The Determinants of Capital Structure: Evidence from Non-financial Listed German Companies

Master's Thesis in Finance and Taxation

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Biographical note

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Abstract

In this paper we analyze the determinants of the leverage choice of German firms and analyze which financial theory better explains the leverage ratio, more specifically the trade-off theory, the pecking order theory, the agency theory and the market timing theory. Additionally, we examine three effects: year, economic crisis and industry. The goal is to see if the results change when we introduce these effects. We estimate our econometric model by using panel data and Ordinary Least Squares. Our sample includes 443 non-financial German companies (4430 firm-year observations) over the period of 2005 to 2014. To test the impact on the results to the use of debt with different maturities we use two regressions: total debt and long term debt. The independent variables that we examine are: market-to-book, size, profitability, tangibility, risk and non-debt tax shield. The results show that the main theories apply to German firms and all explanatory variables are statistically significant. We can also conclude that the three effects are relevant in the capital structure for German firms. Investors, managers and shareholders can benefit from this study of what influences and determines capital structure.

JEL codes: C33, G10, G32

Keywords: Capital structure, trade-off theory, pecking order theory, market timing theory.

Index of contents

Index of Tables

1. Introduction

The objective of this paper is to give a contribution to the already existing literature on the topic of the determinants of corporate capital structure. We aim to emphasize on the impact of firm's financial and operational characteristics on the company's leverage.

The capital structure decision is an important aspect of the financial policy decision of a company. Capital structure is how a firm finances their assets through the combination of debt, equity and hybrid securities, Saad (2010). This is an important subject because it is directly associated with the cost of capital, the company's value and also bankruptcy costs. The goal of capital structure research is to find the optimal capital structure for a firm which causes the increase of its value. Optimal capital structure is described as the smallest weighted average cost of capital. Researchers are interested in adopting a universally acceptable model that will help firms in designing their target capital structure, but the problem has become more complex because of the proponents of different theories of capital structure.

A modern theory of capital structure is represented by Modigliani & Miller (1958). These authors state that under a number of specific assumptions, capital structure is irrelevant for both the cost of capital and firm value. The main assumptions presented in this model are the inexistence of taxes and the lack of transaction and bankruptcy costs in the economy. However, this model was criticized because it had little adherence on reality. In the following years, the same authors presented a new version of this model with taxes and concluding that the use of debt increases the company's value and decreases linearly weighted average cost of capital.

Many other studies were developed around these authors conclusions during the next few decades and assumptions have since been reduced. Myers (2001) referred that there was no universal theory on the choice between debt and equity, however the principal theories that have emerged in an attempt to explain the capital structure are *pecking order theory, trade-off theory, agency theory* and *market timing theory*. According to *pecking order theory* the company prefers internal financing, like retained earnings, and then external financing. Based on this theory, profitable companies are less likely to undertake external financing for new projects due to internal financing already set up for this purpose, Hijazi & Tariq (2006). Another theory is *trade-off theory* where it is suggested that the ratio company follows a target debt-equity. *Agency costs* were defined by Jensen & Meckling (1976) and are related with conflicts between agents and principals. These conflicts may arise because of opposed interests between managers and shareholders or the separation of management and ownership structure. Lastly,

market timing theory and this theory suggests that companies issue equity when the cost of equity is low and issue debt when the cost of equity is high, Huang & Ritter (2006).

A number of theories to explain the capital structure have been developed in the last three decades. However, no theory or research has been able to provide an agreement as to what factors affect the capital structure decision, Brealey & Myers (1991).

The study of capital structure is an important subject because companies need resources to finance their projects and need to choose between equity and debt, especially for a large group of people, such as managers, politicians, analysts, investors and financial institutions (for instance banks), particularly those who operate in Germany. Presently, there are multiple studies on the comparison between Germany and other countries, but to the best of our knowledge, there aren´t any studies that analyze only this country during this specific period of time.

The aim of this study involves the analysis of the relationship between leverage and some determinants of capital structure of non-financial German listed companies. Additionally, we intend to understand which characteristics of non-financial listed firms affect the decision taken by managers (they can choose between internal or external funds and they can choose between short, medium or long resources, for example) and the affect it has on the capital structure of the company. Our intention is also to investigate which theory, *pecking order theory*, *static trade-off theory*, *agency theory* or *market timing theory*, better explains the capital structure. we intend to study what impact the industry has on the capital structure for German companies, which means verifying if differences in the capital structure exist, taking into account the fact that firms belong to different industries. Furthermore, we want to analyze if the economic crisis has had an impact on German companies and compare the pre economic crisis period to the post economic crisis period. The Data will be organized through panel data and the Ordinary Least Squares estimator will be used.

The country that we have chosen to analyze is Germany. German firms follow the Germanic tradition where corporate decisions are made through the involvement of banks and financial holdings, Antoniou, et al. (2002). Furthermore, Germany has the largest economy in the European Union and belongs to the G-7 (group of seven major advanced economies in the world). In this way, it is intended to analyze the following three effects: year effect, economic crisis effect and industry effect. Some authors like Cortez & Susanto (2012) and Talberg, et al. (2008) analyze the economic crisis and industry effect, but according to our research, no other

authors have analyzed these three effects together. Furthermore, an analysis of debt (dependent variable) with different maturities will be made – long term debt and total debt – and whether there are differences between the results or not.

Our results show that there is no prevailing theory when we analyze German firms. Unlike in non-debt tax shield (in total debt regression) and risk, all our hypotheses are confirmed. We can verify our results are consistent with previous studies for our research indicates that Market-to-book, profitability and non-debt tax shield have a negative relationship with leverage, as predicted by *market timing*, *pecking order* and *trade-off theory*, respectively. Furthermore, size and tangibility have a positive relation, like *trade-off theory* predicted. These results are consistent with previous studies. When year dummy variables are analyzed all coefficients have a positive sign. In turn, when we analyze industry dummy variables, its possible to see that the coefficients have different signs thus it's possible to see the influence of industry effect on the capital structure of German firms. Finally, we note that after the economic crisis the variables have negative coefficients, which means after the financial crisis debt level starts to decrease, when comparing to the pre economic crisis period, for different reasons than given by the explanatory variables.

This paper contributes to the following factors. Our first contribution is related to our sample, as most studies analyze a set of countries, mainly being United States of America, United Kingdom and The European Union. Furthermore, most studies have not considered corporate differences between the countries, like corporate culture, and that's why we have only analyzed firms listed in Deutsche Boerse. Secondly, our contribution is related with our period of time, because it is broad and recent. In this way, we can observe how and which of our determinants affect the structure of capital in recent period. Thirdly, we contribute significantly to the already existing literature when considering the three effects all together. Previous investigation, like Cortez & Susanto (2012), analyze above financial and operational indicators, while this article demonstrates that the capital structure of German firms also depending the industry where firms operate.

The remainder of the paper is organized as follows: In section II we analyze literature and developed hypotheses. In section III we discuss the variables definition and the sample selection criteria. In section IV we examine the methodology that we will use in our study. In section V we show our empirical findings. In section VI we present our conclusions. In section VII we give the references consulted in this research.

2. Literature review and hypotheses development

2.1. Literature review

The study of capital structure increased especially with the theoretical developments of the Modigliani and Miller (1958). The discussion focuses on explaining the financing sources used by companies to finance their investments. The capital structure means how a firm finances their operations which can be between equity and debt. The goal is to find an optimal capital structure, which means finding the balance between debt and equity that allows the minimum cost of capital and maximum market value.

