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DETERMINANTS OF THE NEGATIVE DEBT PHENOMENON

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Abstract

Firms may fund their investment projects with retained earnings, debt and equity, but what determines their financing decisions? Traditionally, firms adjust their capital structures to the point where marginal benefits and costs of debt are balanced. An optimal capital structure involving large amounts of cash leads a firm to have negative net debt what may conflict with that traditional approach.

Due to their individual characteristics (namely the nature of their business, growth opportunities, governance structure, profitability), firms have different needs regarding the capital structure.

Applying a probit model to a sample of US-listed firms between 2003 and 2017, this study aims to analyze the probability of a firm having negative net debt considering its characteristics. Analyzing the estimation results, it is possible to realize what are the determinants of negative net debt.

There are many studies focusing on capital structure, cash holdings, and debt, but not on the manifestation of negative net debt that is the focus of this dissertation. This dissertation contributes to increasing the literature on this subject.

The results of this study evidenced a significant and positive relation between the probability of a firm having negative net debt and cash flow volatility and tax rate. Conversely, it is evidenced a significant and negative relation between that probability and firm size, intangibility, the preponderance of noncurrent assets in the total assets, and the amount of cash substitutes. Moreover, it was found that the sector in which a firm operates also influences its probability of having negative net debt.

Key-words: Capital Structure; Negative Net Debt; Cash Holdings
JEL-Codes: G32, G39

Resumo

As empresas podem financiar os seus projetos de investimento recorrendo a resultados retidos, dívida e capital próprio. No entanto, quais são os fatores que determinam as suas decisões por uma destas formas de financiamento? Tradicionalmente, as empresas ajustam as suas estruturas de capitais até ao ponto em que se verifica um balanço entre os benefícios marginais e os custos da dívida. Desta forma, uma estrutura ótima de capital que e grandes quantidades de *cash* e que por isso leva as empresas a apresentarem dívida líquida negativa entra em conflito com esta abordagem tradicional.

Devido às suas características (nomeadamente natureza do negócio, oportunidades de investimento, estrutura do governo da empresa, rentabilidade), as empresas apresentam diferentes necessidades no que diz respeito às suas estruturas de capitais.

Assim, este estudo tem como objetivo perceber quais são as características de uma empresa que influenciam a sua probabilidade de apresentar dívida líquida negativa. Esta análise é realizada através da aplicação de um modelo *probit* a uma amostra de empresas cotadas dos Estados Unidos para o período entre 2003 e 2017. Analisando os resultados da estimação é possível perceber quais são os determinantes da dívida líquida negativa.

Apesar de haver muitos estudos que se centram na análise da estrutura de capitais, *cash holdings* e dívida, não se pode dizer o mesmo relativamente à dívida líquida negativa, o foco desta dissertação. Assim, esta dissertação contribui para o aumento da literatura relacionada com este tema.

Os resultados do estudo evidenciam uma relação positiva e significante entre a probabilidade de uma empresa ter dívida líquida negativa e a volatilidade dos seus *cash flows* e a taxa de imposto que esta suporta. Pelo contrário, verifica-se uma relação negativa e significante entre essa probabilidade e o tamanho da empresa, a intangibilidade dos seus ativos, a preponderância dos seus ativos dos seus ativos não correntes nos seus ativos totais e o montante de substitutos do *cash*. Para além disso, constata-se que o setor no qual uma empresa opera também tem influência na sua probabilidade de ter dívida líquida negativa.

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1. Introduction

Firms may fund their investment projects with retained earnings, debt and equity. What determines their financing decisions? And the gold question: what is the capital structure that maximizes firm's value?

According to Passov (2003), firms can have both an optimal level of positive net debt and an optimal level of negative net debt. The author questions whether firms' value is higher when they adjust their capital structures to the optimal level of positive or negative net debt.

Traditionally, and according to the popular trade-off theory (for example, Kraus and Litzenberger, 1973; Scott, 1976), firms adjust their capital structures so that the marginal benefits and costs of debt are balanced. An optimal capital structure that leads firms to hold large amounts of cash may lead them to present a negative net debt, which conflicts with that traditional approach.

Firms which have negative net debt are a case apart because they to a large extent renounce to most if not all the advantages of debt (note that firms with negative net debt may still have some level of debt, although it is lower than the amount of cash) - tax advantage and management control - and become more vulnerable to information asymmetry and agency costs between managers and shareholders because managers have control over the firm and therefore they can use firm's funds according to their own will (Jensen, 1986) and shareholders cannot track the cash such as when the firm has debt and they know that the firm's funds are used to pay interest. Thus, a question arises: What leads firms to have negative net debt?

Due to their particular characteristics, firms have different needs in terms of capital structure. For example, Passov (2003) evidences that firms having large intangible assets are quite unstable and cannot be easily valued. It makes them more susceptible to financial distress than firms with a majority of assets to be tangible. This way, due to the risk of their businesses, they cannot get external financing so easily or it can be excessively expensive. To deal with it, these firms could maintain large amounts of cash which leads them to present negative net debt. In addition, in such firms most of their value relates to growth opportunities associated with intangible assets and R&D and their ability to keep on investing in such assets as a condition to preserve firm´s value. As a consequence, those firms will desire to maintain the value of such assets intact by keeping low levels of debt and possibly negative net debt to ensure the absence of restrictions to their continuous investment in R&D and intangible assets.

This way, the purpose of this study, in accordance with Passov's (2003) hypothesis, is to analyze how firms' characteristics influence their probability of having negative net debt. More specifically, using a sample of US-listed firms for the 2003-2017 period, this study aims to calculate the probability of a firm having negative net debt taking into account its characteristics and to discuss on the reasons for it. Analyzing the estimation results of the probit model it is possible to realize what are the determinants of negative net debt. In other words, firm-related characteristics leading it to have negative net debt are identified.

There are many studies focusing on capital structure, cash holdings, and debt, but not on net debt that is the focus of this dissertation. To evaluate a firm's financial situation and to calculate the firm value, it is important to look not only to the amount of debt or to the amount of cash on its balance sheet because a firm can have high debt but still not be in a poor financial situation since it may also have large amounts of cash. This way, it is useful to look to both, using the net debt. This dissertation contributes to increasing the literature on this subject.

Besides this section, this report is organized as follows: in Section 2, a literature review related to the subject of this dissertation is developed. In section 3, the methodological aspects are described. In section 4, the analysis of the estimation results is developed and, lastly, the conclusions and future research suggestions are advanced in section 5.

2. Literature Review

In this section, will be presented the literature review of the prominent theories that have been advanced to explain firms' capital structure and cash holdings, the theoretical motives that lead firms to hold cash and the determinants of negative net debt.

Section 2.1 exposes the capital structure theories as well as an approach about cash holdings for each of them. It starts with the irrelevance theory of Modigliani and Miller (1958), followed by the main theories of capital structure: *Trade-off Theory*, *Pecking Order Theory, Agency Costs Theory*, and *Market Timing Theory*. Section 2.2 contains the theoretical motives for cash holdings. Section 2.3 reports a summary of previous empirical studies. Lastly, section 2.4 presents a review of the determinants of capital structure and cash holdings pointed out in the literature and introduces the hypotheses under study.

2.1. Capital Structure Theories

Capital structure is the combination of equity and debt that firm uses to finance its overall operations. It should be chosen considering firm's investments and their expected future cash flows since this choice may influence the value of the firm (Myers, 2001).

Since Modigliani and Miller (1958) proposed their capital structure irrelevance principle, this has been one of the themes of corporate finance that has received a lot of attention from researchers. Thus, several theories have been advanced to explain the capital structure. However, as mentioned by Myers (2001, p. 81):

> *"There is no universal theory of the debt-equity choice, and no reason to expect one. There are several useful conditional theories, however."*

In the following subsections will be explained the theorem of Modigliani and Miller (1958) and the main theories triggered by it, namely *Trade-off Theory*, *Pecking Order Theory, Agency Costs Theory* and *Market Timing Theory*.

2.1.1. Modigliani and Miller Contributions

To understand what influences firms' financing decisions, Modigliani and Miller (1958) advanced their theorem of the capital structure irrelevance. It argues that, under the assumption of perfect and frictionless capital markets, firm's value and cost of capital are independent of the combination of debt and equity of its capital structure.

As in efficient and perfect markets the costs of different financing options do not vary independently, firms have no incentive to switch between equity and debt (Baker and Wurgler, 2002).

However, the assumption of perfect markets is too strong, implying unrealistic assumptions, such as no taxes; no agency, transaction and bankruptcy costs; no financing restrictions; no arbitrage opportunities; perfect market competition; and homogeneous expectations of investors.

Consequently, this theorem is not valid in the real world. The existence of taxes and market imperfections entails that firms' financing decisions influence their value and cost of capital (Myers, 2001).

Despite this theorem is not realistic, it contributes theoretically to the development of other theories. Afterwards, Modigliani and Miller (1963) presented a correction of their first work where they relax the assumption of no taxes and thus they considered the impact of tax shields associated with debt on the firm value and on the cost of capital. This way, they have begun to consider that the capital structure is relevant to the firm's value.

Thus, based on the Modigliani and Miller (1958) theorem, but considering that financing decisions affect firm value and cost of capital, other theories have emerged. Myers (2001) says that the main reasons why financing is relevant are taxes, asymmetric information, and agency costs and that the differences between capital structure theories are related with the importance they give to these aspects. Following will be presented these theories.

2.1.2. Trade-Off Theory

The trade-off theory arose after the theory of irrelevance of Modigliani and Miller (1958) which assumes a complete and perfect capital market. Afterwards, relaxing the assumption of no taxes, Modigliani and Miller (1963) turned to consider their effect on capital structure.

Thereafter, the expected bankruptcy costs were incorporated into the firm's financing decisions, thus emerging the trade-off theory proposed by Kraus & Litzenberger (1973). This way, it includes the impact of market imperfections, namely taxes and bankruptcy costs. As stated by Kraus and Litzenberger (1973, p. 911):

> *"The taxation of corporate profits and the existence of bankruptcy penalties are market imperfections that are central to a positive theory of the effect of leverage on the firm's market value."*

According the trade-off theory, firms choose the combination of equity and debt that maximizes their value. The attainment of that optimal capital structure implies the existence of a balance between benefits and costs of debt and equity financing. This way, to set the amount of debt of its capital structure, firm considers the tax benefits - tax shields - resulting from debt, but also the debt-related bankruptcy costs (Myers, 1984). These costs result from the fact that more debt entails more debt obligations - payment of reimbursements and interest payments - that, if not fulfilled, may lead to bankruptcy. So, raising the level of debt implies a higher probability of firms incurring in bankruptcy costs (Scott, 1976).

Abeywardhana (2017) explains that the trade-off theory postulate that all firms have an optimal debt ratio at which the tax shield equals the financial distress cost. However, that optimal ratio changes over time due to variations in benefits and costs of debt. As a mismatch between them represents a loss in firm's value, Elliott et al. (2008) explicate that firms should adjust their capital structure periodically until they reach their optimal debt-to-equity ratio (dynamic trade-off theory).

However, the change from one capital structure to another implies firms incurring in adjustment costs (Myers, 1984). This way, firms will act to eliminate the deviation only occasionally, in the cases where the net benefit of adjustment outweigh the cost (Fischer et al., 1989) (*Apud* Strebulaev, 2007).

According to Myers (2001, p. 81):

> *"The tradeoff theory says that firms seek debt levels that balance the tax advantages of additional debt against the costs of possible financial distress. The tradeoff theory predicts moderate borrowing by tax-paying firms."*

Trade-off theory notes that there is an incentive for firms to have a moderate level of debt, but it is not sustained by empirical studies. Wald (1999) and Myers (2001) found that most profitable companies are the ones presenting lower debt-equity ratios.

Myers (2001) clarifies that, in general, industry debt ratios are low or negative when profitability and business risk are high. This is because profitable firms generate the necessary cash-flow to finance themselves and high business risk increases the probability of financial distress, which means that it is more difficult to obtain financing and hence firms are led to present lower debt ratios.

Even presenting this weakness, the trade-off theory still be one of the dominant theories explaining firms' capital structure, being presented considering other factors. It can

include the agency costs as a cost of debt (Jensen and Meckling, 1976; Jensen, 1986) to explain why firms do not have moderate debt ratios as would be expected.

Addressing this theory from the cash holdings perspective, it also proposes the existence of an optimal level of cash holdings that maximizes the firms' value by balancing the benefits and costs of holding cash (Ferreira and Vilela, 2004; Sola et al., 2013).

According Keynes (1936), Ferreira and Vilela (2004) and Sola et al. (2013), the cash holdings' benefits are related to the fact that they can be used as a precaution against unexpected capital needs (precautionary motive), can be used to finance the firms' operational cycle (transaction motive), and can be used to avoid the loss of profitable investments (underinvestment). These motives are explained in more detail in section 2.2.

