Optimal Capital Structure and Global Financial Crisis: A Case Study of German Non-Financial Corporations

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ABSTRACT

After an extensive literature review, it seems that there exists a considerable gap and inadequacy on examining the effects of global financial crisis on the capital structure and its important determinants for firms. Accordingly, the main objectives of this research work are two folds; first is to examine the relationships between the determinants of capital structure and the leverage. Secondly, investigate the impact of the global financial crisis on these determinants and their relationships.

In order to do this, 43 non-financial companies from 5 different sectors in Germany which are publicly traded in Frankfurt Stock Exchange (FSE), have been considered and explored. The effects of the crisis are investigated by dividing the data period into two distinct time intervals as the pre-crisis (2004-2007) and the post-crisis (2008-2011) periods. Here, we use the panel data analysis by the ordinary-least-square and fixed effects techniques on the regression model for the capital structure. The study follows to explore the possible relationships of the important determinants and the influences of the crisis on these determinants of capital structure during the mentioned periods.

In this respect, the relation of tangibility, profitability, size, growth, non-debt tax shield, age and liquidity with the leverage of the firm is discussed. We found that tangibility, size and liquidity have positive relation while profitability and non-debt tax shield have negative relationship with the leverage. Further, examining the effects of the crisis on these determinants shows that during the crisis the tangibility,

profitability and size are relatively more influential and thus they play more significant role on the capital structure decisions.

Keywords: Capital Structure, Leverage, Global Financial Crisis

ÖZ

Kapsamlı bir literatür taraması sonrası, firmalar için yapılan çalışmalarda, küresel krizler söz konusu olduğunda, sermaye yapısı ve onların belirleyici faktörleri üzerine yeteri kadar çalışma olmadığı görülmüştür. Bu yüzden bu çalışmada sırasıyla sermaye yapısının belirleyici faktörleri ve kaldıraç faktörü arasındaki ilişki yanında krüsel mali kriz etkileri gösterilme hedeflenmektedir. Bunun için, Almanya'nın, mali sektor dışında olan, 5 farklı sektöründen Frankfurt Borsasında listelenmiş olan 43 şirket incelenmiştir. Krizin etkisi, veriyi iki farklı zaman aralığına bölerek sırasıyla 2004-2007 kriz öncesi ve 2008-2011 kriz sonrası dönemlerini incelenerek belirlenmiştir. En küçük kareler yöntemi kullanılarak panel veri analizi ve sabit etkiler teknikleri sermaye yapısı için regresyon analizinde kullanılmıştır. Belirlenen dönemlerde krizlerin belirleyici faktörleri ve birbirleriyle olan ilişkileri bu çalışmada gösterilmiştir. Bu çerçeve içerisinde, firmalar için, sabit varlıkların büyüklüğü, karlılık, toplam varlık büyüklüğü, büyüme, amortisman oranı (amortisman vergi kalkanı), yaş, likidite ve kaldıraç faktörü arasındaki ilişkiler belirlenmiştir. Analizlere göre bu çalışmada, sabit varlıkların büyüklüğü, toplam varlık büyüklüğü ve likidite kaldıraç faktörü ile olumlu ve pozitif bir ilişkiye sahipken, karlılık ve amortisman oranı kadıraç faktörü ile negatif bir ilişkiye sahip olduğu tespit edilmiştir. Krizlerin belirleyici faktörler üzerindeki analizi, sabit varlıklar toplamı, karlılık ve toplam varlıkların büyüklüğünün kriz dönemlerinde sermaye yapısı kararlarında daha etkili olduğunu göstermektedir.

Anahtar Kelimeler: Sermaye Yapısı, Kaldıraç Faktörü, Finansal Kriz

To My Family

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LIST OF ABBREVIATIONS

LIQ	Liquidity
LTD	Long-term Debt
MV/BV	Market to Book Value
NDTS	Non-debt Tax Shield
PROF	Profitability
STD	Short-term Debt
TANG	Tangibility
TA	Total Asset
TD	Total Debt

Chapter 1

INTRODUCTION

In this introduction chapter the background for the subject will be presented, together with importance and purpose of the study. Further, the basic research questions, objectives, terminology, definitions and delimitations will be explained. Finally, the structure and organization of the chapters are outlined to give an overview to the reader.