Initially, based on certain assumptions the authors Modigliani & Miller (1958) observed that the company's value is not influenced by the way it is financed. In their point of view, the company's value and the weighted average cost of capital are independent of the capital structure, but it is dependent of the income generated by assets and the performance of the firm. In 1963, the same authors introduced tax in the model and concluded that the leverage increased the value of the company and decreased, linearly, the weighted average cost of capital. This way, the value of the company is maximized with a minimum of equity. This conclusion revolutionized the theory of capital structure.

However, when the level debt increases, consequences to the financial level of companies appear. The contributions of Altman (1984) and Jensen (1986) appeared to have overcome some of the limitations of excessive debt, like financial distress and bankruptcy costs. These authors concluded that the market value of the company isn't proportional to its debt and the optimal structure doesn't correspond to the maximum debt level. In a certain way, it contradicts the theory of capital structure, but both theories continue to coexist.

Some authors, like DeAngelo & Masulis (1980) criticize the Modigliani & Miller (1958) theorem because occasionally it is very sensitive to changes in tax code and can offer a better internal leverage decision. Modigliani and Miller theorem recognizes the tax deductibility of interest payments, but fails to capture the fact that increasing debt will heighten the probability of bankruptcy. By this process, the equity is overvalued and the debt is undervalued, making the decision of an unclear capital structure, Scott (1976).

Progressively, there has been a decrease in the assumptions of Modigliani & Miller (1958) and new theories have begun to emerge as well as the discussion about the relevance of capital structure choice for the determination of firm value, like the *trade-off theory*, the *pecking order theory*, the *market timing theory* and the *agency theory*.

The *trade-off theory* suggests that firms choose the "optimal" capital structure taking into account costs and benefits in relation to the use of the debt and the equity. This theory presupposes a target debt ratio and explains this ratio as a trade-off between tax and other benefits (advantages) against financial distress and other costs that are consequences of the use of debt (disadvantages), Kraus & Litzenberger (1973) and Graham & Harvey (2001). According to Kraus & Litzenberger (1973) there is a level that maximizes the market value of the firm and this level is a trade-off between the benefits of tax shield and the costs of debt. Thus, the benefits of debt increases with tax exemption and firm's value increases with debt ratio. However, this theory has a limitation because it can't explain why capital structures vary across the firms that have the same taxation rate, Chen & Strange (2006).

Another theory emerged from *trade-off theory* and it was developed by Jensen & Meckling (1976). This theory is called *agency theory* and it mentions that an optimal capital structure could be obtained by trading off the agency cost of debt against the benefit of debt. According to some authors it is possible to identify two potential sources of conflict. On the one hand, there are conflicts between debt-holders and equity-holders because the access to debt gives equity-holders an incentive to invest sub-optimally. On the other hand, conflicts between shareholders and managers arise because managers don't control the total capital.

Agency theory raises a fundamental problem in the organization: self-interest behavior for corporation's managers may have personal goals that compete with the owner's goal, which is the maximization of the shareholder's wealth. Since shareholders authorize managers to administer the firm's assets, a potential conflict of interest exists between the two groups. According to Jensen (1986) if managers use debt, they will avoid using free cash flow in inadequate decisions. This author defines free cash flow as the amount of money left after the firms have invested in all projects with a positive net present value. In this case, the agency costs between managers and shareholders would be decreased with leverage. Similarly, Lubatkin & Chatterjee (1994) argue that increasing debt to equity ratio would help firms ensure that managers are running the business more efficiently.

Agency costs may also appear between managers and bondholders. These costs arise when a firm invests in projects with negative net present value or with higher risk. In this case, we can say that debt financed firms are more appropriate for investors, but with high debt levels, the cost of capital increases as well as bankruptcy costs. This problem can be reduced by limiting the debt ratio or with the use of short-term debt, Jensen & Meckling (1976).

Another theory that began to emerge was the *pecking order theory*, developed by Myers & Majluf (1984) and it is an alternative to the *trade-off theory*. This theory refers that a company chooses capital according to the preference orders: first internal financing and then external financing. Ross (1977) refers that this theory concentrated on the information asymmetry as a determinant of the capital structure because managers know better the reality of the company than outsiders. Managers will not use debt when company performance is poor. Based on the assumption of asymmetric problem, companies will prevent issuing external equity which is susceptible to mispricing and adverse selection.

This theory predicts a hierarchical corporate financing pattern in which new investments are financed by internal funds first then by low risk debt and hybrid securities and as a last resort external equity. According to Shyam-Sunder & Myers (1999) companies do not aim towards any target debt ratio. The debt ratio is defined as a ratio like the cumulative result of hierarchical financing over time. In this way, the most profitable firms use their own retain earnings to finance their projects and, consequently, issue less debt and equity, Myers (1984).

After a long debate on *trade-off theory* and *pecking order theory* of the capital structure, Fama & French (2005) concluded that perhaps it is best to regard the two models as stable mates with each having elements that explain some aspects of financing decisions.

Another line of research that began to study the impact of market timing on capital structure was *market timing theory*. This theory suggests that the timing of equity issuances has long-lasting effects on issuing firms' capital structure, i.e., firms adjust their capital structures to target structures taking into account changes in the firm's market values, Baker & Wurgler (2002). These authors empirically show that low leverage firms issue equity when their market valuations are high, and repurchase equity when their market valuations were low. According to this theory the choice of the best moment to issue new shares is the decisive factor in the corporate financing strategy. Market timing exists because of the existence of asymmetry information. For this, managers issue overvalued stock and repurchase when the stock is undervalued.

Our study will focus on the German market, because Germany is one of the biggest economies in the world. This country is a member of G-7 – group of seven major advanced economies in the world – and it is the largest economy of the European Union. It also represents a distinct economic system in comparison to the United Kingdom (UK) and the United States (US). Germany is a typical "bank-oriented" economy and UK and the US being "market-

oriented" economies, Rajan & Zingales (1995). In general, most companies operate in "bank-oriented" economies which use bank financing instead of capital markets. This close relationship between banks and firms means that the companies present reduced indirect bankruptcy costs, like agency costs between lenders and borrowers. In addition, they are also characterized by high collateral requirements in bank loans and have a more concentrated ownership structure, Acedo-Ramírez & Ruíz-Cibestre (2014).

We intend to analyze the industry effect. There are few articles focusing on industrial effect. Mackay & Phillips (2005) mentions that capital structure of the companies depends on the industries as well as other determinants. It is expected to find similar level of debt among industries because all companies are listed in Germany and they have similar possibilities of access to finance, Talberg, et al. (2008).

2.2. Hypotheses development

There are different factors which affect capital structure and a company must choose the best mix between debt and equity. The determinants that we will analyze are: profitability, tangibility, market-to-book ratio, size, non-debt tax shields and risk because it is the most commonly used in previous research.

Size (SIZE)

A determinant of the capital structure that we will analyze is the size of the firm. The *trade-off theory* sustains a positive relationship between size and the leverage of the company. This theory suggests that large firms are more diversified, have lower financial distress and agency costs, thus, they are able to borrow more than other small companies. The authors López-Garcia & Sogorb-Mira (2008) found a positive relationship in small and medium firms and they confirm that the risk of bankruptcy is related with the size.

Based on the *pecking order theory*, Harris & Raviv (1991) identify the existence of a positive relationship because larger companies give more information to market players and as a result obtain new funding from creditors.