The costs of hold cash are related with the opportunity cost of holding cash (Ferreira and Vilela, 2004; Sola et al., 2013) and with the agency costs between managers and shareholders (Jensen, 1936; Sola et al., 2013). The latter is explained in section 2.1.4.

2.1.3. Pecking Order Theory

The Pecking Order Theory (Myers and Majluf, 1984) is based on the concept of asymmetric information to explain firm's capital structure.

This theory assumes that there are three sources of financing: retained earnings, debt, and equity and it suggests the existence of a hierarchy between them because of adverse selection costs. According to Myers (2001, p. 81):

> *"The pecking order theory says that the firm will borrow, rather than issuing equity, when internal cash flow is not sufficient to fund capital expenditures. Thus, the amount of debt will reflect the firm's cumulative need for external funds."*

This order is a result of the existence of asymmetric information between managers and investors. The asymmetry of information arises from the fact that managers or more broadly that insiders have access to private information about the characteristics of the firm's return or investment opportunities that outside investors have not access to (Harris and Raviv, 1991). However, according to Ross (1977), when a firm faces an investment opportunity, the choice of the financing source signals to outside investors the information of insiders (Signalling theory).

If the company is profitable, it has higher retained earnings, so it will not need to issue debt or equity and it will keep its flexibility for future financing needs.

However, if external financing is required, the firm must support issuance costs – higher in the case of equity issuances. Thus, the firm will first issue debt giving a signal of confidence to the market (Frydenberg, 2004) (*Apud* Abeywardhana, 2017), since it means that firm expects it will be able to meet debt obligations, at least. On the contrary and as stated by Myers and Majluf (1984), if investors are less well-informed than insiders about the firm's assets value, equity issues will not be well perceived by the market because it can be interpreted as a signal of stocks overvaluation and consequently a decrease in share's price of the firm can be triggered. This way, the firm will issue equity only when it has no capacity to raise its debt (Myers, 1984).

Summarizing, asymmetric information leads managers to create an order of preference in the use of financing sources. "*It is generally better to issue safe securities than risky ones*" (Myers and Majluf, 1984, p. 219), therefore firms prefer internal financing to external funding and debt to equity when they face an investment opportunity (Myers, 1984).

Thus, under the Pecking Order Theory, there is no optimal capital structure because "*there are two kinds of equity, internal and external, one at the top of the pecking order and one at the bottom*" (Myers, 1984, p. 581).

This theory assumes that managers act in the interest of existing shareholders of the firm so that they may renounce good investments rather than issue equity to finance them (Myers and Majluf, 1984). They do it to avoid the negative market reaction to new equity issuances (Myers, 2001; Dittmar and Thakor, 2007)[1]. However, this assumption is one of the criticisms of this theory because it does not consider the influence of agency costs, in particular, the financing consequences of managers' superior information (Myers, 2001).

Regarding the cash holdings perspective, the theory also suggests that firms do not have a target cash level and that, as first order, they should use retained earnings, then debt and, lastly, equity.

This way, the theory argues that firms must accumulate cash that can be used to finance investments when retained earnings are not sufficient. In the other cases, when retained earnings are sufficient, firms can use them to repay debt and to accumulate cash (Opler et al., 1999; Ferreira and Vilela, 2004). This way, firms avoid using external financing and, consequently, avoid asymmetric information costs and higher financing costs triggered by this type of financing (Opler et al., 1999).

[1] See also Hovakimian and Hutton (2010).

2.1.4. Agency Costs Theory

Jensen and Meckling (1976) and Jensen (1986) defended that agency costs influence firms' financing decisions and that they are, thus, a determinant of capital structure.

Agency costs are related to the separation between ownership and management. They arise because of the existence of conflicts of interest and information asymmetry between managers, debtholders and shareholders. An increase of debt decreases the costs between management and shareholders but increases the costs between debtholders and shareholders.

There are agency costs between management and shareholders because of information asymmetry (the first ones know more about the real value of the firm's current assets than the second ones) and when shareholders have little control over managers. As the interests of managers and shareholders are not the same, managers can put the funds of the firm on investments that has no advantages for shareholders, or they can put their own interests above shareholders' interests, maximizing their own wealth against shareholders' wealth. Moreover, Harris and Raviv (1990) argue that managers want always to continue operations even if liquidation is preferred by investors. These situations lead shareholders incurring costs to control the activities of managers, namely regarding free cash-flows management (Jensen and Meckling, 1976).

One way of doing it is resorting to debt. It reduces the agency costs since by increasing the debt, managers "[…] *give shareholder recipients of the debt the right to take the firm into bankruptcy court if they do not maintain their promise to make the interest and principle payments. Thus debt reduces the agency costs of free cash flow by reducing the cash flow available for spending at the discretion of managers. These control effects of debt are a potential determinant of capital structure"* (Jensen, 1986, p. 324). However, although debt creates discipline in the use of the available cash-flows and therefore it resolves the overinvestment conflict, an increase on leverage intensifies the bankruptcy costs and increases the funds allocated to debt payments. Thus, the funds available to invest on profitable investments are reduced and, consequently, firm can be conducted to underinvestment situations (Stulz, 1990). Considering it, and as outlined by Jensen (1986), Stulz (1990) defends an optimal debt-equity ratio that maximizes firm value in the point where the benefits outweigh the costs of debt.

Regarding agency costs between debtholders and shareholders, they are related to the exposure of debtholders to the risk of wealth expropriation by shareholders. Debtholders cannot control where will firms invest, so, if shareholders decide to invest in risky projects and then they fail, debtholders will be harmed because they have to support high losses.

Shareholders can make investments that increase the risk of the firm, but debtholders can take measures to minimize interest conflicts (Jensen and Meckling, 1976), for example, by using covenants, protective put or convertible bonds. This way, an increase of debt decreases flexibility to invest in profitable projects.

Regarding to cash, firms are led to accumulate it for precautionary reasons, since the existence of asymmetric information and agency costs makes external financing more expensive (Opler et al., 1999). However, as mentioned before, managers may accumulate excessive amounts of cash so that they have more resources under their domain (Jensen, 1986). In this way, they can assume a more compliant position and use the cash at their convenience even if it does not match the shareholders' interests (Opler et al., 1999; Ferreira and Vilela, 2004). Nevertheless, to discipline managers and to reduce the agency costs, shareholders can resort to debt, as explained above.

According Jensen (1986), conflicts of interest are particularly strict when a firm generates considerable free cash flow.

2.1.5. Market Timing Theory

The market timing theory is an empirically inspired theory that was proposed as an alternative to classic theories about firms' capital structure. Its key idea is that firms' capital structure is strongly related to market conditions, specifically market values and their fluctuations (Zavertiaeva and Nechaeva, 2017).

The theory assumes that, when firms must take financing decisions, managers analyze the conditions in both debt and equity markets to determine which one is more advantageous (Frank and Goyal, 2009). In other words, this theory states that a firm can raise additional capital when market conditions are favourable for a specific type of capital (Zavertiaeva and Nechaeva, 2017).

According to this theory, firms measure the market timing opportunities based on the market-to-book ratio. It argues that when the firms' market values are high compared with their book and past values (high market-to-book ratio) it is more probable firms issue equity, and when market values are low (low market-to-book ratio) they probably repurchase equity. It assumes the existence of a strongly negative correlation between leverage and historical market values (Baker and Wurgler, 2002). In the words of Baker and Wurgler (2002, p. 29):

"*Low-leverage firms tend to be those that raised funds when their valuations were high, and conversely high-leverage firms tend to be those that raised funds when their valuations were low.*"

It is supported by Graham and Harvey (2001) that the amount by which firms' stock is undervalued or overvalued is a factor affecting the decision of firms about issuing equity. Thus, the fluctuation in the price of shares affects corporate financing decisions and, consequently, the capital structure of the firm.

Baker and Wurgler (2002) argue that by acting in accordance with this market timing practice, firms intend to exploit a *window of opportunity*. To put in another way, firms intend to take advantage of temporary fluctuations in the cost of equity relative to the cost of other forms of capital, which, as mentioned before, has important implications for capital structure choices. Elliott et al. (2008) also say that successful timing of the equity market lowers the firms' cost of equity and benefits current shareholders at the expense of new ones.

It happens because market timing theory assumes that markets are inefficient, so it admits the existence of asymmetry of information and, therefore, that managers have inside information. Thus, according to this theory, managers will issue shares to finance investments or to build slack particularly when they perceive that firm is overvalued. This way, current shareholders benefit at the expense of new ones (Baker and Wurgler, 2002; Elliott et al., 2008). However, outside investors realize it and, consequently, discount the share price of the firm (Myers and Majluf, 1984), what lead managers to issue equity only when the benefit of the overvaluation based on internal information is expected to exceed the expected price discount following issuance.

Besides that, Baker and Wurgler (2002) detect that fluctuations in market valuations have considerable and permanent effects on capital structure of firms, so they defended that current capital structure is strongly related to historical market values, being "[…] *the cumulative outcome of past attempts to time the equity market*" (Baker and Wurgler, 2002, p. 27).

Thus, this theory is not associated with the existence of an optimal capital structure.

This theory presents some dissenting points regarding the classic theories. The trade-off theory suggests that the effects of fluctuations in the market-to-book ratio are temporary because eventually firms capture these changes and adjust their capital structure. However, Baker and Wurgler (2002) found evidence that the effects derived from variations in the market-to-book ratio are permanent. The pecking order theory presents some similarities with market timing theory such as not admitting the existence of an optimal capital structure and exploiting asymmetric information to benefit current shareholders. However, these

theories also present some differences, as regarding the determinant of leverage. The pecking order theory anticipate that leverage is positively affected by future investment opportunities, while the study performed by Baker and Wurgler (2002) demonstrate that historical values of market-to-book ratio have a much greater impact on leverage.

In short, this theory argues that firms make their financing decisions according to the market conditions and stock returns, being this latter factor – stock returns - pointed out by Welch (2004) as the first order determinant of debt ratios.

Concerning cash holdings, Dittmar (2008) proposes that the fluctuations regarding stock repurchases are explained by variations in the profits and cash flows of firms. Besides that, he argues that these variations are a consequence of the increase in cash held by firms.

Bolton et al. (2013) states that holding cash is one way for rational firms to adapt to market fluctuations.

2.2. Theoretical Motives for Cash Holdings

In the literature related to cash holdings, there is a set of theories that are the basis of some empirical studies carried out in this area. Weidemann (2017) identifies two general categories of theories: capital structure theories (Keynes, 1936) and theories focused on agency conflicts between managers and investors (Jensen, 1986; Harford, 1999).

Keynes (1936) and Opler et al. (1999) point out two main reasons for firms hold cash: transaction and precautionary motives. The first one is related to the cash that firms need to have promptly available to bridge the gap between the time when cash is needed and when it is available. This gap is inherent in the operational and financial cycle of firms and, to deal with it, they can accumulate enough cash and avoid incurring costs of external financing and/or liquidation of assets, since it is costlier than retain cash internally. The second one is based on the idea of firms hold cash to resort in case of unexpected events or to finance their activities and investments when they generate a very low cash flow and alternative sources of financing are unavailable or are extremely costly. Opler et al. (1999) studies emphasize that firms accumulate excess cash for precautionary reasons because the cost of failing an investment opportunity due to lack of financing is costlier than the tax disadvantage of holding cash.

Harford (1999) suggests that the increase in the cash reserves is linked to agency problems. This way, agency-based theories recognize the threat of having an outside manager holding cash to go ahead with its own goals at the expense of the shareholders (Opler et al.,

1999). In addition, and despite the agency conflicts that it triggers, these theories predict an increase in cash holdings when firms face liquidity limitations. This happens because firms will prevent against a shortfall of funds since a positive investment opportunity may emerge and they do not want to take the risk of facing an underinvestment situation.

2.3. Empirical Studies

Most of the studies developed in the finance area discuss the capital structure or the cash holdings of firms, but not both. However, net debt, the focus of this dissertation, is jointly influenced by debt and by cash. Thus, in this section will be presented a review of the specifications and findings of the main studies developed for both capital structure and cash holdings.

