relationship, respectively.

included in Chapter 3, in which, based on data gathered from the AIDA database, an econometric model will be estimated in order to identify the determinants of the financial structure of Italian pharmaceutical companies.

According to the Italian classification of the economic sectors, known as "ATECO 2007", the pharmaceutical industry is part of the manufacturing sector and can be divided into the following three main activities: 1) Manufacture of basic pharmaceutical products (*Fabbricazione di prodotti farmaceutici di base*, code 21.10.00); 2) Manufacture of in vivo radioactive diagnostic substances (*Fabbricazione di sostanze diagnostiche radioattive in vivo*, code 21.20.01); 3) Manufacture of medicines and other pharmaceutical preparations (*Fabbricazione di medicinali ed altri preparati farmaceutici*, code 21.20.09).[8]

The Italian economy is recovering after the financial crisis of 2007–2008, but at a still too weak pace. This is why the country needs sectors capable of driving growth, such as the pharmaceutical industry, which is one of the most dynamic and innovative sectors in the Italian economy.

In fact, since 2010, the pharmaceutical industry is at first position in terms of growth of production (+19% compared to -5% for the manufacturing average) and of exports (+69% compared to +33%), allowing it to contribute positively to the Italian GDP both during the crisis and economic recovery.

Besides, in recent years, it has always been ranked in the top positions of the competitiveness ranking of the economic sectors compiled yearly by the Italian National Institute of Statistics (Istat).[9]

The "Synthetic Competitiveness Index" (ISCo) provides a measure of the performance of each sector compared to that of the whole manufacturing industry. It also allows to define a ranking of the manufacturing sectors taking into account four dimensions of competitiveness, expressed by five basic indicators: 1) cost competitiveness; 2) profitability; 3) performance on foreign markets and 4) innovation. The indicators measuring the four dimensions considered are: cost competitiveness (ratio between added value per employee and cost of labor per employee), gross profitability (ratio of gross operating profit to added value), the propensity to export (exported share of turnover), the variation in exports (compared to the three-year reference period 2005-2007) and the propensity to innovation (share of innovative companies).

In recent years, the pharmaceutical sector has always been ranked at the top of the competitiveness ranking with an index value abundantly higher than 100, that is the value of the whole manufacturing industry taken as a reference. The other sectors of the Italian manufacturing industry characterized by high competitiveness were: Beverage (11), Chemical products (20), Machinery and Equipment (28) and Electric devices (27).

With reference to 2015, the last year for which data is available, the sector's competitiveness has undergone a significant fall, although it has remained above the manufacturing average. The peak was reached in 2014, with an index value above 160.

The Italian pharmaceutical industry is characterized by a unique composition in Europe, with Italian-controlled companies that make up 40% of the industry, and foreign-owned companies, which instead determine the last 60%. Among the latter, 23% belong to the USA and the remaining 37% to other countries.

Moreover, Table 1 shows some structural characteristics and some performance indicators of the pharmaceutical sector and compares them with those of the manufacturing sector as a whole. In 2015, the pharmaceutical sector was made up of 453 companies, that is just 0.12% of manufacturing companies, which amounted to around 390,000 units. In terms of employees, the pharmaceutical industry accounted for 1.60% of the manufacturing sector (58,000 employees out of 3.6 millions).

It is therefore a small sector, but characterized by a high productivity as in 2015 it produced 3.8% of the manufacturing added-value. This is also evident from the high added-value per employee of around 140,000 Euros compared to about 60,000 of the manufacturing sector. It is also true that pharmaceutical labor costs were higher as they amount to around 70,000 Euros per employee, compared to an average of 42,000. However, taking both these data into account at the same time, the cost competitiveness, given by the ratio between the added-value per employee and the cost of labor per employee, is considerably higher than that of the manufacturing sector (201.9 against 138.8). This implies a greater efficiency of the pharmaceutical sector compared to the average, which translates into higher profitability: in 2015 it was over 50%, while the manufacturing sector as a whole stopped at 31.3%.

The added-value was produced to a large extent (72.6%) by large companies that accounted for a substantial part of the total. In fact, companies with more than 250 employees were 13% of the total; this percentage rises to 40% if 50 employees are considered as the minimum threshold. The large size of the companies that make up the sector is also evidenced by a concentration index CR5 (sum of the market shares of the 5 largest companies) equal to 23.6%. In the pharmaceutical sector, however, there was also a large percentage (36%) of small businesses, that is, with less than 10 employees.

Thus, the average size of pharmaceutical firms is certainly larger than that of manufacturing firms, but this is true also for the most highly capital-intensive sectors. Nevertheless, small and medium-sized companies represent an important component of the sector from a quantitative point of view, but also for their qualitative characteristics, for example in terms of added-value and qualification of human resources.

Finally, companies in the pharmaceutical sector were slightly more vertically integrated than the average: the

[8] See https://www.istat.it/it/archivio/17888.
[9] See Istat (2018a).

ratio between added-value and turnover[10] in 2015 was equal to 31.7% compared to 24.1% of the manufacturing sector as a whole.

Table 1 - Structural characteristics and economic results - Year 2015

Index	Pharm.	Manuf.
Structural characteristics		
Number of companies	453	389,317
Number of employees	57,573	3,618,368
Added-value (% of total manufacturing)	3.8	100
Added-value of large companies (in % of the total sector)	72.6	33.9
Concentration ratio (CR5) (%)	23.6	
Vertical integration (added-value/turnover) (%)	31.7	24.1
Economic Results		
Added-value per employee (thousands of Euros) (A)	139.8	58.8
Cost of labor per employee (thousands of Euros) (B)	69.3	42.4
Cost competitiveness (% ratio between A and B)	201.9	138.8
Gross profitability[(a)] (%)	50.5	31.3

[(a)]Ratio between gross operating profit and added-value.
Source: Istat (2018b).