1.1 Background of the Study

Financing decisions for investments has always been one of the most challenging tasks for companies to determine their best financial composition or optimal capital structure. The main aim of a financial manager would be addressing a maximum firm value through these decisions. Therefore, in order to maximize the firm value a financial manager needs to determine where to invest and how to promote the start-up companies and support them during their different developing phases. On the other hand, the way of financing the assets of companies regarding how much debt and equity are used has an important role on financing decisions of a corporation (Myers 2001, and Brounen et al., 2006). Another important factor is to identify the determinants of a corporation and understand the way that these determinants affect the capital structure of companies. This is due to the fact that the companies must be managed to manifest an optimal capital structure upon the impacts of such determinants. Extensive researches have already been done on the determinants of capital structure and exploring how their effects lead to the minimum cost of the

capital. However, a little notification is done to show how these determinants of capital structure and its corresponding expected minimum cost of capital is affected by financial crisis. The substantial importance of investigating the effects of crisis on the determinants of capital structure is trying to help companies to adapt themselves with the crisis and also help them to recover themselves immediately after crisis. Therefore, the impacts of the determinants like size of the company, asset structure, profitability, growth opportunities, liquidity, non-debt tax shield and its risk on capital structure must be investigated in detail.

To propose a theoretical and quantitative approach to the problem of identifying the possible determinants and their mutual interactions as well as their links to the capital structure, many efforts have been done dating back to 1950 with a considerable number of academic papers.

Of course, there has been a long time belief that the nature of these sorts of problems being as much as complicated in order to be compiled in the framework of a reasonable and well posed theory in this criterion. The starting ploy in this respect is done by Weston (1955) which opened a new window to discuss the possibility of compiling such theories. However, the first influential paper on the theory of capital structure is introduced by Modigliani and Miller (1958). Later on, different theories and various models dealing with capital structure of corporations have been suggested by different authors (Harris and Raviv, 1991; Frank and Goyal, 2003; Frydenberg, 2004 and Myers, 2001).

However, due to the complicated and multivariable nature of the subject, it seems that there is no a unique and complete theory to determine and interpret the factors

which directly affect the capital structure. In other words, they do not provide a perfect answer to the typical questions such as ‘why some of the firms, in order to finance their activities, prefer to use their internal funds as a priority, and some others prefer equity or debt (Myers 2001, Frydenburg 2004, Frank and Goyal 2003, and DeAngelo and DeAngelo 2006)?’.

It is not surprising that Myers (1984) linked the capital structure of corporations to the puzzle and later on Kamath (1997) looked at it as an enigma and the magazine of *The Economists* called it a kind of mystery. Furthermore, Myers (1984) suggested two different theories which were inconsistent with each other! According to him the hypothesis of firms balance their bankruptcy costs using the tax savings from debt (the trade-off theory) on one hand, on the other hand the assumption of firms at first finance their investments with internal funds and then with external funds (pecking-order theory). He believes that upon the trade-off theory one can obtain an optimal capital structure or a target debt ratio and realize an algorithm to balance the debt and equity according to the target adjustments and prohibiting the possible deviations in the course of time. The pecking-order theory, suggests the existing of a preference order over financing choices. Myers (1984) also suggested that these two theories can constitute a combined comprehensive framework, or at least as a part of a general theory, which can help one to explain the existing facts regarding the determinants of the capital structure. In contrast, some experts argue against the integration of these two theories and are looking for a possibly unique and consistent model (Frank and Goyal, 2003).

In this thesis, the effects of each of these factors on capital structure and their possible changes during the global financial crisis of 2008 for some German non-financial companies are considered and explored.

1.2 Purpose and Motivation of Study

Finding a unique optimal capital structure for companies is an important unresolved issue in the finance filed of studies (Myers, 2001). Also there is no a consensus on a single theory that explains capital structure choices properly (Frydenburg, 2004). Despite rigorous efforts done during more than sixty years on findings and justifying the determinants and their possible impacts on the capital structure, there is relatively a little information on how capital structure is affected by the financial crisis. The aim of this research is trying partly to fill this gap by exploring the determinants of capital structure and as a case study, to investigate how capital structure decisions change with the global financial crisis of 2008 in some German non-financial companies.