Table 1 - Similar Studies

Author (year)	Sample	Period under analysis	Methodology	Findings
CAPITAL STRUCTURE				
Wald (1999)	Firms from France, Germany, Japan, UK and US	Either 1991 or 1992	Heteroskedastic tobit regressions	There is an association between leverage and eight factors, being consistent across countries for moral hazard (+), tax deductions (-), R&D (-), profitability (-). However, he found different effects in different countries regarding risk (-), growth (-), firm size (+), and inventories (+), being these last signals the ones found for US.
Fama and French (2002)	More than 3000 firms (an average of 1618 firms per regression)	1965-1999	Time series of annual cross-section regressions	Leverage is associated with profitability (-), investment (+/- with regard to book leverage and – with regard to market leverage), firm size (+), volatility (-), and nondebt tax shields (-).
Frank and Goyal (2009)	Publicly traded American firms	1950-2003	Linear regression models	Leverage is associated with size (+), market-to-book ratio (-), median industry leverage (+), tangibility (+), profits (-), expected inflation (+), and dividend payment (-).
Öztekin (2015)	15177 firms from 37 countries	1991-2006	Dynamic panel data model	Leverage is associated with firm size (+), tangibility (+), industry leverage (+), profitability (-), and inflation (-). Furthermore, the results indicate associations between leverage and the institutional indexes, actual debt and equity transaction costs, and cross-country differences in adjustment speeds.
CASH HOLDINGS				

Kim et al. (1998)	US industrial firms	1975-1994	Pooled time-series cross-sectional regression	Cash levels are associated with size (-), growth opportunities (+), cash flows volatility (+), and profitability of productive assets (-).
Opler et al. (1999)	Publicly traded US firms	1971-1994	Linear regression models	Cash levels are associated with size (-), growth opportunities (+), and activity risk (+).
Ferreira and Vilela (2004)	Economic and Monetary Union countries	1987-2000	Cross-sectional regressions	Cash levels are associated with investment opportunities (+), cash flows (+), substitutes for cash (-), leverage (-), size (-), bank debt (-), investor protection (+), and capital markets development (-).
Ozkan and Ozkan (2004)	UK firms	1984-1999	Dynamic panel data model	Cash levels are associated with ownership structure, families control over firm (+), cash flows (+), growth opportunities (+), liquid assets (-), leverage (-), and bank debt (-).
Teruel and Solano (2008)	Spanish SMEs	1996-2001	Panel data models – General Method of Moment (GMM)	Firms have a target level of cash holdings according to which adjust their level; Cash levels are associated to bank debt (-), growth opportunities (+) although with little impact, short-term debt (+), information asymmetry (+) and capacity to generate cash flows (+), substitutes for cash (-), and interest rates (-) although limited impact.

Source: Author's Elaboration

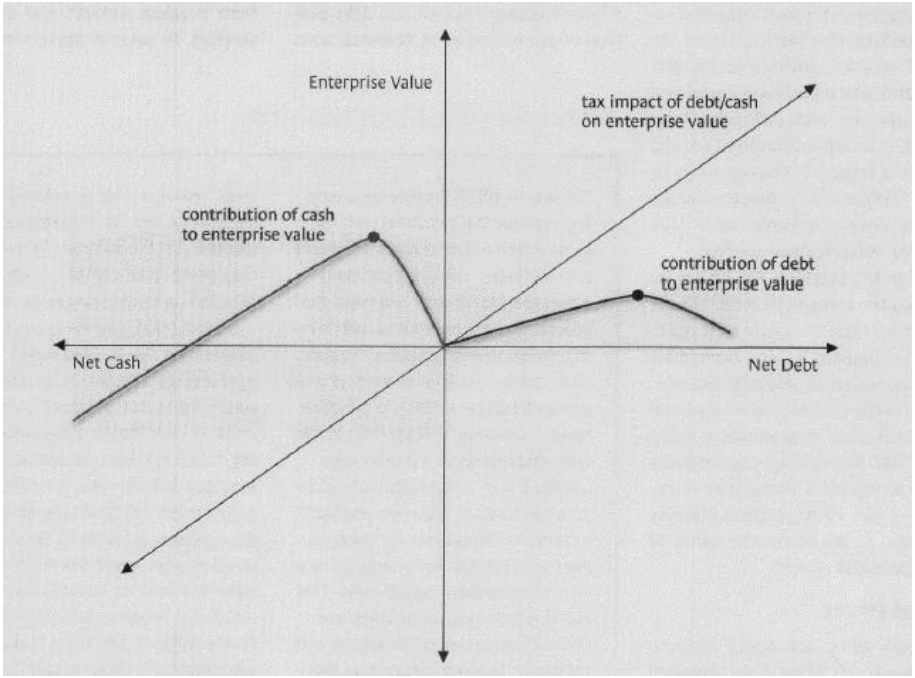
2.4. Determinants of Negative Net Debt–Theoretical Foundations and Hypotheses

Before moving forward, it is necessary to clarify that net debt is given by the total amount of debt minus the amount of cash and short-term investments of a firm. In other words, it represents the quantity of debt remaining on the balance sheet of a firm if it uses all its cash and investments easily converted in cash to pay its debt obligations. This way, net debt is jointly influenced by the determinants of debt as well as by determinants of cash.

Considering it, firms can assume a net cash (negative net debt) or a positive net debt position, what influences their value. For some firms, the capital structure that maximizes the firm's value lays on the net cash curve evidenced in figure 1. It means that, for those firms, the contribution of the insurance value of cash is greater than the contribution of the

tax shields of debt. As mentioned before, it can result from the influence of several determinants affecting both debt and cash holdings.

Figure 1 - Net Cash and Net Debt Contributions to Enterprise Value



Source: Passov (2003)

As is displayed in figure 1, saying that a company has negative net debt is the same as saying that it has positive net cash. Although in some contexts there are differences between negative net debt and cash (see Acharya *et al.* (2007), Gamba and Triantis (2008), and Acharya *et al.* (2012)), these terms will be used indistinctly throughout this dissertation, as is also assumed in the study of Strebulaev and Yang (2013).

Next, we present an analysis of the determinants of negative net debt developed taking into consideration the theories of capital structure and cash holdings and similar studies. Alongside, the hypotheses to be tested in this study are proposed. The determinants and the direction in which they are expected to affect negative net debt are reported in table 2.

Table 2 - Determinants and Relation to Negative Net Debt

Variables	Relation	Theory	Authors
Sector	-	-	Myers (1984); Passov (2003); Dittmar and Smith (2007); Frank and Goyal (2009); Strebulaev and Yang (2013);
Size	Negative	Trade-off, Agency costs	Harris and Raviv (1991); Rajan and Zingales (1995); Opler et al. (1999); Fama and French (2002); Almeida et al. (2004); Ferreira and Vilela (2004); Frank and Goyal (2009); Hadlock and Pierce (2010);
Profitability	Positive/Negative	Trade-off, Pecking Order	Myers and Majluf (1984); Kim et al. (1998); Wald (1999); Opler et al. (1999); Dittmar et al. (2003); Ozkan and Ozkan (2004); Ferreira and Vilela (2004); Teruel and Solano (2008); Frank and Goyal (2009);
Growth Opportunities	Positive	Pecking Order, Market Timing	Jensen and Meckling (1976); Stulz (1990); Kim et al. (1998); Opler et al. (1999); Fama and French (2002); Ferreira and Vilela (2004); Ozkan and Ozkan (2004); Frank and Goyal (2009);
Volatility	Positive	Trade-off, Market Timing	Kim et al. (1998); Opler et al. (1999); Wald (1999); Bates et al. (2009);
Investment Activity	Positive	Pecking Order	Eriotis et al. (2007); Weidemann (2017);
Intangibility	Positive	Pecking Order	Rajan and Zingales (1995); Wald (1999); Passov (2003); Bates et al. (2009); Frank and Goyal (2009);
Noncurrent Assets	Negative	Pecking Order	Chittenden et al. (1996);

Debt Maturity Structure	Negative	Trade-off, Pecking Order	Hovakimian et al. (2001); Guney et al. (2003); Ferreira and Vilela, (2004); Teruel and Solano (2008); Dangl and Zechner (2016);
Dividend Policy	Positive/Negative	Pecking Order	Opler et al. (1999); Dittmar et al. (2003); Bates et al., 2009); Frank and Goyal (2009);
Cash Substitutes	Positive/Negative	Pecking Order	Harris and Raviv (1991); Ozkan (2001); Guney et al. (2003); Ozkan and Ozkan (2004); Teruel and Solano (2008);
Board Structure			
Board Size	Positive/Negative	Agency Costs	Yermack (1996); Klein (2002); Anderson (2004);
Independence of Board Members	Negative	Agency Costs	Anderson (2004);
Tax Rate	Negative	Trade-Off	Graham (1996); Opler et al. (1999); Antoniou et al. (2008); Frank and Goyal (2009); Faulkender and Smith (2010).

Source: Author's Elaboration

(i) Sector

The industry is a characteristic that can be appointed as a determinant of negative net debt because it impacts both the amount of debt in firms' capital structure (Myers, 1984; Frank and Goyal, 2009; Strebulaev and Yang, 2013) and the amount of cash held by firms (Dittmar and Smith, 2007).

Myers (1984) argue that debt ratios differ according to the industry because firms belonging to different industries also present differences concerning to the asset risk, the type of assets used and the external financing needs. Frank and Goyal (2009) evidence that firms leverage is positively affected by the median leverage of their industries. Strebulaev and Yang (2013) demonstrate that the behavior of the firms regarding to the decision of having

zero-leverage is driven by industry-specific factors. Dittmar and Smith (2007) identified different levels of cash holdings according to industries.

Passov (2003) argues that industries highly dependent on intangible assets are most vulnerable to financial distress. So, to avoid a loss of value resulting from non-investment in their intangible assets, firms operating in these industries keep larger amounts of cash as a way to protect themselves against an eventuality and credit limitation. Knowledge firms, particularly technological and life science firms, are the ones he identifies as being highly dependent on intangible assets. This way, it is possible hypothesize that:

H1: Negative net debt is affected by the industry where the firm operates.

(ii) Size

In literature, firm size is mentioned as a determinant of both debt and cash, so this is certainly a determinant of negative net debt.

It is suggested that leverage increases with firm size (Harris and Raviv, 1991; Frank and Goyal, 2009; Öztekin, 2015) and cash holdings are negatively affected by firm size (Opler *et al.*, 1999; Ferreira and Vilela, 2004). So, ceteris paribus, negative net debt (net cash) would decrease with firm size.

It is evidenced that firm size is a good predictor of financial distress, financial constraint, and information asymmetry. Smaller firms are more likely to suffer financial distress (Rajan and Zingales, 1995) and to be financially constrained (Hadlock and Pierce, 2010), so they tend to keep larger amounts of cash (Almeida *et al.*, 2004) and not to increase their leverage. On the contrary, larger firms may be able to get debt at a lower cost than smaller firms (Fama and French, 2002) because they face less information asymmetry and agency costs than the smaller ones in such way that they take more leverage. On the basis of these arguments, it is possible to admit the following hypothesis:

H2: Negative net debt is negatively affected by firm size.

(iii) Growth Opportunities

Empirical studies (Kim *et al.*, 1998; Opler *et al.*, 1999; Ferreira and Vilela, 2004; and Ozkan and Ozkan, 2004) have shown that the existence of growth opportunities positively affects the level of cash. Moreover, Jensen and Meckling (1976), Stulz (1990), Fama and French (2002) and Frank and Goyal (2009) say that firms with improved growth opportunities are expected to present lowest amounts of debt.

As it is uncertain that growth opportunities are successful, firms presenting more growth opportunities are likely to face higher financial distress and bankruptcy costs. These firms also have higher information asymmetry (Ozkan and Ozkan, 2004) and agency costs (Myers, 1977). Consequently, they face higher external financing costs (Myers and Majluf, 1984) which can lead them to underinvestment situations by leaving behind positive investment opportunities.

This way, to avoid such situations, these firms are expected to maintain larger amounts of cash and thus avoid incurring external financing costs and/or assets' liquidation since it is more expensive than retaining cash internally.

Thus, it is hypothesized that:

H3: Negative net debt is positively affected by growth opportunities.

(iv) Profitability

The effect of profitability on net cash is more ambiguous.

Myers and Majluf (1984) argue that in the presence of information asymmetry firms prefer resort to internal funds than to the debt market to finance themselves, which leads profitable firms to maintain higher cash levels and to have less debt. This way, they predict a negative relationship between profitability and debt, as it is also evidenced by Öztekin (2015) and by Wald (1999) and Frank and Goyal (2009) for the US market.

Furthermore, there are authors (Opler et al., 1999; Dittmar et al., 2003; Ozkan and Ozkan, 2004; Ferreira and Vilela, 2004; Teruel and Solano, 2008) who argue that the capacity of firms to generate cash flow has a positive relation with cash holdings due to the preference of firms for internal financing. This way, they keep higher amounts of cash to prevent underinvestment. This way, all these authors predicted a positive association between profitability and negative net debt. However, there are few studies (e.g. Kim et al., 1998) that verified a negative association between profitability and cash holdings. They explain that cash flow can be seen as a cash substitute since it is a source of additional liquidity for firms.

Hence, it is hypothesized the existence of an association between net debt and profitability, but nothing about its direction. Thus:

H4: Negative net debt is affected by profitability, but the sign is ambiguous.

(v) Volatility

The volatility of cash flows has also been a factor pointed out by researchers as having a negative relation with debt (Wald, 1999) and a positive relation with cash holdings (Kim et al., 1998; Opler et al., 1999; Bates et al., 2009). They found evidence that firms hold cash to protect themselves against adverse cash flow shocks, which is even more pronounced in the case of riskier firms. It happens because, as evidenced by Passov (2003), the extent of value loss caused by a financial distress is positively associated with the firm's asset volatility, that is, with the firm's underlying business risk.