In the pharmaceutical industry, the high investments in research and the high probability that these investments do not translate into positive economic results entail a high risk profile of the activity, which in turn calls for a legal form that guarantees the limited liability of the entrepreneurs. Then, it is not by chance that more than 95% of the companies in the sector are constituted in the form of a *società di capitali*. Moreover, this legal form facilitates, more than other forms, the raising of capital in the financial markets and therefore facilitates the financing of the considerable investments required by the pharmaceutical production.

An important feature of the pharmaceutical industry with respect to the rest of the Italian economy is the qualification of employees. Indeed, graduates are 54% of employees compared to 21% in the manufacturing industry. People holding a degree or a diploma represent 90% of employees, compared to 63% of the industry average.

Moreover, female presence is high in the pharmaceutical industry. Women are 44% of employees, significantly more than the average of the manufacturing industry (25%). Most of women are managers and they also represent 52% of employees in R&D.

Thanks to investments and quality of human resources, the pharmaceutical sector has high added-value and higher salaries than the average of the manufacturing industry. Therefore, the quality of Human Resources is an important factor of competitiveness for Italy and the main factor that attracts investments in the country from abroad.

One of the critical success factors in the pharmaceutical industry is undoubtedly research and innovation, which in fact is considered by Istat as one of the dimensions underlying the competitiveness index. Both investments and the number of employees in R&D have increased in recent years. More specifically, in 2015 investments reached 538 million Euros which, in relation to turnover, means 2.12%, while employees in the in R&D were 4,064, or 7.05% of the total.

Furthermore, the use of IT has been significant. In fact, in 2016, 84% of companies had a website, and almost all (97.13%) a broadband connection, with 43% of employees connected to the internet. In addition, about 48% of companies used the web to buy inputs or sell their products.

The R&D investments in the pharmaceutical industry amount to 7% of the research carried out in Italy, a value much higher than its weight in terms of turnover, and this shows the specialization of the sector in the innovation activity. In terms of R&D investments, the pharmaceutical industry is the third sector in Italy (with 13% of the manufacturing industry), after "Means of transport" and "Mechanical sector".

In terms of number of R&D employees, the pharmaceutical industry ranks third only after the same two sectors, which however have a much greater total number of employees. Therefore, R&D investments in the pharmaceutical industry are huge, both in absolute terms and in relation to the size of the sector.

Moreover, almost all companies (94%) will renew their plants in the next 3 years, giving rise to a virtuous process that will make the sector even more competitive than now. In particular, investments will be done in automation and digitalization in order to comply with the so-called "smart factory".

The most evident effect of the strong competitiveness and profitability of Italian pharmaceutical companies consisted of an intense process of internationalization both in terms of participation of foreign entities in the capital and exported production.

This is evident, first of all, from the comparison of some indicators of the degree of internationalization of pharmaceutical companies compared to the average ones of the manufacturing sector, reported in Table 2. In 2015, pharmaceutical companies that exported part of their production accounted for 64.5% of the total, compared to an

[10]The greater the added value compared to the value of production (turnover), the lower the value of intermediate goods used and therefore the greater the degree of vertical integration.

average of only 22.7% of the manufacturing sector. In the same year, pharmaceutical companies exported 73.6% of their turnover, while companies of the whole manufacturing sector exported only 36.7% of it. Sales abroad were largely a prerogative of large companies whose exports accounted for 87.3% of those of the entire pharmaceutical industry. Finally, more than half of the added-value was produced by companies controlled by foreign entities, which once again testifies the good health of pharmaceutical companies, considering that the corresponding percentage for the manufacturing sector was only 18.5%.

Table 2 - Internationalization - Year 2015

Index	Pharm.	Manuf.
Exporting companies (in % of companies in the sector)	64.5	22.7
Exports on turnover (%)	73.6	36.7
Exports of large companies (in % of the total sector)	87.3	50.4
Added-value of foreign-controlled companies (%)	52.7	18.5

Source: Istat (2018b).

The extraordinary performance in terms of exports by pharmaceutical companies, compared to other companies in the manufacturing sector, is nevertheless a fairly recent phenomenon. The overtaking has only recently occurred, but throughout the period 2012-2017 the pace of growth of the pharmaceutical sector in terms of the share of exported turnover has been considerably faster.

The continent to which exports were mainly directed was Europe, and to a lesser extent Asia and America. Furthermore, while exports to European countries have grown during the period 2005-2016, those to the other two continents mentioned have remained substantially unchanged over time.

Indeed, 75% of exports and 79% of imports are related to Europe. Among the other continents, the main trading partner is America (13% of exports and 17.5% of imports). The weight of trade with Asia, which accounts for 9.4% of total exports, is also significant, while imports represent only 3.6%.

Ultimately, the internationalization process involves the pharmaceutical sector much more than the overall manufacturing industry, both due to the presence of foreign companies in Italy and exports of Italian ones abroad.

The financial ed economic crisis occured in 2007-2008, in the subsequent years, led to both a strong reduction in bank credit and the possibility of accessing the capital market to finance investment projects. This has resulted in numerous bankruptcies or, at best, a reduction in the growth capacity of companies.

The "credit tension index", calculated by Istat and based on questionnaire data, is the difference between the percentage of responses which indicate less favorable conditions for access to credit and the percentage of those that indicate the most favorable conditions for access to credit. A positive value, therefore, indicates that companies which perceive to be subject to a financial constraint prevail, while a negative value indicates the perception of being able to finance investments without difficulty and at acceptable costs.