However, some authors identified a negative relation between size and debt ratio. According to Rajan & Zingales (1995), in Germany, leverage decrease with size. A possible explanation is that bigger firms are better diversified and have a lower probability of being in financial distress. Lower expected bankruptcy costs enable to take on more leverage. Some authors like White (1993) and Kaiser (1994) argue that "in Germany the bankruptcy code is not

conducive to reorganizing firms, and firms entering bankruptcy are usually liquidated. Since liquidation values are generally lower than going concern values, bankruptcy is potentially costlier in Germany". A possible explanation is that large companies use big funding sources diversity. Cortez & Susanto (2012) present the analysis of the relationship between the firm's specific experience and debt level in Japanese firms, in which they found a negative relationship between the level of debt and size.

Although some researchers found a negative relationship, we will test the following hypothesis:

H1: Company size has a positive impact on leverage.

Market-to-book (MB)

MB ratio is a proxy for Growth Opportunities. The main goal of this determinant is to measure the market value expectations of investment opportunities and business growth. Companies with high market-to-book reduce the level of leverage and companies with low market-to-book tend to increase the leverage rather than using the capital market.

The *pecking order theory* predicts a positive relation because internal funds are not sufficient to support investment opportunities for firms with growth opportunities. The *trade-off theory* refers to companies holding future growth opportunities that take the form of intangible assets, tends to borrow less than firms with high tangibility, because growth opportunities cannot be collateralized, Jensen (1986). Firms with high growth opportunities has more flexibility to invest sub optimally. According to the authors Baker & Wurgler (2002) external finance weighted-average of historical market-to-book ratio is negatively related with leverage, and this is evidence for *market timing theory*.

In literature it is mentioned that firms with high MB ratio have higher costs of financial distress which is why we expect a negative correlation. Another reason seems to be related to the tendency of firms to issue stock when their stock price is high in relation to earnings or book value. This would imply that the correlation between market-to-book and leverage is driven by firms who issue lots of equity. Some authors like Rajan & Zingales (1995), Gaud, et al. (2005) and Akdal (2010) found a negative relation between market-to-book ratio and leverage ratio.

In this way, we will test the following hypothesis:

H2: Market-to-book has a negative impact on leverage.

Profitability (PROF)

PROF is commonly used like a determinant of capital structure, because firms acquire more debt to prevent managers from wasting free cash flows gained from profits. In turn, high level of profit will allow firms to have higher debt capacity and making it easier to access debt.

According with *trade-off theory*, profitable firms should be more highly leveraged to offset corporate taxes. According to this theory, there is a positive relationship with debt. Gaud, et al. (2005) found that past earnings are a good proxy for the estimation of future profits.

On the other hand, and according to the *pecking order theory*, the companies more profitable will choose internal financing because it is cheaper than borrowing from external sources. More profitable companies tend to issue their stock constantly to reduce the divergence between the book value and the market value of their stock. So, a negative relation between profitability and debt level can be expected. Titman & Wessels (1988) and Fama & French (2002) argue that there's a negative relationship between measures of past profitability and current debt levels. Hovakimian & Opler (2001) refers that firms with high profitability are likely to have more valuable assets-in-place and thus have higher target debt-ratios.

In this way, we will test the following hypothesis:

H3: Profitability has a negative impact on leverage.

Tangibility (TANG)

This determinant takes the role of collateral in debt issuance. So companies with a large amount of tangible assets can access more debt with better conditions and with reduced costs. According to Rajan & Zingales (1995) and Titman & Wessels (1988) tangible assets have a positive relationship with debt ratio because the collateral may alleviate agency costs of debt. Tangible assets can mitigate the agency costs of debt financing since they can be regarded as collateral for debt, Berger & Udell (2002). However, companies with high tangible assets face difficulties in shifting their investments to riskier projects as their debt is secured against these assets, Johnson (1997).

Some authors, like Berger & Udell (2002) show that firms with close relationships with creditors need less collateral because this relationship substitutes physical collateral, so we should say that the determinant tangibility is less important in bank-oriented countries like Germany.

In Germany, the importance of collateral for loans is caused by institutional factors; saving accounts from Banks are generally subject to limits on the amount of uncollateralized loans they may make. Therefore, traditionally banks search for sufficient collateral causing a positive relationship between fixed assets and leverage.

Nevertheless, some authors have found a negative correlation between assets and debt, Pandey (2001). This is because companies with a high level of debt are limited to using their internal funds, for lenders are closely monitoring them.

Taking into account the current financial crisis, fixed assets have an important role in the approval of bank financing. The access to bank financing has become more severe, debt has become more expensive and fixed assets are necessary to have access to loans. Jensen & Meckling (1976) refers if a firm has a lot fixed assets, these assets can be used as collateral reducing the lender risk.

In this way, we will test the following hypothesis:

H4: Tangible assets have a positive impact on leverage.

Risk (RISK)

RISK is a proxy for the probability of financial distress and it is expected to be negatively related with leverage. This can imply that growing companies have enough internal funds for their financing needs but it may imply that they tend to be riskier.

Many authors have included the variable risk as a determinant of the debt level and have shown that firm's optimal debt level is a decreasing function of the volatility of its earnings, Titman & Wessels (1988) and Booth, et al. (2001).

The *trade-off theory* predicts a negative relationship between leverage and business risk, because financial distress increases with risk. Furthermore, the probability of wasting interest tax shields increases when earnings are less than tax shields, Frank & Goyal (2008). Additionally, *pecking order theory* predict a negative relationship between leverage and business risk, because firms with high volatility of results try to accumulate cash during the years that have profit, to avoid under investment in the future.

In this way, we will test the following hypothesis:

H5: Firms with higher risk exhibit lower levels of leverage.

Non-debt tax shield (NDTS)

Some researchers included tax benefits and they found a significant impact on debt ratio and other researchers did not find any support it, Titman & Wessels (1988). The interest of debt is a deductible expense and offers a major benefit in issuing debt, because it raises the amount of after-tax income.

Debt is not the only one tax-free, non-cash expenses are also tax-deductible. Therefore, non-debt tax shield provided by depreciation expense can serve as a substitute for debt tax shield. In this case, the tax reducing property from debt is no longer needed, Cortez & Susanto (2012).

According to *trade-off theory* firms prefer debt because this gives a non-debt tax shield. With very high tax rates, companies will use more debt. As a result, non-debt tax shield has an indirect impact on debt maturity and financial leverage, but it is more protruding in large companies than small ones.

Jarrel and Kim (1994) found a negative relationship between non debt tax shields and leverage on firms classified according to the SIC code (two-digits).

We can say that firms with high depreciation expenses have less need for the interest deductions provided by debt financing. In this way, we will test the following hypothesis:

H6: Non-debt tax shields are negatively correlated with debt.

3. Variables definition and sample selection

3.1. Variables definition

A. Dependent variables

We are interested in studying the determinants that can affect the firm's debt-equity in German companies. As dependents variables we have total debt and long term debt. We will concentrate on book value because it can be justified on the grounds that financial managers focus on book value when designing financial structure, Mackay & Phillips (2005).

In previous studies, some authors use one or two dependent variables to study the leverage. The authors Rajan & Zingales (1995) used the dependent variable as the ratio of total debt to net assets, being that net assets are stated as the total assets less accounts payable and

other liabilities. In turn, Cortez & Susanto (2012) used as the measure of the leverage, the ratio of total debt over total equity.

Many other authors used more than one ratio to analyze the leverage. Chen (2004) analyzed the determinants of firm-level capital structure in China from 1994 to 2000 and used two dependent variables, total debt and long term debt. Booth et al. (2001) analyzed 10 developing countries during the period of 1980 to 1990 and they also used two dependent variables, total debt and long term debt.