Thus, it is hypothesized that:

H5: Negative net debt is positively affected by volatility.

(vi) Investment Activity

The influence of investment activity on debt and cash levels is in line with what is expected to happen with growth opportunities.

Firms with larger investment activities demand more for financing (Weidemann, 2017). Thus, they are presumed to keep higher amount of cash to alleviate the risk of underinvestment, in particular when they face financial distress and when their profitability or the availability of liquidity substitutes decrease.

In addition, these firms should use less debt to avoid underinvestment costs incurred as a result of debt-overhang situations. This means that firms should use less debt than its borrowing limit in order to have the flexibility to resort to debt in the future when additional capital is needed to take advantage of good investment opportunities (Eriotis et al., 2007).

This way, it is hypothesized that:

H6: Negative net debt is positively affected by the magnitude of firm's investment activity.

(vii) Intangibility

The type and the proportion of assets owned by a firm are also pointed out in the literature as a determinant of leverage and cash held by a firm.

Rajan and Zingales (1995), Wald (1999), and Frank and Goyal (2009) argue that firms with a higher preponderance of tangible assets tend to have higher leverage because they can use those assets as a collateral and it makes creditors more willing to lend their funds.

Passov (2003) evidences that firms having large intangible assets are highly volatile and cannot be easily valued. It makes them more susceptible to financial distress than firms with a majority proportion of tangible assets. Thus, these firms cannot get external financing so easily or it can be excessively expensive. To deal with it, they tend to hold large amounts of cash (Bates et al., 2009).

Thus, it could be hypothesized that:

H7: Negative net debt is positively affected by assets' intangibility.

(viii) Noncurrent Assets

Ceteris paribus, the more cash the firms hold, the lower the proportion of noncurrent assets in total assets, since cash is embedded in current assets.

Noncurrent assets include fixed assets and intangible assets. If the increase in noncurrent assets results from the increase in fixed assets, it is expected the firm increase its debt level since it can obtain financing more easily using those assets as a collateral in the case of financial distress (Chittenden et al., 1996). If the increase results from an increase in intangible assets, the effect on debt will depend on the reliability of those assets to generate cash because they can only support debt if it is proved that the firm will be able to use them to generate future economic benefits.

Thus, the amount of noncurrent assets may exert some influence on negative net debt, but the effect depends on the composition of noncurrent assets.

H8: Negative net debt is affected by the preponderance of noncurrent assets, but the sign is ambiguous.

(ix) Debt Maturity Structure

Debt maturity structure is indicated as influencing the debt level (Hovakimian et al., 2001; Dangl and Zechner, 2016) and the amount of cash held by a firm (Guney et al., 2003; Ferreira and Vilela, 2004; Teruel and Solano, 2008).

The effect of debt maturity on the firm's debt levels depends on the quality of the firm's management and the transaction costs they face.

According to Dangl and Zechner (2016), short debt maturities commit shareholders to leverage reductions. The reason behind it is that short-term maturities require firms renew a larger part of their debt, periodically; therefore, when the firm's profitability decreases, firms dominated by short debt maturities will reduce their debt levels more quickly because

they will not be able to renew that debt. That need to renew maturing bonds frequently, although represents an advantage in the sense it exposes managers to more frequent monitoring, it also leads to higher transaction costs.

On the contrary, long debt maturities eliminate the incentives to voluntarily reduce debt levels in the future. It happens because managers would prefer having a long-term debt to reduce the potential discipline of external monitoring. Hovakimian et al. (2001) points out that long debt maturities seem to be major impediments to debt reductions.

Furthermore, debt maturity structure is appointed as having a negative relation with cash holdings and there are two reasons appointed as being behind it.

The first one concerns with the risk of renewing short-term financing. As mentioned before, firms that rely on short-term debt are obliged to renegotiate their credit terms periodically, becoming exposed to the refinancing risk. Thus, to avoid experiencing financial distress due to the non-renewal of their short-term debt, these firms may want to keep more cash (Guney et al., 2003; Ferreira and Vilela, 2004; Teruel and Solano, 2008).

Besides that, Barclay and Smith (1995) evidence that firms with more problems of information asymmetry are expected to possess more short-term debt. Since the access to external financing is limited as far as firms present information asymmetry, they will keep higher cash holdings (Guney et al., 2003; Teruel and Solano, 2008). Thus, considering that short-term debt is a proxy for the level of information asymmetry, these conclusions are in line with the hypothesis that firms with more predominance of short-term debt are expected to present higher levels of cash holdings.

On the basis of these explanations, it is possible to hypothesize that:

H9: Negative net debt is negatively affected by longer debt maturities.

(x) Dividend Policy

The firm's dividend policy is another factor suggested in the literature as affecting the amount of cash and debt it possesses. This determinant is associated with the precautionary motive for firms hold cash.

Firms that pay dividends are expected to have lower debt levels (Frank and Goyal, 2009) and to hold less cash than nonpayers to the extent that, when needed, they have the option of raise funds easily by cutting dividends (Opler et al., 1999; Dittmar et al., 2003; Bates et al., 2009). This way, they increase funds at low cost, in contrast to firms that do not pay dividends and, for that reason, need to resort to the capital markets to obtain financing. In

addition, dividends-payer firms are likely to be less risky and then have greater access to capital markets (Bates et al., 2009; Frank and Goyal, 2009), while non-payers are considered to be financially constrained (Almeida et al., 2004). Consequently, the latter accumulate cash by precautionary motives (Bates et al., 2009).

However, dividend-paying firms could also keep higher levels of cash in order to ensure that dividends are stable regardless of the short-term cash-flow or profit generation ability of the firm because, as evidenced by Brav et al. (2005), management is extremely reluctant to reducing dividends since there are negative consequences resulting from it.

Thus, it is expected dividend-paying firms rely less on debt than firms that do not pay dividends, but there is no consensus regarding the cash holdings. Consequently, it is hypothesized that:

H10: Negative net debt is affected by firm's dividend policy, but the sign is ambiguous.

(xi) Cash Substitutes

The existence of liquid assets that can be considered as substitutes for cash is another factor indicated in previous studies as presenting a relation with debt and cash holdings levels.

Cash substitutes represent liquidity for a company, and, according to Ozkan (2001), the liquidity of firms exerts a negative impact on firms' borrowing decisions because more liquid firms can use their own funds to finance their investments, do not needing to resort to debt. Furthermore, convert non-cash liquid assets into cash is less costly than to convert other assets. Thus, firms with enough liquid assets may have no need to resort to capital markets to increase funds when they face a scarcity of cash (Ozkan and Ozkan, 2004. Therefore, it is expected the amount of cash substitutes impacts negatively the firm's debt level.

The presence of liquid assets apart from cash can also affect the amount of cash held by a firm, since they can be considered substitutes for cash. Firms holding a higher amount of cash substitutes can liquidate them in the event of a cash shortage; hence they are expected to maintain low cash levels (Harris and Raviv, 1991; Guney et al., 2003; Ozkan and Ozkan, 2004; Teruel and Solano, 2008).

This way, as cash substitutes affect both debt and cash holdings negatively, their relationship with net debt depends on the magnitude of those effects.

H11: Negative net debt is affected by firm's dividend policy, but the sign is ambiguous.

(xii) Board Structure

This determinant is associated with agency conflicts between managers and shareholders, issue explored by the agency costs theory. Insiders are an important source of firm-specific information for the board since they have specialized expertise about the firm's activities. However, they may have incentives to accumulate cash and use it for they own benefit rather than generate wealth for shareholder. For this reason, as stated by Raheja (2005), the presence of independent members in the board assumes an importance role in the monitoring and discipline of management since independent members are considered to comply with the shareholders' interests. This monitoring reduces the agency costs of firms, making them more likely to face a reduction in the cost of external financing (Anderson et al., 2004).

Regarding board size there is no consensus. Some authors defend that larger boards increase monitoring effectiveness and provide greater board expertise (Klein, 2002), but others defend that these larger boards are more inefficient, in particular, concerning to the lengthy decision-making, poor discussions of managerial performance, and resistance to risk-taking (Jensen, 1993; Yermack, 1996).

Anderson et al. (2004) develop a study to examine the influence of board independence and board size in the cost of debt financing. They state that board characteristics influence the reliability of financial reports used by creditors to set the price of firm's debt. This way, board characteristics are of great importance to creditors. They found evidence that the cost of debt is inversely related to board independence and board size.

Boone et al. (2007) evidenced that firms in which managers have ample influence, have less independent boards. Moreover, they concluded that firms in which there are large opportunities for managers to take private advantage of funds or in which the managers' monitoring cost is small, have larger boards.

This way, it is expected that the cash holdings and debt levels of firms to be influenced by their board structure.

Firms with a higher proportion of independent members on the boards are expected to take advantage of the lower cost of external financing and therefore are expected to

increase debt levels and to hold lower amounts of cash. Regarding to the effect of board size, it is uncertain. Thus, it is hypothesized that:

H12: Negative net debt is negatively affected by the percentage of independent board members;

H13: Negative net debt is affected by board size, but the sign is ambiguous.

(xiii) Tax Rate

Tax rate is an aspect pointed out as influencing debt positively (Graham, 1996; Antoniou et al., 2008; Frank and Goyal, 2009; Faulkender and Smith, 2010) and cash levels negatively (Opler et al., 1999).

As postulated by the trade-off theory, tax shields are one of the advantages of debt since interest is deducted from taxable earnings. Thus, firms are expected to raise their debt levels when tax rates are higher (Antoniou et al., 2008; Frank and Goyal, 2009). Although there are alternatives to debt in order to reduce taxable income, namely depreciation and R&D expenditures, and firms benefiting from more non-debt tax shields present lower debt levels in their capital structures as sustain DeAngelo and Masulis (1990), Fama and French (2002) argue that it happens because those firms face lower expected tax rates. Graham (1996) and Faulkender and Smith (2010) develop analysis taking into account these two origins of tax shields and they found that firms are expected to raise their debt levels when tax rates are higher.

Regarding cash holdings, Opler et al. (1999) state that higher tax rates increase the cost of holding liquid assets because these assets present tax disadvantages. Those disadvantages result from the double taxation of interest income - at corporate level and then at personal level as it generates income for shareholders when distributed in the form of dividends. Thus, cash holdings are negatively associated with taxes.

Considering such facts, it is possible hypothesize that:

H14: Negative net debt is negatively affected by tax rate.

3. Methodology and Data

3.1. Methodology

In this section, the methodological aspects are introduced. In subsections 3.1.1, the probit model is exposed and, in subsection 3.1.2, the variables incorporated in the models are described.

3.1.1. Probit Model

To estimate the probability of a firm having negative net debt given certain variables, a binary choice model, in particular a probit model[2], will be used. Through the analysis of its output, it will be possible to estimate the effect of the explanatory variables on the probability of a firm having negative net debt and thus perceive what are the most dominant factors influencing it.

Each observation, y_{it}, where i=1, ..., N and t=1, …, T will take the value 1 if the firm has negative net debt or 0 otherwise. According to Stock and Watson (2007), Verbeek (2012) and Wooldridge (2015), the probit model assumes that:

$$\begin{aligned} \mathrm{P}(\mathrm{y}=1 \mid x) &= \Phi(x\beta) \\ &= \Phi(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_K x_\mathrm{K}), \end{aligned} \tag{3.1}$$

where y is the binary dependent variable, Φ is the cumulative distribution function (cdf) of the standard normal distribution that varies between 0 and 1, x is the vector of explanatory variables (or regressors), and β is the vector of parameters to be estimated, which reflect the impact of changes in x on the probability of a firm having negative net debt.

The probit model can be derived from y^*, an unobserved continuous variable named latent variable that reflects the propensity of a firm to have negative net debt. It is related to a set of regressors that are assumed to be linearly related to y^*, such that:

$$y^* = x\beta + \varepsilon, \quad \mathrm{y}=1 \text{ if } \mathrm{y}^*>0 \tag{3.2}$$

where x is a vector of regressors, β is a vector of parameters to be estimated, and ε is a random error term, which is assumed to be normally distributed with mean of zero and

[2] For details on probit model, see Watson (2007), Verbeek (2012) and Wooldridge (2015), for example.

standard deviation equal to one (Wooldridge, 2015). It is assumed that y takes the value of one if y*>0 and of zero otherwise. The choice of 0 as the limit value is completely arbitrary and has no influence on the results. Taking it into account:

$$P(y = 1|x) = P(y^* > 0|x) = P(\varepsilon > -x\beta|x) = 1 - \Phi(-x\beta) = \Phi(x\beta) \quad (3.3)$$

which is precisely equal to the equation 3.1.

However, since probit is a non-linear model, the estimated coefficients do not have a direct interpretation over the effect that a change in an independent variable has on the probability of a firm having negative net debt. This way, in order to estimate the partial effect of a continuous explanatory variable j on that probability, *ceteris paribus*, it is necessary to rely on the calculations of the partial derivative with respect to x_j (Wooldridge, 2015).