Until the last quarter of 2014, the index is positive both for the manufacturing sector and for the pharmaceutical one. Subsequently, it becomes negative, signaling greater ease for companies to access credit. Nevertheless, the most interesting aspect is that the index has assumed a lower value for the pharmaceutical sector than the manufacturing one for the whole period considered. In other words, pharmaceutical companies have faced less financial constraints with respect to companies operating in other sectors of the economy.

This result makes the pharmaceutical sector an ideal laboratory for the study of the determinants of financial choices, since the presence of any constraint could, on the contrary, distort the optimizing behavior of companies in the choice between alternative sources of financing.

However, in the period 2011-2015, the southern regions, and in particular Puglia, Calabria and Sardinia, have experienced birth rates of pharmaceutical companies higher than those of the northern regions. Therefore, souther regions appear to be on the good road to recover the gap in a reasonable time.

Indeed, the pharmaceutical industry is one of those driving the growth of the South of Italy. In total, around 4,000 employees work in the south-regions. Compared to the entire country, the South of Italy represents 7% of employment, 11% of investments in production and 12% of exports, with companies that export all over the world. In the last 10 years in fact, exports from the South have more than doubled, which is a better result than Germany and European average.

Chapter 3 presents the results of an econometric analysis aimed at identifying the determinants of the financial structure of Italian pharmaceutical companies.

The empirical literature considers the characteristics of the company (size, profitability and liquidity) as the main determinants of leverage. However, recent studies have shown that the financial structure of companies can also depend on the territorial context in which the firm operates and in particular on the characteristics of banking markets.

As is known from economic theory, the relationship between firms and banks is characterized by the presence of strong information asymmetries that induce the latter to perform a screening activity of investment projects. This screening activity becomes particularly severe when it deals with companies operating in innovative and risky

sectors, such as the pharmaceutical one. Indeed, companies operating in such a sector must face rather stringent financial constraints, since they perform a high-risk activity due the uncertainty about the results of pharmaceutical research.

Moreover, in a country like Italy, where external financing sources come mainly from the banking sector rather than the financial one (for example through bonds), the financial structure of companies, not just pharmaceutical ones, depends crucially on the relationship established with credit institutions.

More generally, a study based on Italian companies can not ignore the well-known socioeconomic gap between the North and South of the country, which affects the characteristics and results of any economic activity. It is not by chance that most Italian pharmaceutical companies are concentrated in the central-northern part of Italy.

Thus the econometric model presented in this chapter considers both firm and territorial factors as potential determinants of the financial structure of the Italian pharmaceutical companies. The model has been estimated using a panel of 318 firms observed during the period 2008-2016.

When repeated observations over time are available on the same statistical unit, the data take on a so-called panel structure.

This allows us to estimate more realistic models than it would be possible if a single cross-section or time series was available. In particular, it is possible to take into account the unobserved heterogeneity among the statistical units, that is, factors not captured by the independent variables and which however imply a different relationship between the dependent variable and the covariates depending on the statistical unit considered.

This is possible thanks to the introduction in the model of the so-called "individual effects", that is a constant for each statistical unit. These effects can be considered as further parameters to be estimated or as draws from a random variable. In the first case we speak of "fixed effects", while in the second case of "random effects".

The fixed effects model can be written as:[11]

$$y_{it} = \alpha_i + \boldsymbol{x}'_{it}\boldsymbol{\beta} + \varepsilon_{it}, \tag{13}$$

where $i = 1, \ldots, N$ and $t = 1, \ldots, T$ index cross-sectional units and time, respectively, $\varepsilon_{it} \sim IID(0, \sigma^2_\alpha)$ and α_i is an individual intercept, which does not vary over time, $\boldsymbol{x}_{it}$ is a vector of covariates and $\boldsymbol{\beta}$ is the corresponding parameter vector. Thus, equation (13) can be thought as a linear regression model containing a dummy variable for each unit i, that is it can be also written as:

$$y_{it} = \sum_{i=1}^{N} \alpha_j d_{ij} + \boldsymbol{x}'_{it}\boldsymbol{\beta} + \varepsilon_{it}, \tag{14}$$

where $d_{ij} = 1$ if $i = j$ and 0 otherwise. Then, the parameters $\alpha_1, \ldots, \alpha_N$ and $\boldsymbol{\beta}$ can be estimated by OLS; the implied estimator is known as Least Squares Dummy Variable (LSDV) estimator. However, when N is large, this estimator is difficult to compute, so that it is preferable first to eliminate the individual effects by means of the within transformation, that is considering the model in deviation from individual means:

$$y_{it} - \bar{y}_i = (\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)'\boldsymbol{\beta} + (\varepsilon_{it} - \bar{\varepsilon}_i). \tag{15}$$

The OLS estimator applied to equation (15) is called the "within estimator" or "fixed effects estimator" and is numerically equivalent to the LSDV one. Formally:

$$\hat{\boldsymbol{\beta}}_{FE} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)'\right]^{-1} \sum_{i=1}^{N}\sum_{t=1}^{T}(\boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i)(y_{it} - \bar{y}_i). \tag{16}$$

Standard assumptions of the linear regression model ensure that this estimator has desiderable properties. More precisely, if all x_{it} are independent of all ε_{it}, the fixed effect estimator, $\hat{\boldsymbol{\beta}}_{FE}$, is unbiased, while if $\mathrm{E}(x_{it}\varepsilon_{is}) = 0, \forall s, t$, that is if covariates are "strictly exogenous", then it is consistent.[12]

In the random effects model, the α_i are assumed to be random, independently and identically distributed over individuals. Formally:

$$y_{it} = \mu + \boldsymbol{x}'_{it}\boldsymbol{\beta} + \alpha_i + \varepsilon_{it}, \tag{17}$$

where $\alpha_i \sim IID(0, \sigma^2_\alpha)$ and $\varepsilon_{it} \sim IID(0, \sigma^2_\varepsilon)$, with the ε_{it} uncorrelated over time. It is also assumed that α_i and ε_{it} are mutually independent and independent of $x_{js}, \forall j, s$, which ensures that the OLS estimator of $\boldsymbol{\beta}$ is unbiased and consistent.