We will use two dependent variables and they are measured as the ratio of total debt divided by the book value of total assets and as the ratio of long term debt divided by the book value of total assets:

$TDEBT_{i,t}$ = Total $Debt_{i,t}$ / Book Value of Total $Assets_{i,t}$, firm i in year t;

$LDEBT_{i,t}$ = Long Term $Debt_{i,t}$ / Book Value of Total $Assets_{i,t}$, firm i in year t;

B. Independent variables

We will focus on the following factors: Market-to-book, Size, Profitability, Tangibility, Risk and Non-debt tax shield.

Market-to-book (MB)

Market-to-Book is our proxy for Growth Opportunities, in the line with Rajan & Zingales (1995) and Gaud, et al. (2005). The measure that we will apply is the division between Market Value of Assets and Book Value of Total Assets. In DataStream there isn't the variable Market Value of Assets so we will apply the proxy total assets less common equity more market capitalization.

MB= Market Value of Assets/Book Value of Assets.

Size (SIZE)

There have emerged several measures for size variable. Anderson et al. (2003) use the natural logarithm of total assets as the measure of the size of the firm.

For the present study we define size as the natural logarithm of total sales, like the authors Titman & Wessels (1988) and Rajan & Zingales (1995).

SIZE=LOG (Total Sales).

Profitability (PROF)

The measure used for Rajan & Zingales (1995) was EBITDA divided by book value of assets. In turn, Titman & Wessels (1988) use the measure for profitability the ratios of operating earnings over sales and operating earnings over total assets.

However, we decide to use the measure EBITDA divided by book value because.

PROF=EBITDA/Book value of assets.

Tangibility (TANG)

According with Rajan & Zingales (1995), Cortez & Susanto (2012) and Gaud, et al. (2005) the measure for tangibility is the ratio of fixed assets to total assets.

The measure that we will use is the ratio of fixed assets to the total assets, which we will call "tangibility".

TANG=Fixed Assets/Total Assets.

Risk (RISK)

For the purpose of the present study, standard deviation of return on equity is used as a proxy of the risk. We will focus on business risk and we will use the standard deviation of return on equity over the past three years. We expect that this variable will have a negative impact on the debt ratio, Titman & Wessels (1988) and Booth, et al. (2001).

RISK=Stand. Dev. (ROE).

Non debt tax shield (NDTS)

In this study we use the interpretation of Cortez & Susanto (2012), Titman & Wessels (1988) measured by the ratio of total depreciation and amortization over total assets.

NDTS=Total Depreciation Expense/Total Assets

In the following table we summarize all variables, definition and expected sign of coefficients that we want to analyze.

Table 1 – Definition of all variables.

	Variable		Definition	Expected Sign
Dependent Variable	Total debt	TDEBT	Total Debt/Book Value of total Assets	
	Long-term debt	LDEBT	Long Term Debt/Book Value of Total Assets	
Independent Variable	Market-to-book	MB	Market Value of Assets/Book Value of Assets	-
	Size	SIZE	Log Sales	+
	Profitability	PROF	EBITDA/Total Assets	-
	Tangibility	TANG	Fixed Assets/Total Assets	+
	Risk	RISK	Standard Deviation (Return On Equity)	-
	Non-debt tax shield	NDTS	Total Depreciation Expense/Total Assets	-

Table 1 – Definition of dependent and independent variables and expected sign, according to the literature.

3.2. Sample selection

Our investigation is based on the analysis of German listed companies between 2005 to 2014. Initially we considered all Deutsche Boerse AG stocks located in Germany. We decide to remove financial firms, such as banks and insurance companies, from the sample because their leverage is influenced by explicit investor insurance schemes, Rajan & Zingales (1995). Thus they were removed the following sectors: equity investment instruments, financial services, bank, life insurance and non-life insurance.

The primary source of data is Datastream - Thomson & Financial and our sample period covering the period 2005–2014. We choose this period because in 2005 all European Union listed companies were required to prepare their financial statements following International Financial Reporting Standards, ICAEW (2016). Additionally, we want to study the impact of the financial crisis and to examine if the strength of the relationship between leverage and determinants remains or changes. Furthermore, we removed negative sales observations, negative common shareholders' equity observations and companies that don't have at least five observations.

In our sample, we use book value because financial managers focus more on book value when building financial structure, Mackay & Phillips (2005).

We will try to reduce the impact of outliers and we eliminated 1% of the maximum and minimum values of all variables. The final sample covers 443 firms (4430 observations).

4. Methodology

The main goal of this investigation is to analyze the determinants of capital structure of listed companies Deutsche Boerse AG. Additionally, we want to analyze whether there are three effects: year effect, industry effect and economic crisis effect.

The Data will be organized through panel data. There are some advantages in the use of the panel data. For example, with panel data it is possible to develop more efficient estimators and enables the reduction of the collinearity among the explanatory variables. Our panel data have two dimensions: the panel variable (the names of the companies) and the time variable (the years in analysis). Our panel in unbalanced panel because some data is missing at least one period for at least on entity.

The estimator of the coefficients that we will use is Ordinary Least Squares (OLS) estimators because it minimizes the sum of squared mistakes of the regressions that we will analyze. It is unbiased (the disturbance has zero mean), has constant variance, is consistency, i.e., if the sample size increases indefinitely and the estimations converge to the population values. This estimator presupposes that the factors not included in the model (covered in error term) do not unsettle the mean value of the variable dependent. Additionally, presents no serial correlation and null covariance between estimators and residuals.

In our analysis we will use two regressions: long term debt and total debt regression. These two regressions will be determined separately to analyze the potential relationship between capital structure and its potential determinants. Subsequently, we present two panel data regressions. The regressions will take the following form:

(1) $TDEBT_{i,t} = \beta_0 + \beta_1 MB_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 PROF_{i,t} + \beta_4 TANG_{i,t} + \beta_5 RISK_{i,t} + \beta_6 NDTS_{i,t} + e_{i,t}$

(2) $LDEBT_{i,t} = \beta_0 + \beta_1 MB_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 PROF_{i,t} + \beta_4 TANG_{i,t} + \beta_5 RISK_{i,t} + \beta_6 NDTS_{i,t} + e_{i,t}$

Where i refers to the company and t refers to the year.

Initially we started by estimating the two equations through the simple model OLS. We found that the total debt model has an explanatory capacity of 16,71% and long term debt has an explanatory capacity of 14,87%.

However, we haven't decided yet between using fixed effects or random effects in cross-section effects and in period effects. One of the assumptions of the OLS is that there aren't omitted variables which possibility, are correlated with the included explanatory variables. To verify this situation, we can use Hausman test (1978) test to choose between fixed or random

effects. The null hypothesis is that unobservable individual effects are uncorrelated with the explanatory variables, i.e., random effect model is more appropriate. The alternative hypothesis is that fixed effect model is more appropriate. After the Hausman test (1978), we rejected the null hypothesis wich presented a significant level of 5% and we concluded that the best model to use is the fixed effects model.

In this way, we pretend to analyze the following effects: year effect, economic crisis effect and industry effect. The goal is to analyze the various effects and examine whether these effects apply in our sample.