Being

$$\begin{aligned} E(y) &= 1.P(y = 1) + 0.P(y = 0) \\ &= P(y = 1) = \Phi(x\beta) \end{aligned} \quad (3.4)$$

The partial derivative of probability with respect to X_j is given by:

$$\frac{\partial\, E(y)}{\partial x_j} = \frac{\partial\, Prob(y = 1\,|x)}{\partial\, x_j} = \beta_j \phi(x\beta) \quad (3.5)$$

where $\phi(.)$ is the probability density function associated with the standard normal distribution[3].

Thus, it is noted that the marginal effect of a variation in a variable j depends, besides to the associated coefficient, on an identical proportionality factor $\phi(x\beta)$. The marginal effect varies from observation to observation depending on the values of X_{it}.

If x_j is a dummy variable, the marginal effect of a change from zero to one, *ceteris paribus*, is given by:

$$\begin{aligned} &\Phi\left(\beta_0 + \beta_1 x_1 + \cdots + \beta_j \times 1 + \cdots + x_k \beta_k\right) - \\ &\Phi\left(\beta_0 + \beta_1 x_1 + \cdots + \beta_j \times 0 + \cdots + x_k \beta_k\right) \end{aligned} \quad (3.6)$$

[3] The density function associated with the standard normal distribution is given by: $\phi(x\beta) = \frac{1}{\sqrt{2\pi}} e^{-\frac{(x\beta)^2}{2}}$.

Because the density function is non-negative, the marginal effect of x_j will always have the same sign as β_j.

The estimation of the probit model is usually performed by the maximum likelihood method, which consists in maximizing the likelihood function that is given by:

$$\ln L = \sum_{i=1}^{N}\sum_{t=1}^{T}\{(1-y_{it})\ ln[1-\Phi(x_{it}\beta)] + y_{it}\ ln[\Phi(x_{it}\beta)]\} \tag{3.7}$$

3.1.2. Variables and Measures

In the probit model, the dependent variable is qualitative and binary, so it can take only the values 0 or 1, such that:

$$\begin{cases} NDEBT = 1, & if\ the\ company\ has\ negative\ net\ debt \\ NDEBT = 0, & otherwise \end{cases}$$

being net debt measured by the ratio of total debt minus cash and short-term investments to total assets (Bates et al., 2009).

Regarding the independent variables, there are several firm-specific variables used as regressors in this analysis and their selection was carried out considering the determinants mentioned in the literature. A complete description of the calculation formula of those variables is exposed below and displayed in annex 1. The majority of the variables are scaled by a common factor – book value of total assets. Besides that, next, it is presented a brief explanation of the relation of the variables with negative net debt.

The *Sector* variable is denoted by a dummy variable. Each sector has a dummy variable that takes the value of one if the firm belongs to that sector and of zero otherwise. The classification was executed according to TRBC (Thomson Reuters Business Classification) Economic Sector.

Firm Size (SIZE) is measured by the natural logarithm of total assets (Opler et al., 1999; Fama and French, 2002; Ferreira and Vilela, 2004; Ozkan and Ozkan, 2004; Teruel and Solano, 2008). A negative relation between size and negative net debt is expected because smaller firms are more prone to face financing problems, hence they have limited access to

financial markets and tend to keep higher amounts of cash. On the contrary, larger firms can get debt at a lower cost, what leads them to take more debt.

Growth Opportunities (GROWOP) are measured by the ratio of total assets minus book value of equity plus market value of equity to total assets (Ozkan and Ozkan, 2004). A positive relation between growth opportunities and negative net debt is expected since firms with more growth opportunities face higher external costs due to the uncertainty of those opportunities and to agency problems. Consequently, they are expected to keep larger amounts of cash to avoid underinvestment situations.

Profitability (PROFI) is measured by the ratio of EBITDA[4] to total assets (Elliott et al., 2008). The relation of profitability with negative net debt is ambiguous. On the one hand, as firms prefer to fund themselves with internal funds, profitable firms are expected to maintain cash to avoid underinvestment situations and to have lower debt levels in their capital structures. On the other hand, cash flow can be regarded as a cash substitute.

Volatility (VOLATIL) is measured by the ratio of standard deviation of cash flows to the average total assets (Ozkan and Ozkan, 2004). It is expected a positive relation between volatility and negative net debt since firms with higher volatility of cash flows are riskier. This way, they have restrictions on the access to capital markets and they are expected to keep cash to protect themselves against cash flow shocks.

Investment Activity (INVESTACTIV) is measured by the ratio of CAPEX[5] to total assets (Weidemann, 2017). The investment activity is expected to present a positive relation with negative net debt since firms with larger investment activities need more financing. Thus, to alleviate the risk of underinvestment, they are expected to keep more cash and to have low debt levels in order to have the flexibility to undertake future advantageous opportunities.

Intangibility (INTANG) is measured by the ratio of intangibles to total assets minus total current assets. A positive relation between intangibility and negative net debt is expected since intangible assets are highly volatile and cannot be easily valued, making the firms with a large preponderance of intangibles more susceptible to financial distress. Thus, they do not get financing so easily or just at high cost, in contrast to what happens with firms with a higher preponderance of tangible assets since they can use those assets as a collateral.

[4] EBITDA = Earnings before interests, taxes, depreciation and amortization.
[5] CAPEX = Capital Expenditures.

The amount of *Noncurrent Assets* (NONCURRASSETS) is measured by the ratio of total assets minus total current assets to total assets. The relation between noncurrent assets and negative net debt is unclear because it depends on the composition of noncurrent assets and the possibility of using them as collateral.

Debt Maturity (DEBMAT) is measured by the ratio of long-term debt to total debt (Guney et al., 2003; Teruel and Solano, 2008). A negative relation between longer debt maturities and negative net debt is expected because short-term debt requires frequent renewals of the credit terms exposing firms to the risk of financing, what leads them to face higher transaction costs. Thus, to avoid financial distress situations, firms with more short-term debt tend to keep more cash. Furthermore, firms with more information asymmetries tend to rely more on short-term debt. Since the more information asymmetry a firm faces, the more limited its access to external financing, it is expected it maintains more cash.

Dividend Policy (DIVIDEND) is defined as a dummy variable that takes the value of one if the firm paid dividends and takes the value of zero otherwise (Ferreira and Vilela, 2004). The relation between dividend policy and negative net debt is ambiguous. Dividend-paying firms could maintain lower levels of both debt and cash because they can increase the funds available by cutting dividends or, on the contrary, they could keep higher levels of cash in order to ensure that dividends are stable regardless of the short-term cash-flow or profit generation ability of the firm.

The amount of *Cash Substitutes* (CASHSUB) is measured by the ratio of working capital minus cash to total assets (Opler et al., 1999; Ferreira and Vilela, 2004; Ozkan and Ozkan, 2004; Teruel and Solano, 2008). The relation between the cash substitutes held by a firm and negative net debt is ambiguous because the amount of cash substitutes influences the level of both debt and cash in the same direction. Firms with cash substitutes can use those funds to finance themselves in the case of a financial shortfall, having no need to resort to capital markets or to increase the amount of cash retained.

The *Independence of Board Members* (INDEPBM) variable is measured by the percentage of independent members who serve on the board of directors (Klein, 2002; Ozkan and Ozkan, 2004). A negative relation between the level of independence of board members and negative net debt is expected since independent members monitor and discipline managers avoiding them from retaining cash to employ in the pursuit of their own interests. Consequently, they are decreasing the agency costs and, thus, the cost of external financing faced by the firm.

Board Size (BOARDSIZE) is measured by the number of directors serving on the board (Yermack, 1996). The association between board size and negative net debt is ambiguous because on the one hand, the increase in board size can increase the monitoring effectiveness and expertise of the board and, on the other hand, can become it inefficient in the decision-making process due to lower coordination and processing skills.

The *Tax Rate* (TAXRATE) is measured by the ratio of net income before taxes minus net income after taxes to net income before taxes (Acedo-Ramírez and Ruiz-Cabestre, 2014). It is expected a negative relation between the tax rate and negative net debt because the higher the tax rate, the greater the interest tax benefits of debt. On the contrary, the higher the tax rate, the higher the cost of a firm hold liquid assets, since the returns from cash will be taxed.

3.2. Data

In this section, it is presented the data used in this study. Subsection 3.2.1 explains the collection procedure and subsection 3.2.2 describes the data.

3.2.1. Data Collection

The data used in this study were collected from the Eikon database of Thomson Reuters. This database provides financial information that was filtered according to the following criteria: (1) US-listed firms, (2) inclusion of dead firms, and (3) exclusion of financial firms. Financial firms were excluded from the sample because they are highly leveraged, what, although is normal for them, for nonfinancial firms indicates financial distress (Fama and French, 1992). The application of these criteria resulted in an initial sample of 5929 firms tracked over the period 2000 to 2017[6]. This way, initially, a sample composed of 106722 observations (5929 firms x 18 years) was obtained. However, from that initial sample, only observations with available data for all variables in study were kept. As a result, it was achieved a panel data with 5655 observations, being included observations of

[6] According to Iyer et al. (2013), the financial crisis has imposed financial constraints affecting the access of firms to credit. It prompts them to change their capital structures and to build cash reserves as a buffer against potential capital requirements (Almeida et al, 2004). Hence, initially, the period under analysis extended from 2000 to 2017 to incorporate the pre and post-crisis period. However, due to the lack of data, it was adjusted for the period 2003-2017.

991 firms and 15 years as the sample period was adjusted to the period between 2003 and 2017. Thus, it is an unbalanced panel, since some units do not appear in each time period.

The use of panel data allows firms to be tracked over time. It means that the sample contains observations of multiple aspects of the firms over time. According to Hsiao (2014), panel data possess several advantages over cross-sectional or time-series data sets, such as the reduction of problems of multicollinearity, production of more accurate inference for model parameters because it generally contains more degrees of freedom and sample variability, simplification of computation and statistical inference, and easier identification and measurement of effects that might not be detectable in sectional data[7].

3.2.2. Data Description

Table 3 reports the empirical distribution of the firms-year observations by sector. As mentioned before, the sector classification was settled according to TRBC (Thomson Reuters Business Classification) economic sector. The sample includes firms belonging to nine sectors: basic materials, consumer cyclicals, consumer non-cyclicals, energy, healthcare, industrials, technology, telecommunications services and utilities.

The analysis of the table denotes that the technology sector is the one in which there is the highest percentage of firms having negative net debt (58.58%), with more than half of the observations presenting negative net debt. It is followed by healthcare (31.24%) and consumer cyclicals sectors (22.88%). Utilities sector has no observations with negative net debt, which means that all firms of the sample belonging to this sector have more debt than the amount of cash they hold.

[7] "Panel data provides major benefits for econometric estimation in at least six areas: (1) increasing degrees of freedom and reducing problems of data multicollinearity; (2) constructing more realistic behavioral models and discriminating between competing economic hypotheses, (3) eliminating or reducing estimation bias, (4) obtaining more precise estimates of micro relations and generating more accurate micro predictions, (5) providing information on appropriate level of aggregation, and (6) simplifying cross sections or time series data inferential procedures." (Hsiao, 2014, p. 464)

Table 3 - Distribution of Observations by Sector

This table shows the distribution of the firm-year observations by sector. The column n_1 lists the number of observations in each sector, and the column $\%_1$ its percentage in the total number of observations. The column n_2 lists the number of observations presenting negative net debt in that sector, and columns $\%_2$ and $\%_{\text{by sector}}$ its percentage in the total number of observations presenting negative net debt and its percentage in the total number of observations of that sector, respectively.

			Firms having negative net debt		
Sector	n_1	$\%_1$	n_2	$\%_2$	$\%_{\text{by sector}}$
Basic Materials	626	0.1107	43	0.0332	0.0687
Consumer Cyclicals	1189	0.2103	272	0.2099	0.2288
Consumer Non-Cyclicals	622	0.1100	68	0.0525	0.1093
Energy	242	0.0428	31	0.0239	0.1281
Healthcare	573	0.1013	179	0.1381	0.3124
Industrials	1185	0.2095	195	0.1505	0.1646
Technology	862	0.1524	505	0.3897	0.5858
Telecommunications Services	102	0.0180	3	0.0023	0.0294
Utilities	254	0.0449	0	0	0
Total	5655	1	1296	1	0.2292

The possibility that the passage of time affects the level of cash and debt and, consequently, the net debt held by a firm can also be incorporated into the model. It can be done by including in the explanatory variables a set of dummy variables corresponding to the year in which that observation occurred. In this case, fifteen year dummies were created and fourteen will be included in the list of independent variables. In doing so, it is possible to control changes in firms that may be the result of temporal factors common to all firms. Table 4 shows the distribution of the firm-year observations by time.