However, since the variance-covariance matrix of the composite error term $\alpha_i + \varepsilon_{it}$ is not diagonal, more efficient estimates can be obtained through Generalized Least Squares (GLS).

[11] What follows is mainly based on Verbeek (2004, Chapter 10).

[12] As N goes to infinity.

Then, the GLS estimator is:

$$\hat{\boldsymbol{\beta}}_{GLS} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(\boldsymbol{x}_{it}-\bar{\boldsymbol{x}}_i)(\boldsymbol{x}_{it}-\bar{\boldsymbol{x}}_i)' + \psi T\sum_{i=1}^{N}(\bar{\boldsymbol{x}}_i-\bar{\boldsymbol{x}})(\bar{\boldsymbol{x}}_i-\bar{\boldsymbol{x}})'\right]^{-1} \times \left[\sum_{i=1}^{N}\sum_{t=1}^{T}(\boldsymbol{x}_{it}-\bar{\boldsymbol{x}}_i)(y_{it}-\bar{y}_i) + \psi T\sum_{i=1}^{N}(\bar{\boldsymbol{x}}_i-\bar{\boldsymbol{x}})(\bar{y}_i-\bar{y})\right]. \tag{18}$$

For large T ($T \to \infty$), $\psi \to 0$ and then the GLS estimator is equivalent to the fixed effects one,[13] while if $\psi = 1$, one gets the OLS estimator.

In order to choose among alternative panel data estimators, some tests are available. First, one could test the joint significance of the individual effects in model (14), that is $H_0 : \alpha_1 = \alpha_2 = \cdots = \alpha_{N-1} = 0$, by performing the following F-test:[14]

$$F = \frac{(RRSS - URSS)/(N-1)}{URSS/(NT-N-K)}, \tag{19}$$

where $RRSS$ is the residual sums of squares from the OLS on the pooled model, $URSS$ is the residual sums of squares from the fixed effects model and K is the number of regressors (excluding the constant). Under the null hypothesis, the test statistic (19) is distributed as an F with $N-1$ and $NT-N-K$ degrees of freedom.

The random effects model can be tested against the classical linear model by means of the Breusch-Pagan Lagrange multiplier test, whose system of hypothesis is:[15]

$$H_0 : \sigma_\alpha^2 = 0$$
$$H_1 : \sigma_\alpha^2 \neq 0.$$

The test statistic is:

$$LM = \frac{NT}{2(T-1)}\left[\frac{\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{\varepsilon}_{it}\right)^2}{\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{\varepsilon}_{it}^2} - 1\right], \tag{20}$$

where $\hat{\varepsilon}_{it}$ are the OLS residuals. Under the null hypothesis, the limiting distribution of LM is Chi-squared with one degree of freedom.

Finally, the choice between fixed and random effects can be based on the Hausman specification test.[16] The latter compares two estimators, one which is consistent under both the null and alternative hypothesis and one which is consistent (and typically efficient) under the null hypothesis only. A significant difference between the two estimators indicates that the null hypothesis is unlikely to hold. In a panel data context, the null hypothesis is that $\boldsymbol{x}_{it}$ and α_i are uncorrelated, so that $\hat{\boldsymbol{\beta}}_{RE}$ is consistent and efficient only under the null, while $\hat{\boldsymbol{\beta}}_{FE}$ is always consistent. The test consists in evaluating the significance of the difference $\hat{\boldsymbol{\beta}}_{FE} - \hat{\boldsymbol{\beta}}_{RE}$ and then its statistic is:

$$H = (\hat{\boldsymbol{\beta}}_{FE} - \hat{\boldsymbol{\beta}}_{RE})'[\hat{V}_{\hat{\boldsymbol{\beta}}_{FE}} - \hat{V}_{\hat{\boldsymbol{\beta}}_{RE}}]^{-1}(\hat{\boldsymbol{\beta}}_{FE} - \hat{\boldsymbol{\beta}}_{RE}), \tag{21}$$

where $\hat{V}$ denotes the estimated variance-covariance matrix of the corresponding estimator. Under the null, H has an asymptotic Chi-squared distribution with degrees of freedom equal to the number of elements in $\boldsymbol{\beta}$.

So far it has been assumed that the panel is "balanced", that is for each of the N individuals exactly T observations are available for the same period of time. However, it is not uncommon that the panel is "incomplete" (or "unbalanced"), in the sense that for some statistical units one has a number of observations less than T. If the lack of such observations is random, estimation methods and tests discussed previously remain valid although formulas require some adjustment.[17]

In order to identify the determinants of the financial structure of Italian pharmaceutical companies, we estimate the following econometric model for panel data:

$$Y_{it} = \alpha_i + \beta_1 TANFIX_{it} + \beta_2 \ln SIZE_{it} + \beta_3 GROWTH_{it} + \beta_4 PROF_{it} + \beta_5 LIQU_{it} + \beta_6 CONC_{it} + \beta_7 SOUTH_i + \varepsilon_{it} \tag{22}$$

where i and t index company and time, respectively, α_i is a firm-specific component and $\varepsilon_{ij} \sim IID(0, \sigma_\varepsilon^2)$ is an error term uncorrelated over time. The dependent variable, Y, is either the Debt-to-Equity ratio ($DEBEQU$) or the Debt-to-Capital ratio ($DEBCAP$).

[13] See (16).
[14] See Baltagi (2005, p. 13).
[15] See Greene (2012, p. 376).
[16] See Verbeek (2004, p. 351).
[17] See Verbeek (2004, Section 10.8). If, on the other hand, some individuals are observed incompletely for an endogenous reason then this can lead to distorted estimators and invalid tests (selection bias).