Regarding the effect year, we use 9 dummy variables to verify the interaction between year and the debt level. The regressions will take the following form:

(3) $TDEBT_{i,t} = \beta_0 + \beta_1 MB_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 PROF_{i,t} + \beta_4 TANG_{i,t} + \beta_5 RISK_{i,t} + \beta_6 NDTS_{i,t} + \beta_7 Y6_{2006} + \beta_8 Y7_{2007} + \beta_9 Y8_{2008} + \beta_{10} Y9_{2009} + \beta_{11} Y10_{2010} + \beta_{12} Y11_{2011} + \beta_{13} Y12_{2012} + \beta_{14} Y13_{2013} + \beta_{15} Y14_{2014} + e_{i,t}$

(4) $LDEBT_{i,t} = \beta_0 + \beta_1 MB_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 PROF_{i,t} + \beta_4 TANG_{i,t} + \beta_5 RISK_{i,t} + \beta_6 NDTS_{i,t} + \beta_7 Y6_{2006} + \beta_8 Y7_{2007} + \beta_9 Y8_{2008} + \beta_{10} Y9_{2009} + \beta_{11} Y10_{2010} + \beta_{12} Y11_{2011} + \beta_{13} Y12_{2012} + \beta_{14} Y13_{2013} + \beta_{15} Y14_{2014} + e_{i,t}$

Where i refers to the company and t refers to the year.

Additionally, we pretend to study the economic crisis effect. The regressions (3) and (4) will be calculated separately: first between 2005 to 2008 and the second 2008 to 2014. We want to analyze the effect of financial and economic crisis. The goal is to analyze if the economic crisis has had some impact on the determinants of capital structure.

Furthermore, we intend to study if there are differences between industries. Based on the SIC Code of listed companies of our sample, we classify the companies according Fama & French (1997) 12 Industry Classification. The application of this model allows access to the development of a proxy which consists of several companies in the same industry. The industries sectors are as follows: Consumer Nondurables – constituted by food companies, tobacco companies, textile companies, apparel companies, leather companies and toy companies; Consumer Durables – constituted by car companies, TV companies, furniture companies and household appliances companies; Manufacturing – constituted by machinery companies, trucks companies, air craft companies, paper and printing companies; Energy – constituted by oil companies, gas and coal extraction companies in addition to product companies; Chemicals and Allied Products; Business Equipment – constituted by computers

companies, hardware and software companies plus electronic equipment companies; Telephone and Television Transmission; Utilities; Wholesale, Retail and some services (laundry and repair shops); Healthcare, Medical Equipment and Drugs; Finance; and Other – constituted by mining companies, construction companies, transportation companies, hotel companies, business service companies and entertainment companies. We decided to introduce eleven dummy variables to regression (1) and (2) as follows:

(5) $TDEBT_{i,t} = \beta_0 + \beta_1 MB_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 PROF_{i,t} + \beta_4 TANG_{i,t} + \beta_5 RISK_{i,t} + \beta_6 NDTS_{i,t} + \beta_7 D2 + \beta_8 D3 + \beta_9 D4 + \beta_{10} D5 + \beta_{11} D6 + \beta_{12} D7 + \beta_{13} D8 + \beta_{14} D9 + \beta_{15} D10 + \beta_{16} D11 + \beta_{17} D12 + e_{i,t}$

(6) $LDEBT_{i,t} = \beta_0 + \beta_1 MB_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 PROF_{i,t} + \beta_4 TANG_{i,t} + \beta_5 RISK_{i,t} + \beta_6 NDTS_{i,t} + \beta_7 D2 + \beta_8 D3 + \beta_9 D4 + \beta_{10} D5 + \beta_{11} D6 + \beta_{12} D7 + \beta_{13} D8 + \beta_{14} D9 + \beta_{15} D10 + \beta_{16} D11 + \beta_{17} D12 + e_{i,t}$

Where i refers to the company and t refers to the year.

Table 2 presents the 12 industry classification codes, according with Fama & French (1997). Consumer Nondurables (D1) was not included in the regressions. As we can see, our sample is heterogeneous. The industry with the largest number of companies is Business Equipment and the industry with the least number of companies is Oil, Gas, Coal Extraction and Products.

In order to reduce the effect of possible outliers in results, we eliminated 1% of the maximum and minimum values of all variables.

5. Results

5.1. Univariate results

We analyzed two regressions in order to test which of the regressions better explains the leverage of German companies that belong to Deutsche Boerse. The descriptive statistics are presented in table 3. We will analyze mean, median, standard deviation, maximum value, minimum value and the number of observations for dependent and independent variables from 2005 to 2014.

Table 2 –Fama and French industry classification.

	Dummy Variables	Percentage of companies
Consumer Nondurables	D1	7%
Consumer Durables	D2	4%
Manufacturing	D3	19%
Oil, Gas, and Coal Extraction and Products	D4	1%
Chemicals and Allied Products	D5	4%
Business Equipment	D6	24%
Telephone and Television Transmission	D7	3%
Utilities	D8	2%
Wholesale, Retail, and Some Services	D9	7%
Healthcare, Medical Equipment, and Drugs	D10	7%
Finance	D11	2%
Others*	D12	20%

Note: Table 2 Catalog the sample with Fama & French industry classification. Others* includes sectors such as Mining, Construction, Transportation, Hotels, Business Services and Entertainment.

As we can see in the table 3, the average of the variable total debt is 18,71% and the average of the variable long term debt is 12,28%. This means that German companies have low level of leverage. According with Rajan & Zingales (1995) part of the low leverage occurs because of the way pension liabilities are treated. It is possible to see that the minimum debt amount is zero so there are companies with no debt in their capital structure.

When we analyze the standard deviation of our independent variables only Profitability and Risk presents high dispersion because is bigger than the mean of the variables. All other variables, MB, SIZE, NDTS and TANG, have little volatility.

As expected, our sample consists in large German firms and this justifies the mean of the SIZE variable (513,93%). We can also see that there is considerable difference between the maximum and minimum values.

The variable MB presents an average of 157%, whereas the maximum value is 871,30% and the minimum value is 33%. We can say market valuation on average is 157% of the book

values of the companies. The variable PROF has an average of 7,76%, and we can note that there are indebtedness firms, because the minimum value of this variable is negative. The standard deviation of the variables under analysis is low, with the exception of the MB ratio, SIZE and RISK variable.

Table 3 – Descriptive statistics for all variables.

	Mean	Median	Std. Dev.	Maximum	Minimum	Observations
TDEBT	0,18711	0,15298	0,18150	0,84757	0,00000	4224
LDEBT	0,12280	0,07297	0,14453	0,73668	0,00000	4224
MB	1,57236	1,23663	1,06801	8,71299	0,33579	4182
SIZE	5,13933	5,07233	1,07891	7,86627	1,82608	4112
NDTS	0,04475	0,03672	0,03630	0,26161	0,00000	4187
TANG	0,19414	0,13530	0,18937	0,86086	0,00171	3389
PROF	0,07763	0,10209	0,16506	0,50796	-0,99250	4182
RISK	0,42483	0,09366	1,21160	13,48490	0,00664	4126

Note: Table 3 presents the descriptive statistics for all variables. TDEBT is Total Debt/Book Value of total Assets. LDEBT is Long Term Debt by Book Value of Total Assets. MB is Market Value of Assets by Book Value of Assets, SIZE is Log Sales, NDTS is Total Depreciation Expense by Total Assets, TANG is Fixed Assets by Total Assets, PROF is EBITDA by Total Assets. RISK is Standard Deviation of the Return On Equity. We analyze 443 German companies during 2005-2014 and this represents 4430 firm-year observations.

Table 4 shows Pearson's correlations between all explanatory and dependent variables. As we can see the correlation between the variables is very low and we don't need to be concerned with the multi-collinearity problem in regressions. The variables that have a negative impact on LDEBT are MB ratio and RISK. MB and RISK have negative impact on LDEBT. Otherwise, SIZE, NDTS, TANG and PROF have positive impact on LDEBT. The only variable that affects negatively TDEBT is MB. This occurs, because firms with higher growth opportunities use more leverage for financing their activity. The variable TANG has a positive relationship in the two regressions. As we said earlier, if one company has lot of tangible assets it can serve as collateral, diminishing the risk of the lender and the agency costs of debt.