The research explains different capital structure theories especially those that are commensurate with German corporate world. It also gives a short review of some research works done on German context in order to make a comparison between their results and those obtained here.

The study is considerable regarding the limited works done in terms of finding the determinants of capital structure for German non-financial corporations as well as their importance during financial crisis. According to La Porta et al., (2000) the particular characteristics and specific conditions of individual countries could affect the determinants of capital structure differently. In this respect, Germany is one of

the most developed countries and therefore, it is highly motivated to understand the behavior of non-financial firms in this country. This research considers the financial data of 43 German companies over the two periods of pre-crisis and post-crisis which are specified by the time intervals of 2004 to 2007 and 2008 to 2011, respectively. The corresponding results obtained are expected to help managers to make the optimal capital structure decisions in their future works and possibly react well during the crisis.

1.3 Research Questions

In this respect, the study aims to answer the following questions:

1. What are the major determinants of capital structure and their effect in German non-financial sectors?
2. How has the global financial crisis (2008) affected the capital structure of German non-financial companies and its' determinants?

1.4 Research Objectives

The research emphasizes on investigating the determinants and their possible impacts on the capital structure and their corresponding reactions to the global financial crisis in 2008. To achieve the above goals, this study has followed three objectives. The first is establishing a relationship between determinants of capital structure and debt level of firms in Germany to identify determinants of the capital structure. The second one is examining how these determinants of capital structure and the debt ratios of those firms possibly are affected by financial crisis.

1.5 Coverage and Scope of the Study

This study is based on the data covered by 43 non-financial firms in Germany from five different sectors, i. e., alternative energy; automobiles & parts; electricity; gas, water & multiutilities and technology hardware & equipment. This research is based on analyzing a panel data over periods of 2004-2007 and 2008-2011 using the ordinary least square, fixed effects and random effects methods.

1.6 Limitations

The study is suffering from the following limitations:

a) Our data is limited to the quoted firms listed in Frankfurt Stock Exchange and is used due to their availability.
b) Due to the data temporal limitation (based on the least aged company) the panel data regression is limited to the period of 2004 to 2011.

1.7 Statistical Data Reliability

In spite of the delimitations mentioned in the last section, our data are statistically reliable due to the following reasons:

a) Working with data obtained from 43 companies which is statistically a reliable sample.
b) Germany, as a developed country, releases more transparent and reliable source of data on Thomson – Reuter's database.

1.8 Key Terms and Definitions

Here, the key terms which will be appeared frequently in this study are defined to provide their easier understanding.

Capital Structure**:** capital structure refers to the composition of debt, equity and hybrid securities of a firm's capital in financing its overall operations and investments. Debt is like bonds and loans, equity is like common and preferred stock and hybrid securities are like preferred shares and convertible bonds (Myers, 1984).

Financial Crisis**:** the term financial crisis refers to the situation in which the stock market crashes, financial and non-financial companies fail and assets lose the part of their value (Kindleberger, 1978).

1.9 Disposition

The following chapters are structured as follows:

Chapter two which includes the literature review, starts with an introduction of optimization issue with some examples. Then, the dominant theories in capital structure criterion are introduced. Also the determinants of capital structure and their possible relations with capital structure are explained. Finally, the global financial crisis of 2008 will be discussed.

In chapter three, the research data and methodology is provided together with the models and variables which are used in this study. Also the descriptive analysis and the possible effects of crisis on the results obtained by descriptive analysis are explained. Finally the techniques that are used to analyze the regression results are introduced.

Chapter four outlines the empirical results that are obtained from regression analysis after the correlation analysis that examined the multicollinearity. Furthermore, the

interpretation of results obtained regarding the comparison of pre and post crisis situation for determinants of capital structure are explained.

Finally, chapter five is devoted to the summary and conclusions. In this chapter, reference to the existing empirical studies and results obtained from this research are compared. In addition, determinants that have more impact on the capital structure are identified, as well as their reactions to the global financial crisis of 2008 are discussed.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

As noted before, starting up or operating a corporation as a subset of business organizations needs to implement a capital structure decision made by the managers to get an optimal financing choice. A relatively strong judgment in selection of these choices and their proper combination prohibits the firm from bankruptcy and possible financial distresses. In this respect, one must possibly argue on the basis of theoretical and empirical approaches to reduce the possible errors and discrepancies.