The independent variables are defined as follows:

- $TANFIX$, that is the ratio between tangible assets and total assets. Companies with a greater share of tangible assets should have a greater ability to issue debt because in the event of bankruptcy these assets, unlike the intangible ones, retain their value and can be used to satisfy creditors, who should therefore be more willing to finance the company (Harris and Raviv, 1991). Moreover, as argued by Rajan and Zingales (1995), the guarantee offered by this type of assets implies a less risk and agency costs associated with debt incurred by the creditors, and then the company's leverage should be higher. Therefore, there is a positive relationship between tangible assets and financial leverage.
  Conversely, and according to Grossman and Hart (1982), the monitoring costs of the agency relationship between shareholders and managers are higher in firms with lower assets' tangibility. In order to reduce the opportunistic behaviour of managers, some firms may choose higher debt levels. In other words, firms with less collateralizable assets (that is with a lower share of tangible assets) may choose higher debt levels to limit their managers' consumption of perquisites. Then, the relationship between the assets' tangibility and financial leverage should be negative. In sum, the sign of $TANFIX$'s impact on the debt ratio is not determinable a priori;
- $\ln SIZE$, that is the natural logarithm of assets.[18] Larger companies are more diversified in terms of activities, thus less risky and more able to issue debt. For this reason, many authors (Rajan and Zingales, 1995; Booth et al., 2001; Frank and Goyal, 2003) argue that the relationship between size and leverage must be positive. On the other hand, for larger companies there are fewer information asymmetries between insiders and investors in the capital markets. Large firms should thus be more able to issue informationally sensitive securities like equity, and should have less debt;
- $GROWTH$, that is the growth rate of sales. According to Jensen and Meckling (1976), a firm's growth opportunities are a proxy for the agency cost of debt. Indeed, when a firm grows there should be sufficient internal funds available for its investments and then it reduces leverage. However, if these funds are not sufficient, the company must resort to debt with the consequence that the leverage could also increase;
- $PROF$, which is profitability measured as the ratio between EBITDA[19] and assets. The sign of its impact on financial leverage could be both positive or negative. Higher profitability makes the use of debt more attractive due to tax reductions and, at the same time, increases the company's ability to pay interests and thus reduces its likelihood of bankruptcy. Moreover, higher profits mean greater liquid resources disposable to management, so if the theory of "free" cash flows is valid, this implies higher agency costs of equity, with the result that the firm needs to increase the debt to regulate managers. Therefore, profitability could have a positive impact on financial leverage. On the other hand, the sign could be negative by virtue of the pecking-order theory: more profitable companies have a greater capacity to finance investments with internal resources and therefore they are less in debt;
- $LIQU$, that is the liquidity index, calculated as the fraction of the assets consisting of cash, cash equivalents (bank accounts) and financial assets that can be promptly liquidated without costs. In this case, the expected sign is negative as greater liquidity indicates a higher capacity of self-financing and so less debt. Nevertheless, in presence of greater liquid resources the liquidation value in the event of bankruptcy is greater (Shleifer and Vishny, 1992) and thus the firm is more likely to get debt financing from credit institutions. Therefore, according to this different kind of reasoning, this variable should positively impact on the leverage. However, Weiss and Wruck (1998) argue that asset liquidity is a factor reducing, not increasing, the firm's ability to issue debt securities;[20]
- $CONC$, that is the concentration index in the banking market, computed at a provincial level. From a theoretical point of view, the impact of this variable on the leverage can be either positive or negative;
- $SOUTH$, that is a dummy variable equal to 1 if the company's registered office is in a region of the South or the Islands[21] and 0 otherwise. The purpose is to verify if there is a significant difference in terms of leverage between southern companies and those operating in other parts of the country. In fact, it may be that the well-known socio-economic gap between the two areas also has an impact on the financial choices of companies.

Ultimately, for all the independent variables included in the model, the expected sign of their impact on leverage is difficult to determine, as it depends on the theory by which it is analyzed. This, on the one hand, shows a non-univocity of the theory on the determinants of indebtedness and, on the other hand, it requires a considerable and continuous effort of empirical research in order to find those regularities that the theory can not provide.

From a theoretical point of view, the effects of concentration in banking markets on corporate leverage depend crucially on the hypothesis about the degree of information asymmetry characterizing these markets. Depending on

[18] The use of the logarithm allows to take into account any non-linearity of the relationship between leverage and size and in any case represents a consolidated practice in the literature.

[19] EBITDA stands for "Earnings Before Interest, Taxes, Depreciation and Amortization" and therefore corresponds to the Operating Result gross of depreciation. The $PROF$ variable, therefore, is a measure very close to the most common ROI. An alternative measure of profitability is ROE, but this is in turn influenced by the interest on the debt and therefore by the financial choices of the company; its use instead of the measure of profitability adopted here would therefore generate, from an econometric point of view, a problem of endogeneity. SeeVerbeek (2004, p. 110).

[20] See also Morellec (2001).

[21] According to the ISTAT's classification, the southern or insular regions are:Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicily, Sardinia.

this hypothesis, the effect of concentration on the financial structure may be either positive or negative.

When there are no information asymmetries, that is when both companies and banks know the quality of investment projects and the effort that the latter will exert to ensure their success, then the so-called Structure-Conduct-Performance (SCP) paradigm should hold.[22]

According to this theory, there exists a positive relationship between price or profits and the level of market concentration. Therefore, in the case of banking markets, the higher the market concentration the higher interest rates on loans. Although the SCP paradigm has been criticized by more recent theories, it still represents the reference of many antitrust authorities in the world, who use the Herfindahl-Hirschman Index (HHI)[23] to assess any anti-competitive effect of merger and acquisition (M&A) operations.