Table 4 – Pearson's correlations.

	MB	SIZE	NDTS	TANG	PROF	RISK
MB	1,00000					
SIZE	-0,18344	1,00000				
NDTS	-0,02471	-0,01698	1,00000			
TANG	-0,18043	0,17667	0,14337	1,00000		
PROF	-0,04539	0,29646	0,05746	0,09150	1,00000	
RISK	0,02312	-0,03318	0,01173	-0,05317	-0,08290	1,00000

Note: Table 4 present Pearson's correlations between all explanatory variables. TDEBT is Total Debt divided by Book Value of Total Assets. LDEBT is Long Term Debt divided by Book Value of Total Assets. MB is Market Value of Assets divided by Book Value of Assets, SIZE is the Log of Sales, NDTS is Total Depreciation Expense by Total Assets, TANG is Fixed Assets divided by Total Assets, PROF is EBITDA divided by Total Assets. RISK is the Standard Deviation of the Return on Equity. We analyze 443 German companies during 2005-2014 and represents 4430 firm-year observations.

5.2. Multivariate analysis

The model has been estimated using Ordinary Least Squares estimation technique through panel data. The aim of this study is to identify the determinants of capital structure of non-financial German firms which belong to Deutsche Boerse. Then we will analyze the previously identified determinants considering three effects: year effect, industry effect and economic crisis effect.

- **Year effect**

In order to test which determinants, influence the structure of capital, we estimate the equation (3) and (4). In column 1 of Table 5 we can see the independent variables coefficients, while columns 2 and 3 present coefficients regressions results for total debt (TDEBT) and long term debt (LDEBT) regressions, respectively. These variables only differ in the numerator, because the denominator is total assets.

It is evident from table 5 that the F-statistic, for both equations, is significant at 1% level. This means that explanatory variables have an important role in determining capital structure of German companies. The determination coefficient (R-square) measures the capacity of the regression model in predicting the values of the dependent variable and the fraction of the variance of the explained variable by the regression. Our R-square is 80,97% and 75,16% respectively for equations total debt and long-term debt, respectively. When the dependent variable of the regression is the variable total debt all variables are statistically highly

significant. However, when the dependent variable is long-term debt, non-debt tax shield and the variable risk loses significance.

The variable size (SIZE) has a positive and significant association between total debt and long-term debt. In the first regression when size increase 1%, total debt increase 6,05% and long-term debt increase 4,25%. As expected by *trade-off theory*, big firms have more possibilities to issue debt. One of the reasons why this happens is because large firms are more diversified and have lower risk of bankruptcy. Another reason is that large companies have dilute ownership and have loss control from bankruptcy, Chen (2003). This combination confirms hypothesis 1 and are consistent with the results obtained by Acedo-Ramírez & Ruíz-Cibestre (2014).

The variable market-to-book (MB) presents a negative association between total debt and long-term debt, and they are highly significant. When the Market-to-book increases by one, TDEBT decreases 1,32% and long-term debt decrease 0,83%. These results are consistent with *trade-off theory*. Firms, with growth opportunities are more likely to lose value in financial distress. This combination confirms the hypothesis 2.

The variable profitability (PROF) has a negative association with total debt and long-term debt, with high significance. In this case, if the profitability increases 1% total debt decrease 12,86% and long-term debt decrease 5,07%. This result support our hypothesis 3. Titman & Wessels (1988) and Fama & French (2005) refers that equity is not as expensive as debt, therefore firms can choose equity over debt if they are profitable. We can also say that profitable companies can choose to issue their equity several times to decrease the difference between their market value and their book value. This result is in line with *pecking order theory* for high profit firms use internal financing whereas low profit companies are more indebtedness because they have insufficient resources. Additionally, our results are not in line with the predictions of the *trade-off theory* because this theory refers that profitable companies are more likely to have a high tax burden and low bankruptcy risk Sayilgan, et al. (2002).

The variable tangibility of assets (TANG) has a positive association with total debt and long-term debt, both with statistically highly significant. In this case, we find support for our hypothesis 4. This result is in line with Rajan & Zingales (1995), Booth, et al. (2001) and Cortez & Susanto (2012). In practice, when tangible assets of the company increase 1%, total debt increase 18,24% and long-term debt increase 13,55%. This indicates that companies look for resources to finance their investments, which means guarantees for lenders. We can say that

this positive relation is in line with the *trade-off theory*, indicating that fixed assets are used like a bank guarantee making access to loans easier. Companies will use more debt because the cost of debt is smaller and retains internal equity. *Agency theory* predicts positive relationship, because agency costs of equity leads to underinvestment problems, and our results are on accordance with this theory. This result is in agreement with *pecking order theory* and we can say that with high levels of fixed assets, the problems with asymmetric information are smaller, and debt issue less debt.

The variable risk (RISK) has a positive association and statistically significant with total debt and long-term debt. In the case of German companies when risk increase 1%, total debt increase 0,44% and long-term debt increase 0,16%. This result doesn't support our hypothesis 5 but is in line with the results of Booth, et al. (2001). According with these authors, the sign is different across different countries, different industries and different legal systems.

The variable non-debt tax shield (NDTS) show a positive and highly significant association with total debt as well as a negative association with long-term debt. In relation to equation (3) when non-debt tax shield increases 1% the total debt increases 23,23% and in the equation (4) when non-debt tax shield increases 1% long-term debt decreases 5,84%. Our prediction is confirmed in long-term debt regression and is consistent with the *trade-off theory*. This relation is explained by DeAngelo & Masulis (1980), i.e., depreciation expense can substitute interest expense offered by debt like tax shield. If a company has many depreciation expenses, the incentive to use debt decreases. However, in total debt regression the coefficient is positive and highly significant. This result is not in accordance with *trade-off theory*, because according to this theory firms with high level of non-debt tax shield are expected to have less debt than other firms, i.e., firms with non-debt tax shields have tax benefits and they have no tax incentives to issue debt, Fama & French (2002). Thus, we will have to reject our hypothesis 6.

Analyzing now year dummy variables, in the regression (3) all year dummy variables coefficients are positive but only Y07, Y08 and Y09 are statistically significant. This means that compared with 2006, the debt level of German listed companies increased in 2007, 2008 and 2009. This is maybe related to the 2008 financial crisis because during the entire period the coefficients are positive but only the year before, during economic crisis and the year after economic crisis became significant.

Table 5 – Panel Data regressions.