It is noted that the proportion of observations in which firms present negative net debt is similar for all years, at around 20%. The year 2010 is the one in which the percentage of firms having negative net debt is greatest (27.46%) and 2003 is the year with the lowest percentage of observations with negative net debt (15.75%).

Table 4 - Distribution of Observations by Year

This table shows the yearly distribution of the firm-year observations. The column n_1 lists the number of observations for each year from 2003 to 2017 and column $\%_1$ its percentage in the total number of observations. The column n_2 lists the number of observations presenting negative net debt in that year, and columns $\%_2$ and $\%_{\text{by year}}$ its percentage in the total number of observations presenting negative net debt and its percentage in the total number of observations of that year, respectively.

			Firms having negative net debt		
Year	n_1	$\%_1$	n_2	$\%_2$	$\%_{\text{by year}}$
2003	127	0.0225	20	0.0154	0.1575
2004	190	0.0336	46	0.0355	0.2421
2005	229	0.0405	59	0.0455	0.2576
2006	243	0.0430	62	0.0478	0.2551
2007	277	0.0490	62	0.0478	0.2238
2008	370	0.0654	72	0.0556	0.1946
2009	429	0.0759	107	0.0826	0.2494
2010	448	0.0792	123	0.0949	0.2746
2011	465	0.0822	116	0.0895	0.2495
2012	427	0.0755	109	0.0841	0.2553
2013	420	0.0743	104	0.0802	0.2476
2014	405	0.0716	95	0.0733	0.2346
2015	649	0.1148	127	0.0980	0.1957
2016	749	0.1324	144	0.1111	0.1923
2017	227	0.0401	50	0.0386	0.2203
Total	5655	1	1296	1	0.2292

Moreover, in order to describe the firms incorporated in the study, the descriptive statistics regarding the variables included are reported in table 5.

The results expose that, over the period 2003–2017, 22.92% of the firm-year observations have negative net debt, that is, the amount of cash the firms hold were higher than the amount of debt in their capital structures. Additionally, the average net debt of US non-financial firms composing the sample is 15.95% of total assets, ranging between 18.2016 and 26.7242.

The growth opportunities variable range lies between 0.3851 and 15.6868 and its median value is 1.6955. It suggests the existence of outliers with respect to this variable.

Half of the sample firms present a profitability higher or equal to 13.55%, what means that the EBITDA of these firms were more than 13.55% of their total assets. The minimum and maximum observed values suggest the existence of outliers.

The volatility of cash flows ranges from 0.0063 to 5.3204 with a mean value equal to 0.0765 and median of 0.0514.

Regarding to the investment activity, the maximum value it assumes is very high compared with the median value and even with the mean value. Besides that, the standard deviation is equal to 4.6145, what evidences the existence of outliers in the sample.

Moreover, the mean value of the proportion of intangibles in the noncurrent assets is equal to 13.93%, meaning that, for the firms composing the sample, tangible assets are dominant in the total amount of noncurrent assets.

Most of the assets of firms belonging to the sample are long-term, averaging 61.38% of their total assets. Also, long-term debt is the major source of financing for these firms representing 86.19% of their external financing. It may indicate that firms match the maturity of their assets with the one of their debt.

Regarding the dividend policy, it is noted that, on average, 72.84% of the sample firms paid dividends.

In addition, 50% of the firms hold an amount of non-cash liquid assets higher or equal to 2.73% of its total assets. Comparing the mean and median values with the range of this variable, it is evidenced the presence of outliers.

On average, boards of the sample firms comprise 10 directors. The number of directors serving on the boards ranges from 1 to 26, of which, on average, 79.71% are independent members.

Furthermore, 50% of the firms face a tax rate lower or equal to 30.45% and 50% face one higher or equal to that value. Looking at the statistics of this variable, it is possible to note evidence on the existence of outliers.

Table 5 - Descriptive Statistics

This table shows the characteristics of firms incorporated in the sample from 2003 to 2017. The dependent variable is NDEBT, a dummy variable that takes the value of one if NETDEBT is negative and of zero otherwise. NETDEBT is measured as the ratio of total debt minus cash and short-term investments to total assets. SIZE is the natural logarithm of total assets. GROWOP is the ratio of total assets minus book value of equity plus market value of equity to total assets. PROFI is the ratio of EBITDA to total assets. VOLATIL is the ratio of standard deviation of cash flows to the average total assets. INVESTACTIV is the ratio of CAPEX to total assets. INTANG is the ratio of intangibles to total assets minus total current assets. NONCURRASSETS is the ratio of total assets minus total current assets to total assets. DEBMAT is the ratio of long-term debt to total debt. DIVIDEND is a dummy variable that takes the value of one if the firm paid dividends that year and takes the value of zero otherwise. CASHSUB is the ratio of working capital minus cash to total assets. INDEPBM is the percentage of independent members who serve on the board of directors. BOARDSIZE is the number of directors serving on the board. TAXRATE is the ratio of net income before taxes minus net income after taxes to net income before taxes.

Variables	Obs	Mean	Median	Std. Dev.	Min	Max
NDEBT	5,655	0.2292	0	0.4203	0	1
NETDEBT	5,655	0.1594	0.1685	0.2494	-0.7980	2.9947
SIZE	5,655	22.5961	22.4574	1.2983	18.2016	26.7242
GROWOP	5,655	2.0543	1.6955	1.2701	0.3851	15.6868
PROFI	5,655	0.1450	0.1355	0.0878	-1.0306	1.3872
VOLATIL	5,655	0.0765	0.0514	0.2577	0.0063	5.3204
INVESTACTIV	5,655	4.5366	3.4817	4.6145	0	84.8384
INTANG	5,655	0.1393	0.1021	0.1339	0	0.9248
NONCURRASSETS	5,655	0.6138	0.6170	0.1847	0.0443	0.9912
DEBMAT	5,655	0.8619	0.9366	0.2052	0	1
DIVIDEND	5,655	0.7284	1	0.4448	0	1
CASHSUB	5,655	0.0325	0.0273	0.1224	-0.9354	0.5904
INDEPBM	5,655	0.7971	0.8333	0.1354	0	1
BOARDSIZE	5,655	10.2840	10	2.1832	1	26
TAXRATE	5,655	0.2008	0.3045	4.3577	-283.2679	65.7500

Before estimating the models, in order to conclude about the existence of multicollinearity, in annex 2 it is presented the correlation matrix between the variables under study. Analyzing it, it is possible to conclude on the degree of collinearity between them. The degree of correlation between the independent variables is relatively low, being all the coefficients lower than 0.5. The highest correlation coefficient is verified between the variables BOARDSIZE and SIZE and it is equal to 0.4916.

Some variables present outliers[8], as can be noted looking to the standard deviation and minimum and maximum values in table 5. The outlier parameters were handled using winsorization method. It means that all the observations with values greater than the 95th percentile took the value of the 95th percentile and all observations with values lower than the 5th percentile took the value of the 5th percentile. This repositioning of extreme values to the 5th and 95th percentiles of the distribution reduces their effect in the conclusions and brings robustness to the estimators. Winsorization was carried out for the variables NDEBT, NETDEBT, GROWOP, PROFI, VOLATIL, INVESTACTIV, INTANG, NONCURRASSETS, DEBMAT, CASHSUB, INDEPBM, and TAXRATE.

The descriptive statistics of the variables after winsorization are displayed in annex 3.

[8] There are several procedures for handling outliers. For example, Aguinis et al. (2013, p. 279-280) present a list of techniques to deal with it, including correct the outlier, keep it, eliminate it of the observations, winsorize, trim the lowest and highest values, among others.

4. Results

This section will present the differences between the models to be tested with regard to the inclusion of explanatory variables. Thereafter, for each explanatory variable, the expected results will be compared with those obtained and their statistical significance will be analyzed.

It will be estimated the probability of a firm having negative net debt and, through the analysis of the results, it will be possible to conclude on the determinants of that probability. In this way, a set of probit models will be estimated, where the probability of having negative net debt is assumed to fluctuate as a function of variables representing firm-related characteristics. As previously mentioned, those variables are commonly denoted in the theoretical and empirical studies as factors that may affect decisions relating to the capital structure and cash held by a firm. The empirical models to be tested are represented as follows:

$$Prob\,(NDEBT = 1) = f(\,Firm - related\ characteristics) \tag{4.1}$$

$$Prob\,(NDEBT = 1 \mid X) = \Phi(\beta X_{i,t} + \varepsilon_{i,t})$$

$$\begin{aligned} Prob\,(NDEBT = 1 \mid X) \\ = \Phi\,(&\beta_0 + \beta_1 SIZE_{i,t} + \beta_2 GROWOP_{i,t} + \beta_3 PROFI_{i.t} \\ &+ \beta_4 VOLATIL_{i.t} + \beta_5 INVESTACTIV_{i.t} + \beta_6 INTANG_{i.t} \\ &+ \beta_7 NONCURRASSETS_{i.t} + \beta_8 DEBTMAT_{i.t} + \beta_9 DIVIDEND_{i.t} \\ &+ \beta_{10} CASHSUB_{i.t} + \beta_{11} BOARDSIZE_{i.t} + \beta_{12} INDEPBM_{i.t} \\ &+ \beta_{13} TAXRATE_{i.t} + \beta_{14} TECHNOLOGY_{i,t} \\ &+ \beta_{15} BASICMATERIALS_{i.t} + \beta_{16} CONSUMERCYCLICALS_{i,t} \\ &+ \beta_{17} CONSUMERCNONYCLICALS_{i,t} + \beta_{18} HEALTHCARE_{i,t} \\ &+ \beta_{19} TELECOMMUNICATIONSSERVICES_{i,t} \\ &+ \beta_{20} UTILENE_{i,t} + \varepsilon_{i,t}) \end{aligned}$$

where NDEBT takes the value 1 if a firm has negative net debt and 0 otherwise, X correspond to the set of explanatory variables which represent firm-related characteristics, and ε is the error term.

As exhibited in table 3, the distribution of observations presenting negative net debt by sector is in accordance with what Passov (2003) argued. The technology sector is dominant, being the one presenting a higher percentage of observations with negative net

debt. For that reason, it will be estimated a model including only one dummy variable named TECHNOLOGY that takes the value 1 if the firm belongs to the technology sector and 0 otherwise. Following, it will be estimated another model including sector dummies (a dummy for each sector, excluding industrials to avoid the dummy variable trap scenario) – model developed in the equation 4.1. The inclusion of sector dummies allows to control the influence of unspecified structural characteristics (entry-barriers, capacity conditions, sector growth rate, factor market conditions, sector business risk, and sector-specific capital market imperfections) on the probability of a firm having negative net debt.

Moreover, models could include year dummies to capture the year to year changes in policies and regulations that may be important to explain the variance in the net debt level of a firm.

To decide what probit to apply, it was run four probit models to check which one presents a smaller log likelihood and Akaike's Information Criterion (AIC), which means that the fit of the model is better. The results obtained are displayed in table 6. Moreover, the estimation output of these models is exhibited in annex 4.

Table 6 - Models Adjustment

	Log Likelihood	AIC
Probit with sector dummies and **no temporal fixed assets**	-1909.2	3860.5
Probit with sector dummies and **temporal fixed assets**	-1896.5	3863.1
Panel probit with sector dummies and **no temporal fixed assets**	-1400.6	2845.2
Panel probit with sector dummies and **temporal fixed assets**	-1375.4	2822.9

The results of the models with sectional data and panel data do not differ widely regarding the level of statistical significance and the coefficients' signals. However, when the repetitions of observations per firm are not controlled, marginal effects suggest a greater impact of the determinants on the probability of a firm having negative net debt. Moreover, considering the AIC criterion and the log likelihood, random effects models (panel data models) present better results. For these reasons, models with panel data will be analyzed.

In order to decide between the panel probit model considering or not the temporal fixed effects, a Wald test was carried out to examine the significance of those effects. The result of the test is exhibited in annex 5. As can be concluded from the rejection of the null hypothesis, the test is positive, meaning that the addition of the year dummies entails a statistically significant improvement in the fit of the model. Taking that into account and

analyzing the table 6, it is concluded that the panel probit model with temporal fixed effects is the one presenting a better fit.

However, it will be compared the two panel probit models. In the first one, the variables describing the characteristics of the firm, the dummy variable identifying the inclusion or not of the firm in the technology sector, and the year dummies are incorporated. In the second panel probit model, further the variables embedded in the first model, dummy variables associated with the remaining sectors are added, being included in the model a dummy for each sector (except for the industrials).

The estimation results of two panel probit models are reported in table 7. Positive coefficients indicate that the variable contributes to increasing a firm's propensity to have negative net debt while negative coefficients indicate that firms are more likely to have positive net debt as the variable increases (or changes from zero to one in the case of dummy variables). Further the estimation of the variables' coefficient, as mentioned before, it is also presented the marginal effects to quantify the impacts of the variables on the probability of a firm having negative net debt. The marginal effects correspond to the average change in the probability of a firm having negative net debt associated with a one-unit change in a certain independent variable. The standard errors for both the estimated coefficients and respective marginal effects are presented in parentheses and the degree of statistical significance is signaled with asterisks, where * means that the variable is significant at 5% ($p<0.05$), ** means that the variable is significant at 1% ($p<0.01$), and *** means that the variable is significant at 0.1% ($p<0.001$). The number of observations included in the model (N), AIC, log likelihood (ll), f-statistics and prob(f-statistics) are reported at the bottom of the table.