Following this argument, a negative relation might be expected between concentration in banking and firm's leverage, because of the higher interest rates on loans caused by the increased concentration. In fact, studies like those by D'Auria et al. (1999) and Degryse and Ongena (2005) show that, in Italy and Belgium respectively, a higher concentration implies a higher cost of fund for firms who finance themselves through the credit market.

However, the hypothesis of symmetric information in banking markets is hardly reflected in reality. The attempt to explain why banks specialize in lending, that is, in activities that are difficult to negotiate and therefore strongly illiquid, led to the birth of a strand of literature based on the so-called "lemons principle" of Akerlof (1970).

In particular, the latter shows that when the characteristics of the good being traded are not observable by buyers, and therefore when ex-ante (that is before the conclusion of the contract) information asymmetries exist, an "adverse selection problem" arises: prices reflect the average quality of the good, so that the bidders of the best quality goods apply higher prices, but customers can not observe goods' characteristics and quality. Therefore, the bidders of the best quality goods come out of the market and the supply of the good decreases until the market disappears.

A similar phenomenon could occur in the credit market: the characteristics of the investment projects of borrowers are not fully observable by banks, which therefore charge the rate and other conditions of the loan contract on the basis of the average quality of these projects. This induces companies with the best projects to exit the credit market with a consequent deterioration of the average quality of the remaining projects. Banks try to mitigate this problem through the collection of information on the potential borrower and its project (screening) before concluding the contract.

In the presence of ex-post (that is after the conclusion of the contract) information asymmetries, a problem of "moral hazard" may arise. As the agency theory shows, this phenomenon occurs in the context of a contractual relationship between a principal and and an agent having conflicting preferences. In order to get private benefits, the agent could reduce the effort in realizing the agreed performance ("hidden action") or lying about the state of the world ("hidden information"). To solve this problem, the principal will have to offer a contract such that it induces the agent to act in accordance with his own interests, or to carry out a control activity (monitoring) of his behavior. With reference to the credit market, the borrower (agent) could reduce its effort in managing the funded project, especially if he is protected by limited liability, or lying about the results of his business in order to avoid paying the debt or reducing its amount through, for example, a renegotiation.

Adverse selection and moral hazard lead to the establishment of long-term relationships between banks and borrowers ("relationship banking") (Booth et al., 2001; Dell'Ariccia and Marquez, 2004). Indeed, the firm prefers a multi-period contract with payments in favor of the bank related to the results of the project, rather than a sequence of uniperiodal debt contracts. The fact that the firm achieved good results in the past allows the bank to save on monitoring costs and then it can charge a lower interest rate on loans.

Therefore, if a higher concentration in the banking markets favors relationship banking, the availability of credit increases, thereby reducing fir's financial constraints and increasing leverage. Thus, we must expect a positive relationship between banking markets' concentration and financial leverage. However, the empirical evidence on the impact of concentration on relationship banking and thus on leverage is mixed.

For the purpose of our study, we used the HHI index, since it, unlike the CR_k one, takes into account all the firms operating in the market. In principle, the concentration index should be calculated using deposits or loans of banks. However, since these data are not available at a local level, we resort to geographical distribution of banks' branches.[24] Formally, the HHI index of province j in year t has been computed as:

$$HHI_{jt} = \sum_{i=1}^{N} \left(\frac{b_{ijt}}{\sum_{i=1}^{N} b_{ijt}} \right)^2$$

where i, j and t index banks, provinces and years respectively, N is the number of banks in province j and year t, and b denotes the number of branches. In other words, the index is the sum of the squared market shares, where the market share of bank i (for each province and year) is computed as the ratio between the number of its branches and the total number of branches in the province.

The sample of Italian pharmaceutical companies used to estimate the econometric model (22) comes from the database called AIDA, managed by Bureau van Dijk, which contains the financial statements of Italian firms.

[22] See, among others, Mason (1939) and Bain (1951).

[23] The HHI index is defined as the sum of the squared market shares of the firms operating in market. For more details, see below.

[24] Like, for example, Degryse and Ongena (2005).

From this database we extracted data on companies belonging to the ATECO categories "Manufacture of basic pharmaceutical products" (*Fabbricazione di prodotti farmaceutici di base*, code 21.10.00) and "Manufacture of medicines and other pharmaceutical preparations" (*Fabbricazione di medicinali ed altri preparati farmaceutici*, code 21.20.09), for the the period 2007-2016.

Before to proceed with the estimation of the model, the available data have been suitably filtered. First of all, the companies that by 2016 were found to be bankrupt or subjected to another bankruptcy procedure were eliminated. Some of the remaining firms had an unreasonably low asset value, probably due to the fact that the current legislation makes it possible to set up a company also with an extremely limited social capital (at most one euro). A second selection is therefore consisted in eliminating companies with asset value less than 1,000 Euros. Thirdly, the observations for which the equity was negative were eliminated. After the application of these filters, the initial number of companies decreased to 368.

A further selection was made after calculating the variables to be included in the model. In fact, some of them, namely $DEBCAP$, $TANFIX$ and $LIQU$ should vary between 0 and 1, extremes included. Therefore, the observations for which the above variables fell outside this range were eliminated.

For the remaining variables, we checked for the presence of outliers. Observations for which these variables were lower than the 1st centile or larger than the 99th centile were dropped. Finally, we excluded companies for which less than three observations were available.

The final sample consists of 2,492 observations on 318 firms and covers the period 2008-2016.[25] Since, according to ISTAT data, in 2015[26] the pharmaceutical sector was made up of 453 companies, our sample includes about 70% of the whole sector and therefore is very representative of the population. The panel is unbalanced, and includes about 8 observations for each firm. Table 3 provides some descriptive statistics of the sample.