Independent Variables	Dependent Variables	
	TDEBT	**LDEBT**
B0	-0,150309*** (-2,988417)	-0,115082** (-2,525213)
Y06	0,004734 (0,678844)	0,010605* (1,680369)
Y07	0,017997** (2,409120)	0,018360*** (2,715818)
Y08	0,020030*** (2,650039)	0,012016* (1,756456)
Y09	0,022767*** (3,052223)	0,021618*** (3,207804)
Y10	0,012020 (1,611472)	0,014081** (2,086684)
Y11	0,002613 (0,346849)	0,005202 (0,761295)
Y12	0,004975 (0,646980)	0,007888 (1,134509)
Y13	0,002363 (0,308728)	0,007540 (1,090688)
Y14	0,003501 (0,447899)	0,014142** (1,996576)
MB	-0,013151*** (-5,135558)	-0,008275*** (-3,590926)
SIZE	0,060716*** (6,166495)	0,04209*** (4,778937)
NDTS	0,232337*** (2,810776)	-0,058418 (-0,781231)
TANG	0,182782*** (9,260596)	0,135631*** (7,598337)
PROF	-0,128466*** (-7,23991)	-0,050647*** (-3,530090)
RISK	0,004129** (2,104760)	0,001466 (0,826036)
R^2	0,809635	0,751610
Adj. R^2	0,778154	0,710533
F-statistic	25,71811***	18,29762***
Total panel (Unbalanced) observations	3003	3003

Note: Table 5 summarize the estimation of equation 3 and 4. The dependent variable are TDEBT (Total Debt/Book Value of total Assets) and LDEBT (Long Term Debt/Book Value of Total Assets). The explanatory variables are: MB (Market Value of Assets/Book Value of Assets), SIZE (Log Sales), NDTS (Total Depreciation Expense/Total Assets), TANG (Fixed Assets/Total Assets), PROF (EBITDA/Total Assets) and RISK (Standard Deviation (Return On Equity). We use Ordinary Least Squares (OLS), panel data, during the period: 2005-2014. Coefficient values are listed at the first row and t-statistics are in brackets. The symbol * means that the variables is significant at 10% level, ** means that the variable is significant at 5% level, and *** means that the variable is significant at the 1% level.

In regression (4) all coefficients are positive and only Y11, Y12 and Y13 are not statistically significant. This means that comparing with 2005, the debt level increase in 2006, 2007, 2008, 2009 and 2010. Additionally, in 2014 it also increases comparing with 2013. With these results we can´t come to a conclusion.

In short, the coefficients that are not significant for any equations are Y11, Y12 and Y13. So we can say from 2011 to 2013, year dummy variables do not affect structure capital. There are some year dummy variables which affects capital structure but others no. However, in nine years only three years are not statistically significant so we can say it is possible to confirm year effect.

- **Industry effect**

At this time, we will analyze the industry effect. The results for the equation (5) and (6) are present in Table 6. If we estimate regression (1) and (2) without fixed effects or weights, R-squared is 16,70% and 14,87%, respectively. However, if we introduce industry dummy variables and cross-section weights, R-squared is 74,19% and 56,67%, respectively. As we can see the coefficients of dummy variables differ from industry to industry. The explanation for this stems from factors we can not control, like human capital, Talberg, et al. (2008).

The interpretation of dummy coefficient may be difficult in the previous literature, because industry can be a proxy for some variables, like growth or tangibility. However, we have the control of these variables because we introduced them in our model, Talberg, et al. (2008).

The dummy coefficients are significant and the constant is negative only when dependent variable is LDEBT. This means that consumer non-durables y-axis interception is negative.

If we analyze regression (5) only industrial dummy coefficient for Oil, Gas and Coal Extraction and Products (D4) is not statistically significant when TDEBT is dependent variable. Furthermore, Telephone and Television Transmission industry (D7) and Finance (D11) are the only industry dummies with positive coefficients: 3,82% and 21,15%, respectively. With respect regression (6) dummies variables coefficients Consumer Durables industry (D2), Manufacturing industry (D3), Oil, Gas and Coal Extraction and Products industry (D4) and Chemicals and Allied Products (D5) are not statistically significant. However, Utilities (D8) is the industry dummy coefficient with negative coefficient. We can note that the level of leverage varies from industry to industry and with different intensities.

Table 6: Panel Data regressions: industry effect

Independent Variables	**Dependent Variables**	
	TDEBT	**LDEBT**
B_0	0,005669 (0,533930)	-0,071261*** (-9,053317)
D2	-0,059431*** (-6,157249)	-0,009250 (-1,154752)
D3	-0,046296*** (-7,725343)	0,006631 (1,305025)
D4	-0,011902 (-0,339689)	-0,003329 (-0,154484)
D5	-0,070053*** (-7,729708)	0,011669 (1,537702)
D6	-0,049436*** (-8,335840)	0,012741*** (2,641023)
D7	0,038180*** (3,795667)	0,106818*** (11,74008)
D8	-0,105898*** (-7,966667)	-0,034302*** (-3,779324)
D9	-0,005285 (-0,689902)	0,040122*** (5,482263)
D10	-0,038991*** (-5,285103)	0,030495*** (5,427750)
D11	0,211518*** (8,330920)	0,166400*** (7,975818)
D12	-0,022297*** (-4,098071)	0,022128*** (4,221040)
MB	-0,023459*** (-13,47708)	-0,012433*** (-10,92124)
SIZE	0,030668*** (21,67147)	0,024436*** (20,38204)
NDTS	0,472799*** (9,066843)	0,100394*** (2,620642)
TANG	0,299324*** (33,61310)	0,260056*** (32,80970)
PROF	-0,078329*** (-6,512402)	-0,028471*** (-3,430555)
RISK	0,002665 (1,624495)	-0,002186* (-1,887395)
R^2	0,741865	0,566652
Adj. R^2	0,740395	0,564184
F-statistic	504,6302***	229,6020***
Total panel (Unbalanced) observations	3003	3003

Note: Table 6 summarize the estimation of equation 5 and 6. The dependents variables are TDEBT (Total Debt/Book Value of total Assets) and LDEBT (Long Term Debt/Book Value of Total Assets). The explanatory variables are: MB (Market Value of Assets/Book Value of Assets), SIZE (Log Sales), NDTS (Total Depreciation Expense/Total Assets), TANG (Fixed Assets/Total Assets), PROF (EBITDA/Total Assets) and RISK (Standard Deviation (Return On Equity). The dummy variables are: D2 (Consumer Durables), D3 (Manufacturing), D4 (Oil, Gas and Coal Extraction and Products), D5 (Chemicals and Allied Products), D6 (Business Equipment), D7 (Telephone and Television Transmission), D8 (Utilities), D9 (Wholesale, Retail, and Some Services), D10 (Healthcare, Medical Equipment and Drugs), D11 (Finance) and D12 (Others). We use Ordinary Least Squares (OLS), panel data, between 2005 and 2014. Coefficient values are listed at the first row and t-statistics are in brackets. The symbol * means that the variables are significant at 10% level, ** means that the variable is significant at 5% level, and *** means that the variable is significant at the 1% level.

The MB ratio is negative and significant. MB ratio is a proxy for growth opportunities and, as we can see, the industries do not need too much debt when they are growing, Talberg, et al. (2008). Growing companies would have more internally funds available to fund new projects and do not need too much debt to financing them. This result is in agreement with *market timing theory*. The SIZE coefficient is positive at a level of 5% significance. This means that the debt level increases with the size of the company. SIZE variable can be interpreted as a measure of asymmetric information and, in this case, we can say large firms are more transparent and more people have access to the information. This result is consistent with Talberg, et al. (2008) and consistent with *trade-off theory*. The TANG coefficient is positive and highly significant for both regressions. This result is consistent with our hypothesis: firms that have more assets tend to have more debt and is consistent with *trade-off theory*, *pecking order theory* and *agency theory*. The PROF coefficient is negative and significant. It demonstrates that firms first use retained earnings and then resort to external financing. This result is in line with *pecking order theory*. The RISK coefficient is negative and highly significant only for regression LDEBT and is consistent with *trade-off theory* and *pecking order theory*, as we predicted. The NDTS coefficient is positive and significant for both regressions, but this result is not in accordance with previous literature. This positive impact can imply that NDTS may not be used as a substitute for interest tax shield.