Table 7 - Estimation Results

This table shows the estimation output of panel probit models. The dependent variable is net debt represented by the dummy variable NDEBT that takes the value of one if the net debt is negative and of zero otherwise, where net debt is equal to the ratio of total debt minus cash and short-term investments to total assets. SIZE is the natural logarithm of total assets. GROWOP is the ratio of total assets minus book value of equity plus market value of equity to total assets. PROFI is the ratio of EBITDA to total assets. VOLATIL is the ratio of standard deviation of cash flows to the average total assets. INVESTACTIV is the ratio of CAPEX to total assets. INTANG is the ratio of intangibles to total assets minus total current assets. NONCURRASSETS is the ratio of total assets minus total current assets to total assets. DEBMAT is the ratio of long-term debt to total debt. DIVIDEND is a dummy variable that takes the value of one if the firm paid dividends that year and takes the value of zero otherwise. CASHSUB is the ratio of working capital minus cash to total assets. INDEPBM is the percentage of independent members who serve on the board of directors. BOARDSIZE is the number of directors serving on the board. TAXRATE is the ratio of net income before taxes minus net

income after taxes to net income before taxes. Standard errors are presented in parentheses. The significance levels are represented as follows: * p<0.05, ** p<0.01, *** p<0.001.

	Predicted Signal	Panel probit with technology dummy		Panel probit with sector dummies	
		Coefficient	Marginal Effects	Coefficient	Marginal Effects
Dependent variable: NDEBT					
SIZE	(-)	**-0.184** (0.0683)	**-.0196904** (.007218)	**-0.192** (0.0683)	**-.0204267** (.007176)
GROWOP	(+)	**0.0992** (0.0754)	**.0106444** (.0081037)	**0.0551** (0.0764)	**.0058702** (.0081522)
PROFI	(+/-)	**1.554** (0.969)	**.1666972** (.1039638)	**1.646** (0.970)	**.1753813** (.1034259)
VOLATIL	(+)	**12.65*** (2.670)	**1.35671*** (.2801619)	**12.25*** (2.696)	**1.305458*** (.2802796)
INVESTACTIV	(+)	**-0.00760** (0.0224)	**-.0008154** (.0024017)	**-0.00227** (0.0226)	**-.0002423** (.0024113)
INTANG	(+)	**-1.645**** (0.603)	**-.1764788**** (.0647623)	**-2.028*** (0.614)	**-.2159853*** (.0655318)
NONCURRASSETS	(+/-)	**-10.05*** (0.585)	**-1.077716*** (.0643438)	**-9.879*** (0.584)	**-1.052408*** (.0652882)
DEBMAT	(-)	**-0.618*** (0.255)	**-.0663421*** (.0275553)	**-0.622*** (0.254)	**-.0662888*** (.027341)
DIVIDEND	(+/-)	**-0.0356** (0.143)	**-.0038197** (.015286)	**0.0486** (0.144)	**.0051743** (.0153257)
CASHSUB	(+/-)	**-4.929*** (0.676)	**-.5287016*** (.076285)	**-4.809*** (0.680)	**-.5122607*** (.0761173)
INDEPBM	(-)	**-0.998*** (0.501)	**-.1070499*** (.0539528)	**-1.045*** (0.502)	**-.1113141*** (.0537725)
BOARDSIZE	(+/-)	**-0.0663*** (0.0272)	**-.0071146*** (.0029216)	**-0.0668*** (0.0272)	**-.007113*** (.002898)
TAXRATE	(-)	**0.829**** (0.311)	**.0889505**** (.0332954)	**0.855**** (0.311)	**.091098**** (.0330822)
TECHNOLOGY	(+)	**1.609*** (0.245)	**.1725876*** (.0259545)		
Sector dummies		No		Yes	
Year dummies		Yes		Yes	
CONSTANT		**8.824*** (1.519)		**8.977*** (1.514)	
N		5655		5655	

AIC	2827.2	2822.9
ll	-1383.6	-1375.4
chi2	458.07	456.47
Prob>chi2	0.0000	0.0000

For both models, since the p-value (Prob>chi2) is equal to 0.0000, it is rejected the null hypothesis that all of the explanatory variables do not have significant explanatory power on the dependent variable. It suggests that the models are globally significant and, thus, that the explanatory variables selected are generally relevant in predicting the probability of a firm having negative net debt. The main findings are exposed below.

The results of the model including all sector dummies show that growth opportunities, profitability, investment activity, and the fact of a firm pay or not dividends do not have a statistically significant impact on its probability of having negative net debt. Although the insignificance demonstrated, growth opportunities and profitability present a positive coefficients and dividend presents a negative coefficient in the case of the panel probit considering only the technology sector and a positive coefficient in the case of considering a dummy variable for each sector. The sign of the coefficient of investment activity is negative, which is not in accordance with the expected.

These results contradict, for example, Frank and Goyal (2009) findings concerning growth opportunities, profitability and dividends since they found evidence of reliable and statistically significance of these variables over the debt levels of firms. In addition, among others, Dittmar et al. (2003) found a positive impact of growth opportunities and profitability on firms' cash holdings, and Opler et al. (1999) and Ozkan and Ozkan (2004) also evidenced an impact of growth opportunities on cash hold by a firm.

In contrast, although with little evidence, the estimation results of this study have demonstrated that the variables debt maturity structure, board size, and independence of board members have influence on the probability of a firm having negative net debt. All these variables present a negative coefficient, as expected for the debt maturity structure and independence of board members. There was no consensus regarding the expected sign of the board size coefficient, therefore this study provides some evidence about its negative effect on the probability of a firm having negative net debt.

Furthermore, the results confirm that size, cash flows' volatility, intangibility, the preponderance of noncurrent assets, the amount of cash substitutes, and the tax rate a firm faces have a significant impact on that probability.

The results indicate that an increase of one percentage point in the size of a firm decreases its probability of having negative net debt in 2.04 percentage points. This is in accordance with the expected signal, meaning that larger firms have facilitated access to capital markets, tending to have high levels of debt, as evidenced by Harris and Raviv (1991), Almeida et al. (2004) and Frank and Goyal (2009), so they have no need to keep larger amounts of cash, as demonstrated by Opler et al. (1999) and Ferreira and Vilela (2004).

According to the estimation output, an increase of one percentage point in the volatility of firm's cash flows increases its probability of having negative net debt in 130.55 percentage points. It is also in line with the empirical results found, demonstrating that more volatile firms present lower levels of debt, as evidenced by Bradley et al. (1984) and Wald (1999) for the US-firms, because they are more financially constrained. Consequently, they can maintain more cash to prevent losses resulting from adverse cash flows shocks, as founded by Kim et al. (1998) and Bates et al. (2009).

The results show that ceteris paribus, when firms possess more intangible assets in their total amount of noncurrent assets, their probability of having negative net debt decreases. It is not in accordance with the expected and suggested by Passov (2003). One possible explanation might be that, as these firms are not able to get financing so easily as firms with a predominance of tangible assets, they spend their cash to finance their operational activities, so they are not able to keep larger amounts of cash. In cases where more funds are needed, they have to resort to capital markets to finance themselves, even supporting high costs. Another reason might be that these firms may want to use cash in the first place to maintain the flexibility to resort to capital markets to invest in their intangible assets in the case of cash flow shortfalls since their value is mostly associated with the continued investment in these assets.

The results show that an increase in the preponderance of noncurrent assets in the total assets of a firm decreases its probability of having negative net debt, what may be related with increases in the tangible assets or increases in the intangibles that are proved to generate future benefits and, thus, can be used as a collateral. This explanation is in line with the statistics for this variable since it was verified in the subsection 3.2.2 that firms composing the sample present a preponderance of noncurrent assets in their total assets.

The expected sign of the cash substitutes coefficient was ambiguous because they are expected to negatively affect both firm's debt levels (Ozkan, 2001) and its cash holdings (Ozkan and Ozkan, 2004; Teruel and Solano, 2008) as it can use cash substitutes to finance itself. Thus, the signal of the coefficient would depend on the magnitude of these two impacts. In light of the results, it can be interpreted that the negative impact of cash substitutes is greater on cash than on debt, resulting in a negative coefficient. It means that an increase of one percentage point in the amount of cash substitutes of a firm decreases its probability of having negative net debt in 51.23 percentage points.

The sign of tax rate coefficient is positive and, thus, opposite to the one expected. An increase of one percentage point in the tax rate faced by a firm increases its probability of having negative net debt in 9.11 percentage points. This unexpected coefficient sign might be the result of a predominance of tax shields originated by other sources apart from interests, such as depreciation and R&D expenditures. As DeAngelo and Masulis (1990) argued, firms benefiting from more non-debt tax shields present lower debt levels in their capital structures.

Moreover, comparing the results of the model using only the TECHNOLOGY dummy and all sector dummies, it is possible to note that the fit of the model is improved

To conclude, most of the variables are statistically significant, but there are some differences between what was expected and the estimation results.

5. Conclusions

Resorting to Eikon database of Thomson Reuters, it was collected information of US-listed firms. The sample includes observations of 991 firms for the period between 2003 and 2017.

The study analyzes how firm-related characteristics influence its probability of having negative net debt. To do so, probit models are applied and that probability is assumed to fluctuate as a function of several determinants that are commonly denoted in the theoretical and empirical studies as factors that may affect decisions relating to the capital structure and cash holdings.

The results evidenced a significant and positive relation between the probability of a firm having negative net debt and cash flow volatility and tax rate. Conversely, it is evidenced a significant and negative relation between that probability and firm size, intangibility, the preponderance of noncurrent assets in the total assets, and the amount of cash substitutes.

The sector in which a firm is inserted also influences its probability of having negative net debt. As evidenced by Passov (2003), knowledge-based firms, such as firms belonging to technology and life science sectors, are more volatile. This way, they tend to keep cash in order to avoid being unable to keep investing on their intangible assets. It is in accordance with our results since that the inclusion of a dummy associated with each sector improved the fit of the model and, in our sample, the technology and healthcare sectors are the ones presenting a greater percentage of firms having negative net debt.

Moreover, though weak, it was found a negative association between the probability of a firm having negative net debt and its debt maturity structure, independence of board members and board size.

No evidence was found regarding the influence of growth opportunities, profitability, investment activity, and the fact of a firm pay or not dividends on its probability of having negative net debt.

It is important to note that this study has some limitations namely regarding the lack of data available for some variables, which is why the sample was so drastically reduced.

Lastly, for further research, it is suggested the study of a more extensive sample, what could be undertaken by the inclusion of more countries and, consequently, the inclusion of variables to control for macroeconomic factors.

Furthermore, it could be incorporated an additional measure for dividend policy, namely the amount of dividends distributed and a measure of volatility, specifically the

shares' price volatility. Also, it could be studied the isolated impact of research and development expenditures. Moreover, it could be conducted a similar study incorporating other variables related with ownership structure, investor's protection, reputation, and transaction costs. The inclusion of all these measures may contribute to the achievement of more robust results. They were not included due to the lack of data available.

Additionally, one might be suggested testing whether firms have an optimal level of negative net debt level at which their values get maximized.

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Annexes

Annex 1 - Variables Measurement

Variables	Label	Proxies	Predicted Signal
Dependent Variables			
Net Debt	NDEBT	Dummy variable (1 - Negative net debt; 0 - Otherwise)	-
	NETDEBT	(Total Debt – Cash and Short-Term Investments)/Total Assets	-
Independent Variables			
Sector		Dummy variable - Firms are divided according to TRBC (Thomson Reuters Business Classification) Economic Sector	-
Size	SIZE	Natural logarithm of total assets	Negative
Growth Opportunities	GROWOP	Market-to-book ratio, specifically, (Total assets – Book value of equity + Market value of equity)/Total assets	Positive
Profitability	PROFI	EBITDA / Total assets	Positive/Negative
Volatility	VOLATIL	Standard deviation of cash flows / Average total assets	Positive
Investment Activity	INVESTACTIV	CAPEX / Total assets	Positive
Intangibility	INTANG	Intangibles / (Total assets – Total current assets)	Positive
Noncurrent Assets	NONCURRASSETS	(Total assets – Total current assets) / Total assets	Positive/Negative
Debt Maturity Structure	DEBMAT	Total long-term debt / Total debt	Negative
Dividend Policy	DIVIDEND	Dummy variable (1-Dividend payer; 0-No dividend payer)	Positive/Negative
Cash Substitutes	CASHSUB	(Working capital - Cash) / Total assets	Positive/Negative
Board Structure			
Independence of Board Members	INDEPBM	Percentage of independent members who serve on the board of directors	Negative
Board Size	BOARDSIZE	Number of directors serving on the board	Positive/Negative
Tax Rate	TAXRATE	(Net income after taxes - Net income after taxes) / Net income before taxes	Negative
Years	Y20XX	Dummies for years 2003 to 2017	-

Source: Author's Elaboration

Annex 2 - Correlation Matrix

This table shows the correlation matrix. The dependent variable is net debt represented by the dummy variable NDEBT that takes the value of one if the net debt is negative and of zero otherwise, where net debt is equal to the ratio of total debt minus cash and short-term investments to total assets. SIZE is the natural logarithm of total assets. GROWOP is the ratio of total assets minus book value of equity plus market value of equity to total assets. PROFI is the ratio of EBITDA to total assets. VOLATIL is the ratio of standard deviation of cash flows to the average total assets. INVESTACTIV is the ratio of CAPEX to total assets. INTANG is the ratio of intangibles to total assets minus total current assets. NONCURRASSETS is the ratio of total assets minus total current assets to total assets. DEBMAT is the ratio of long-term debt to total debt. DIVIDEND is a dummy variable that takes the value of one if the firm paid dividends that year and takes the value of zero otherwise. CASHSUB is the ratio of working capital minus cash to total assets. INDEPBM is the percentage of independent members who serve on the board of directors. BOARDSIZE is the number of directors serving on the board. TAXRATE is the ratio of net income before taxes minus net income after taxes to net income before taxes.