Table 3 - Summary statistics of variables

Variable	Mean	Std. Dev.	Min.	1st Quart.	Median	3rd Quart.	Max.
$DEBEQU$	2.406	2.736	0.057	0.653	1.463	2.963	16.347
$DEBCAP$[(a)]	0.568	0.223	0.054	0.395	0.594	0.748	0.942
$TANFIX$[(a)]	0.213	0.195	0.000	0.040	0.163	0.337	0.843
$SIZE$[(b)]	57.801	124.035	0.048	2.798	13.301	51.284	840.973
$GROWTH$[(c)]	0.072	0.292	-0.646	-0.045	0.033	0.130	3.688
$PROF$	0.126	0.100	-0.268	0.065	0.110	0.176	0.468
$LIQU$[(a)]	0.153	0.185	0.000	0.014	0.074	0.230	0.860
$CONC$[(d)]	0.091	0.033	0.035	0.070	0.082	0.104	0.357
$SOUTH$[(e)]	0.099	0.299	0.000	0.000	0.000	0.000	1.000
Observations	2492						

[(a)] Fraction
[(b)] Millions of Euros
[(c)] Variation rate
[(d)] Index in 0–1
[(e)] Dummy

Estimation results of model (22) are reported in Table 4. For both the dependent variables measuring the leverage of Italian pharmaceutical companies ($DEBEQU$ and $DEBCAP$) we estimated a fixed (FE) and random effects (RE) model. In the FE specification, the variable named SOUTH was dropped since it is time-invariant. Indeed, the within estimator (16) leads to the elimination from the estimates of the variables that do not change over time and whose average therefore corresponds to the value assumed in the single observation.

When the dependent variable is the Debt-to-Equity Ratio ($DEBEQU$), the Breusch-Pagan LM test suggests that the RE model should be preferred to the pooled OLS, since it rejects the null hypothesis that the variance of individual effects is equal to zero. Moreover the Hausman test does not reject the null, so that the RE model should be prefereed to the FE one. Therefore, the following discussion is based on the third column of the table.

Most of the parameters are statistically significant at the 1% level. The coefficient of $TANFIX$ is statistically significant and negative, which means that companies with a larger share of tangible assets in total assets have a lower leverage. Therefore, between the two alternative interpretations about the impact of tangible assets on the degree of indebtedness, in our sample seems to prevail that proposed by Grossman and Hart (1982). According to them the monitoring costs of the agency relationship between shareholders and managers are higher in firms with lower assets tangibility. In order to reduce the opportunistic behaviour of managers, some firms may choose higher debt levels. In other words, firms with less collateralizable assets (that is with a lower share of tangible assets) may choose higher debt levels to limit their managers' consumption of perquisites. Moreover, since our econometric model is linear, each parameter can be interpreted as the marginal effect of the corresponding independent variable on the dependent one. In this case, the estimate is equal to about -1.79, which implies that an increase of 0.1 (that

[25] Although the original data also included 2007, this year was lost due to the calculation of the $GROWTH$ variable.
[26] See Table 1.

is, of 10 percentage points) in $TANFIX$ leads to a decrease of 0.179 of the Debt-Equity Ratio.

The coefficient of $\ln SIZE$ is significant and negative as well. Thus, according to our estimates, as the size of the company increases, leverage decreases. This probably happens because larger companies are less opaque in terms of information and therefore can more easily access to the capital market and issue new shares at advantageous prices. This effect seems to prevail over that associated with diversification which, instead, implying a lower risk should allow the company to get into debt more easily. Since the size is measured in logarithm and the independent one is in level, the coefficient can be interpreted as semi-elasticity, that is the percentage increase in the dependent variable when the independent one increases by 1. Thus, according to our estimates, if the size increases by one million Euros, the Debt-Equity Ratio decreases by about 14%.

Firm's sales growth ($GROWTH$) impacts positively on leverage, which means that the investments needed to sustain growth are financed mainly with external resources and so debt, although growth normally also leads to a greater availability of internal funds. However, this impact is very small in magnitude. Indeed, the corresponding coefficient amounts to about 0.46, then an increase in sales growth of 10 percentage points would lead to an increase in $DEBEQU$ of only 0.046.

Conversely, the parameter associated to profitability ($PROF$) is negative, and then when profitability increases, the leverage decreases. This implies that the pecking-order theory, according to which more profitable companies have a greater capacity to finance investments with internal resources and therefore are less in debt, is confirmed by our estimates. The fiscal advantages that could derive from a greater recourse to debt and the need to regulate managers in the presence of high profits therefore seem to have little effect on the financial decisions of pharmaceutical companies. The (negative) impact of profitability on leverage is strong. The corresponding parameter allows to conclude, in fact, that if profitability increases by one percentage point, the Debt-Equity Ratio is reduced by 0.046, which represents a higher impact than that associated with $TANFIX$.

Finally, the liquidity index ($LIQU$) leads to a lower leverage, since the sign of the corresponding parameter is negative. In terms of magnitude, the impact is similar to that of $TANFIX$. This result is consistent with those of Weiss and Wruck (1998) and Morellec (2001), but it is somewhat counterintuitive because a greater liquidity implies a higher liquidation value in the event of bankruptcy and thus easier access to debt financing, so that this variable should positively impact on the leverage. Nevertheless, our result shows that a greater liquidity indicates a higher capacity of self-financing and so less debt.

Since neither $CONC$ nor $SOUTH$ variables are statistically significant, the fact that a firm is located in more concentrated banking markets or in a southern region of Italy has no effects on leverage. However, the coefficient of the first variable is positive and so is consistent with the idea that concentration favors the establishment and preservation of longstanding relationships between banks and firms, so that the latter can more easily access bank credit and increase their leverage. On the other hand, the parameter associated with the $SOUTH$ variable is negative, indicating that companies operating in the South of Italy are on average less indebted than those operating in other areas of Italy.