- **Economic crisis effect**

To capture the effect of the economic crisis in 2008, subsequently we present the results in Table 7, for two dependent variables: LDEBT and TDEBT. The sample was split in 2008, and we will study the period before the economic crisis, 2005-2008, and after the economic crisis, 2009-2014.

Our goal is to analyze if the economic crisis has some effect on the determinants of capital structure of the Deutsche Boerse. As we can see in the table 7, the coefficients of the dummy year variables are positive before the financial crisis and negative after the financial crisis.

The F-statistic of our model is significant, showing that both regressions and periods have potential of forecasting ability. Additionally, our models have high R-squared, for regression TDEBT during 2005-2008 is 87,26% and during 2009-2014 is 83,62%, while for regression LDEBT during 2005-2008 is 79,32% and during 2009-2014 is 77,17%. That means our model has a high explanatory power of the capital structure of German companies.

Table 7 – Panel Data regressions and the economic and financial crisis of 2008

Independent Variables	TDEBT		LDEBT	
	2005-2008	2009-2014	2005-2008	2009-2014
B0	0,028368 (0,276506)	-0,145689** (-1,988879)	0,095765 (1,129327)	-0,193771** (-2,794442)
Y06	0,004971 (0,749017)	-	0,010726* (1,956197)	-
Y07	0,017615** (2,351974)	-	0,018082*** (2,921789)	-
Y08	0,018528** (2,316478)	-	0,010083 (1,520737)	-
Y09	-	-	-	-
Y10	-	-0,011858* (-1,943013)	-	-0,006699 (-1,164831)
Y11	-	-0,020429*** (-3,340406)	-	-0,015807*** (-2,745094)
Y12	-	-0,016823*** (-2,690800)	-	-0,013437** (-2,283559)
Y13	-	-0,020778*** (-3,306347)	-	-0,014950** (-2,531653)
Y14	-	-0,016286** (-2,512877)	-	-0,006697 (-1,095425)
MB	-0,018611*** (-4,492666)	-0,011497*** (-3,010202)	-0,014266*** (-4,132178)	-0,007904** (-2,199219)
SIZE	0,031726 (1,572971)	0,064528*** (4,578394)	0,006661 (0,399848)	0,061251*** (4,591894)
NDTS	-0,043358 (-0,254751)	0,140116 (1,338237)	-0,141736 (-1,007388)	-0,026206 (-0,266655)
TANG	0,167078*** (5,352490)	0,180740*** (5,140072)	0,095047*** (3,683093)	0,144530*** (4,370365)
PROF	-0,187466*** (-6,637757)	-0,112568*** (-5,563114)	-0,103071*** (-4,417843)	-0,042016** (-2,299364)
RISK	-0,002267 (-0,471031)	0,006868*** (2,855050)	-0,001174 (-0,295101)	-0,000671 (-0,296383)
No.Of. Obs.	1212	1790	1212	1790
R^2	0,872627	0,869110	0,858503	0,817883
Adj. R^2	0,813780	0,836021	0,793223	0,771717
F-statistic	14,82884***	26,26572***	13,12539***	17,71584***

Note: Table 7 summarizes the estimation of equation 3 and 4. The dependents variables are TDEBT (Total Debt/Book Value of total Assets) and LDEBT (Long Term Debt/Book Value of Total Assets). The explanatory variables are: MB (Market Value of Assets/Book Value of Assets), SIZE (Log Sales), NDTS (Total Depreciation Expense/Total Assets), TANG (Fixed Assets/Total Assets), PROF (EBITDA/Total Assets) and RISK (Standard Deviation (Return On Equity). We use Ordinary Least Squares (OLS), panel data, during the period: 2005-2008 and 2009-2014. Coefficient values are listed at the first row and t-statistics are in brackets. The symbol * means that the variables are significant at 10% level, ** means that the variable is significant at 5% level, and *** means that the variable is significant at the 1% level.

The MB ratio and PROF for the two periods and both regressions are negative and statistically significant. When the dependent variable is TDEBT, the significance of the

coefficients of the MB ratio and PROF are significant. However, when the dependent variable is LDEBT the significance level of the MB and PROF are 5% during the period 2009 to 2014.

TANG determinant for the two periods and both regressions is positive and highly significant. It means that firms with high fixed assets are more likely to have high debt ratios. The reason is that tangible assets are easy to collateralize and therefore it decreases the agency cost of debt. This result is consistent with previous authors, like Harris & Raviv (1991), Rajan & Zingales (1995). The economic crisis had no impact on this determinant.

NDTS determinant is not significant for TDEBT and LDEBT regression. This result is not consistent with previous results, like Cortez & Susanto (2012). RISK determinant only is significant for TDEBT regression during 2009-2014. SIZE determinant is significant for both regressions during the post-crisis period, 2009-2014.

6. Conclusion

The capital structure is a very important theme for managers to take into consideration when making optimal strategic decisions. The goal of the capital structure investigation is to find the optimal capital structure because it allows access the highest value of a company. Optimal capital structure needs a tradeoff between the tax advantages of borrowed money and the costs of financial distress. There does not yet exist an universal theory of the debt-equity choice, however the theories that we examine in this investigation are the following: the *trade-off theory*, the *pecking order theory*, the *market timing theory* and the *agency theory*. The *trade-off theory* says that firms search for debt levels that balance between tax advantages of more debt against the costs of possible financial distress. The *pecking order theory* states that companies prefer to borrow than issue equity, when internal cash flow is not sufficient to fund capital expenditures. The *market timing theory* refers to the fact of issuing shares at high prices and repurchasing at low prices, (Baker & Wurgler, 2002). The *agency theory* analyzes the relationship between agent (commonly referred to the managers) and principals (commonly referred to the shareholders).

Our main goal is to identify which characteristics of German companies affect the decisions made by managers to finance their projects. Additionally, we aim to identify which theory better explains the German capital structure. For the analysis, we used a sample with 443 companies related to the Deutsche Börse during the period of 2005-2014, panel data and the ordinary least squares with cross-section fixed effects and year dummy variables. Our

dependent variables are total debt (it is measured by the ratio total debt and book value of total assets) and long-term debt (it is measured by the ratio long-term debt and book value of total assets). The determinants that we analyzed are market-to-book, size, profitability, tangibility, risk and non-debt tax shield.

The result of this study shows that there is no theory that stands out. They are all relevant. Regarding the year effect, all year dummy variables positively affect the total debt and long term debt. With regard to the industry effect is also observed which means that industry is an important determinant when we are analyzing capital structure of the German companies. In relation to the economic crisis effect, dummy variables have a positive impact on leverage before 2008 and shows a decrease of leverage during the period after the financial crisis.

In relation to the industry effect many dummy variables differ in terms of signs (however for the majority of industries leverage has a positive effect), magnitudes and significant levels. We can say that the level of leverage ranges from industry to industry. The specific characteristics of the industry can justify these differences. It is also noted that the results differ if the dependent variable is the total debt or long-term debt.

The main limitations of our study corresponds to the fact that only the companies that belong to Deutsche Boerse were analyzed. Additionally, the restrictions introduced in selecting the sample is also a limitation, because some have been eliminated according to our assumptions. One should also be careful when comparing this study with others because the variables or the sample are different than in other studies.

Future research can include an analysis of the effect of taxes in the capital structure for German companies, like corporate and personal income taxes. This topic was addressed by (Faccio & Xu, 2015), however it did not examine German firms in particular. Additionally, to further study this subject, an individual analyzes of each industry can be made, by applying the regressions to every business industry and developing market comparisons. It would also be important to analyze country specific factors, because as we have seen capital structure is influenced by other factors beyond firm-specific factors.

7. References

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