	NDEBT	SIZE	GROWOP	PROFI	VOLATIL	INVEST ACTIV	INTANG	NONCURR ASSETS	DEB MAT	DIVID END	CASH SUB	INDEP BM	BOARD SIZE	TAX RATE
NDEBT	1													
SIZE	-0,1572	1												
GROWOP	0,2767	-0,2629	1											
PROFI	0,0706	-0,0984	0,4339	1										
VOLATIL	0,1350	-0,0788	0,0172	-0,0492	1									
INVESTACTIV	-0,0438	0,0110	0,0219	0,1604	0,0007	1								
INTANG	-0,0551	-0,0379	0,0387	-0,0209	0,0817	-0,2134	1							
NONCURRASSETS	-0,4793	0,2695	-0,3140	-0,1010	-0,0986	0,1849	0,1184	1						
DEBMAT	-0,2309	0,0495	-0,1622	-0,0858	0,0054	0,0146	0,0408	0,1986	1					
DIVIDEND	-0,1892	0,2102	-0,0805	0,1378	-0,1443	-0,0454	-0,0699	0,1102	0,0514	1				
CASHSUB	-0,0778	-0,2134	-0,1503	0,0210	-0,0114	-0,0789	-0,0592	-0,3187	0,1674	0,0838	1			
INDEPBM	-0,0264	0,1143	-0,0250	-0,0073	-0,0069	-0,0493	-0,0938	-0,0411	-0,0195	0,1720	0,0069	1		
BOARDSIZE	-0,1546	0,4916	-0,1171	0,0069	-0,0765	-0,0275	-0,0089	0,1669	0,0036	0,2413	-0,0949	0,1026	1	
TAXRATE	0,0014	0,0265	0,0058	0,0061	-0,0046	0,0056	0,0037	-0,0012	-0,0085	0,0389	-0,0074	-0,0088	0,0310	1

Annex 3 - Descriptive Statistics after Winsorization

This table shows the descriptive statistics of the variables incorporated in the study after winsorization. The dependent variable is NDEBT, a dummy variable that takes the value of one if NETDEBT is negative and of zero otherwise. NETDEBT is measured as the ratio of total debt minus cash and short-term investments to total assets. SIZE is the natural logarithm of total assets. GROWOP is the ratio of total assets minus book value of equity plus market value of equity to total assets. PROFI is the ratio of EBITDA to total assets. VOLATIL is the ratio of standard deviation of cash flows to the average total assets. INVESTACTIV is the ratio of CAPEX to total assets. INTANG is the ratio of intangibles to total assets minus total current assets. NONCURRASSETS is the ratio of total assets minus total current assets to total assets. DEBMAT is the ratio of long-term debt to total debt. DIVIDEND is a dummy variable that takes the value of one if the firm paid dividends that year and takes the value of zero otherwise. CASHSUB is the ratio of working capital minus cash to total assets. INDEPBM is the percentage of independent members who serve on the board of directors. BOARDSIZE is the number of directors serving on the board. TAXRATE is the ratio of net income before taxes minus net income after taxes to net income before taxes.

Variables	Obs	Mean	Median	Min	Max	Std. Dev.
NETDEBT	5,655	0,1562	0,1685	-0,2622	0,5224	0,2111
NDEBT	5,655	0,2292	0,0000	0,0000	1,0000	0,4203
SIZE	5,655	22,5961	22,4574	18,2016	26,7242	1,2983
GROWOP	5,655	1,9756	1,6955	0,9488	4,3584	0,9268
PROFI	5,655	0,1445	0,1355	0,0485	0,2859	0,0634
VOLATIL	5,655	0,0608	0,0514	0,0197	0,1485	0,0352
INVESTACTIV	5,655	4,2275	3,4817	0,9461	11,1693	2,8196
INTANG	5,655	0,1335	0,1021	0,0060	0,4024	0,1152
NONCURRASSETS	5,655	0,6155	0,6170	0,2883	0,8998	0,1758
DEBMAT	5,655	0,8761	0,9366	0,4289	1,0000	0,1560
DIVIDEND	5,655	0,7284	1,0000	0,0000	1,0000	0,4448
CASHSUB	5,655	0,0329	0,0273	-0,1647	0,2233	0,1029
INDEPBM	5,655	0,8040	0,8333	0,5455	0,9231	0,1090
BOARDSIZE	5,655	10,2840	10,0000	1,0000	26,0000	2,1832
TAXRATE	5,655	0,2649	0,3045	-0,1164	0,4768	0,1448

Annex 4 - Estimation Output of Probit Models

This table shows the output estimation of four probit models. The dependent variable is net debt represented by the dummy variable NDEBT that takes the value of one if the net debt is negative and of zero otherwise, where net debt is equal to the ratio of total debt minus cash and short-term investments to total assets. SIZE is the natural logarithm of total assets. GROWOP is the ratio of total assets minus book value of equity plus market value of equity to total assets. PROFI is the ratio of EBITDA to total assets. VOLATIL is the ratio of standard deviation of cash flows to the average total assets. INVESTACTIV is the ratio of CAPEX to total assets. INTANG is the ratio of intangibles to total assets minus total current assets. NONCURRASSETS is the ratio of total assets minus total current assets to total assets. DEBMAT is the ratio of long-term debt to total debt. DIVIDEND is a dummy variable that takes the value of one if the firm paid dividends that year and takes the value of zero otherwise. CASHSUB is the ratio of working capital minus cash to total assets. INDEPBM is the percentage of independent members who serve on the board of directors. BOARDSIZE is the number of directors serving on the board. TAXRATE is the ratio of net income before taxes minus net income after taxes to net income before taxes. Standard errors are presented in parentheses. The significance levels are represented as follows: * p<0.05, ** p<0.01, *** p<0.001.

	Predicted Signal	1 Probit with no temporal fixed effects		2 Probit with temporal fixed effects		3 Panel Probit with no temporal fixed effects		4 Panel Probit with temporal fixed effects	
		Coefficient	Marginal Effects	Coefficient	Marginal Effects	Coefficient	Marginal Effects	Coefficient	Marginal Effects
Dependent variable: NDEBT									
SIZE	(-)	**-0.0531***	**-.0116249**	**-0.0622****	**-.0135475**	**-0.145***	**-.0152999**	**-0.192****	**-.0204267**
		(0.0223)	(.0048715)	(0.0229)	(.0049623)	(0.0652)	(.0067552)	(0.0683)	(.007176)
GROWOP	(+)	**0.0494**	**(.0108177)**	**0.0610**	**.0132833**	**0.0273**	**.0028743**	**0.0551**	**.0058702**
		(0.0327)	.0071855)	(0.0345)	(.0075485)	(0.0670)	(.0070438)	(0.0764)	(.0081522)
PROFI	(+/-)	**0.768**	**.1681616**	**0.547**	**.118951**	**1.879***	**.1976757**	**1.646**	**.1753813**
		(0.489)	(.1067452)	(0.508)	(.1103773)	(0.921)	(.0973994)	(0.970)	(.1034259)
VOLATIL	(+)	**6.212*****	**1.360443**	**6.240*****	**1.35813**	**11.94*****	**1.255325**	**12.25*****	**1.305458**
		(0.764)	(.1677134)	(0.768)	(.167483)	(2.640)	(.2708678)	(2.696)	(.2802796)
INVESTACTIV	(+)	**-0.00243**	**-.0005319**	**-0.0000565**	**-.0000123**	**-0.00761**	**-.0008002**	**-0.00227**	**-.0002423**
		(0.0104)	(.0022697)	(0.0105)	(.0022804)	(0.0217)	(.0022885)	(0.0226)	(.0024113)
INTANG	(+)	**-0.715****	**-.1566556**	**-0.676****	**-.1470849**	**-2.135*****	**-.2245695**	**-2.028*****	**-.2159853**
		(0.247)	(.0538864)	(0.250)	(.054413)	(0.591)	(.0626391)	(0.614)	(.0655318)
NONCURRASSETS	(+/-)	**-4.639*****	**-1.016018**	**-4.628*****	**-1.00721**	**-9.988*****	**-1.050558**	**-9.879*****	**-1.052408**
		(0.186)	(.0411442)	(0.187)	(.0411859)	(0.580)	(.0638844)	(0.584)	(.0652882)
DEBMAT	(-)	**-0.612*****	**-.1340585**	**-0.606*****	**-.1319259**	**-0.692****	**-.0727523**	**-0.622***	**-.0662888**

		(0.135)	(.0296653)	(0.136)	(.0297669)	(0.247)	(.0262934)	(0.254)	(.027341)
DIVIDEND	(+/-)	**0.0253**	**.0055323**	**0.0541**	**.0117728**	**-0.0531**	**-.0055831**	**0.0486**	**.0051743**
		(0.0586)	(.0128193)	(0.0611)	(.013286)	(0.136)	(.0143148)	(0.144)	(.0153257)
CASHSUB	(+/-)	**-2.568*** **	**-.5625061**	**-2.592*** **	**-.5641485**	**-4.649*** **	**-.4889524**	**-4.809*** **	**-.5122607**
		(0.256)	(.0571046)	(0.258)	(.0570499)	(0.665)	(.0738317)	(0.680)	(.0761173)
INDEPBM	(-)	**-0.878*** **	**-.1923742**	**-0.876*** **	**-.1905727**	**-1.078***	**-.1134296**	**-1.045***	**-.1113141**
		(0.221)	(.0483963)	(0.223)	(.0484836)	(0.481)	(.0509371)	(0.502)	(.0537725)
BOARDSIZE	(+/-)	**-0.0232**	**-.005091**	**-0.0268***	**-.0058402**	**-0.0605***	**-.0063648**	**-0.0668***	**-.007113**
		(0.0122)	(.0026693)	(0.0123)	(.0026854)	(0.0267)	(.0028002)	(0.0272)	(.002898)
TAXRATE	(-)	**0.588*** **	**.1288635**	**0.588*** **	**.1279424**	**0.927** **	**.0975141**	**0.855** **	**.091098**
		(0.177)	(.0386512)	(0.177)	(.0386127)	(0.306)	(.0322307)	(0.311)	(.0330822)
Sector dummies		Yes		Yes		Yes		Yes	
Year dummies		No		Yes		No		Yes	
CONSTANT		**3.669*** **		**3.687*** **		**8.201*** **		**8.977*** **	
		(0.527)		(0.566)		(1.436)		(1.514)	
N		5655		5655		5655		5655	
pseudo R-sq		0.373		0.377					
AIC		3860.5		3863.1		2845.2		2822.9	
ll		-1909.2		-1896.5		-1400.6		-1375.4	
ll_0		-3044.0		-3044.0					
chi2		2269.50		2294.87		429.95		456.47	
Prob>chi2		0.0000		0.0000		0.0000		0.0000	
chi2type		LR		LR		Wald		Wald	

Annex 5 - Wald Test for the Significance of Temporal Fixed Effects

(1) [ndebt]y2004 = 0
(2) [ndebt]y2005 = 0
(3) [ndebt]y2006 = 0
(4) [ndebt]y2007 = 0
(5) [ndebt]y2008 = 0
(6) [ndebt]y2009 = 0
(7) [ndebt]y2010 = 0
(8) [ndebt]y2011 = 0
(9) [ndebt]y2012 = 0
(10) [ndebt]y2013 = 0
(11) [ndebt]y2014 = 0
(12) [ndebt]y2015 = 0
(13) [ndebt]y2016 = 0
(14) [ndebt]y2017 = 0

chi2(14) = 47.91
Prob > chi2 = 0.0000