These results are largely confirmed by the model that considers the Debt-Capital Ratio ($DEBCAP$) as dependent variable. In this case, the test results lead to preferring the FE model (fourth column of Table 4) over both the RE model and the pooled OLS.

The only two differences with respect to the model with $DEBEQ$ as the dependent variable are:

1) the non-significance of $TANFIX$, meaning that the share of tangible assets has no impact on leverage;
2) the positive sign of the coefficient associated to $\ln SIZE$, which leads to the assertion that larger companies are more indebted. This result is explained by the fact that, being more diversified, larger companies are less risky and therefore are considered more creditworthy by potential lenders.

In all other cases, the parameters of the independent variables are highly significant as in the first model, but present different values simply because the dependent variable has a different scale.[27]

To sum up, The study of the determinants of the financial structure of companies is an argument widely studied and debated both from a theoretical and empirical point of view. As discussed in Chapter 1, after the fundamental contribution of Modigliani and Miller (1958, 1963), numerous theories have been developed to explain the financial decisions of companies with regard to the relationship between internal and external sources.

However, the choice process supported by these theories is different, as it goes from the optimizing behavior of the trade-off theory to the hierarchical choice of the funding sources highlighted by the pecking-order theory and to the conclusion that financial choices depend on external factors, that is the performance of financial markets, as advocated by the market-timing theory.

The comparison between the different positions has then moved on the empirical ground. In this case, the works of several authors have made it possible to identify a series of characteristics of the company (size, growth, profitability, liquidity) as fundamental determinants of leverage. In addition, more recent contributions have highlighted the importance also of institutional factors in the country in which the company operates, as well as the characteristics of the banking markets to which the company resorts to finance its projects. Finally, the specific characteristics of the sector in which the company operates could also play a role. It follows the need, from the

[27] See Table 3.

empirical point of view, to focus on a homogeneous sample of companies, operating in a specific country and a specific sector.

Following this principle, in this thesis, the determinants of the financial structure of the Italian companies operating in the pharmaceutical industry have been studied through an econometric model for panel data.

The choice of the pharmaceutical sector was not accidental, since, as shown in Chapter 2, during the last years it represented one of the sectors driving the recovery of the Italian economy after the 2007-2008 crisis. In fact, it is a sector characterized by a high degree of innovation, strongly internationalized and therefore very competitive. For these reasons, companies were able to access both external financing from the banking sector and internal financing through the equity markets. Then, the lack of financial constraints makes the pharmaceutical sector particularly suitable for the study of the determinants of leverage.

The econometric model, whose results have been presented and discussed in Chapter 3, has been estimated on the basis of data taken from the AIDA database. In particular, the sample consists of 318 pharmaceutical companies observed during the period 2007-2016.

The dependent variable of the model is the leverage, measured both as the Debt-Equity ratio and the Debt-Capital ratio. Among the independent variables were considered the characteristics of companies in terms of size, growth, profitability and liquidity, and two territorial variables, that is, the degree of concentration in local banking markets and a dummy variable aimed at capturing the impact on the leverage of the well-known socio-economic gap between the North and South of Italy.

The results of the econometric model show that the financial leverage of Italian pharmaceutical companies is significantly and positively correlated with the growth rate of sales and negatively influenced by the share of tangible assets, size, profitability and the degree of liquidity of assets.

On the other hand, there is no evidence of any impact of banking concentration on financial leverage, nor of a statistically significant difference in terms of leverage between companies operating in the northern provinces of the country and those operating in the South. The results are robust with respect to the two ways of measuring the leverage.

Table 4 - Estimation results

Variable	*DEBEQU*		*DEBCAP*	
	Fixed	Random	Fixed	Random
Constant	2.1575***	4.3040***	0.5570***	0.6913***
	(0.5191)	(0.3511)	(0.0332)	(0.0250)
$TANFIX$	-1.9604***	-1.7886***	0.0278	0.0019
	(0.4984)	(0.4023)	(0.0318)	(0.0275)
$\ln SIZE$	0.5297***	-0.1384***	0.0389***	-0.0070*
	(0.1245)	(0.0532)	(0.0080)	(0.0040)
$GROWTH$	0.4011***	0.4638***	0.0487***	0.0507***
	(0.1173)	(0.1174)	(0.0075)	(0.0076)
$PROF$	-4.3753***	-4.6240***	-0.3327***	-0.3466***
	(0.5061)	(0.4878)	(0.0323)	(0.0318)
$LIQU$	-1.4976***	-1.7996***	-0.2055***	-0.2393***
	(0.3336)	(0.3102)	(0.0213)	(0.0204)
$CONC$	6.3488	1.8953	0.1489	0.0509
	(4.3981)	(2.9937)	(0.2810)	(0.2114)
$SOUTH$		-0.4594		-0.0241
		(0.4196)		(0.0324)
Hausman test	-	19.88	-	104.97
	-	(0.1341)	-	(0.0000)
Breusch-Pagan LM test		2697.09		4243.47
		(0.0000)		(0.0000)
F test for $\alpha_i = 0$	15.29	-	24.30	-
	(0.0000)		(0.0000)	
R^2 within	0.0932	0.0800	0.1681	0.1541
R^2 between	0.0041	0.2013	0.0061	0.3040
R^2 overall	0.0008	0.1511	0.0213	0.2468
N. of obs.	2,492	2,492	2,492	2,492
N. of firms	318	318	318	318

Significant at: *** = 1% level; ** = 5% level; * = 10% level. Standard errors of the parameters and p-values of the tests in parentheses. Yearly dummies included but not reported.