As a generic law, any dynamical system evolves in such a way that obeys an optimization principle. In fact during the evolution process, the system among the infinitely many possible paths (virtual paths) selects that individual path (actual path) that makes some functional to assume an optimum value. However, depending on the number of degrees of freedom which shows the order of intricate nature of that system, the theories based on the respective optimization procedure becomes proportionally complicated. While the models with relatively low number of variables could be studied analytically by simplified theories; on the other hand, systems with higher number of determinants become more complicated to be manipulated by simple analytical formulation. In later case one possible solution of the problem comes out by resorting to the statistical arguments and numerical simulations.

To elaborate the subject, let's have an example from physical dynamical systems. Studying the evolution of a falling body in a one-dimensional gravitational field needs only a single independent variable which is time and the position of the body as a dependent variable. The evolution of such a simple dynamical system could be determined by a very simple and exact dynamical formication based on the Newton's law. While, to study the state of evolution of a many body system it is not possible to predict the final state of the system by obtaining a simple dynamical equation and one needs to look at the issue from statistical point of view. In later case, finding a proper and unique model to express the characteristics of such multi-variable systems is not often satisfied.

Financial problems have, in general, multi-variable nature. Sometimes more than 100 variables and determinants enter the case study and one needs to neglect possibly most of these factors upon their priority to reduce the problem to a relatively simplified form to be solved by analytical or even numerical methods. The degree of satisfaction for approximations and simplifying techniques depends on the nature of the problems under consideration and the boundary conditions such as the local parameters, crisis conditions etc. More often, one must use numerical simulations or statistical analysis to get the reliable results. As an example one may consider the asset of a firm as the sum of debt and equity. For financing an investment there might be infinitely many different choices for combination of debt and equity. However, only one possible combination yields the optimum capital structure. Finding this optimum value is the main aim of the managers who wishes to find it by considering the impact of the relevant determinants through an optimization procedure.

In fact one major goal of this study is to use the appropriate models to obtain such an optimum value for the capital structure of a sample of German companies. The reason for focusing on the German companies is because of the considerable development done on different area in this country as a focal point, such as industry, agriculture, science and technology, etc. It is shown that the models and theories constructed for the capital structure in developed countries are more or less applicable to the same issue in the developing countries (Booth et al., 2001). Of course due to the institutional structure, professional experiences, systematic inspections, governmental monitoring and perfect regulations and clarifications, the required database and completeness of the corresponding data are expected to be more reliable in such countries. Furthermore, due to the research abilities and scientific progress in a developed country, their existing infrastructures and research facilities, academic human resources are the complementary factors to provide and enhance the financial theories and empirical models. It must be emphasized that due to the complicated nature of financial theories and models, there is not still a global theory and universal approach to the capital structure optimization problem, however, these theories and empirical rules are helpful in understanding and possibly predicting the corporate funding behaviors (Sheikh and Wang, 2011). The point that must be taken into account in this respect is that some local determinants and institutional factors might have relative impacts on these behaviors.

The next point is to explore the relationship between determinants of capital structure and leverage in one hand and the effects of financial crisis on the capital structure, on the other hand. This issue which has not already attracted the appropriate attention is very important both from academic and empirical points of view.

In the following sections a review of the different existing and more impressive theories of capital structure, its important determinants and the effects of global financial crisis on those determinants will be presented. In addition, the precedence of the determinants looked upon by different theories and their corresponding weights are explored. Since this study is focalized on the German companies, the reviews are done by emphasizing on the works possibly related to the German corporations.

2.2 Theories

In about past sixty years different theories regarding the capital structure such as Modigliani and Miller (1958), financial distress costs (Copeland and Weston, 1992), agency costs (Jensen and Meckling, 1976), trade-off (Myers, 1984) and (Brigham and Houston, 2004), pecking-order and asymmetric information (Myers, 1984) are proposed by different authors. Here we will briefly discuss these theories and address how they interpret the impact of the related determinants on the capital structure. As noted by Myers (2002), these theories although do not determine the exact total debt ratios for companies, however, they help to realize their expected costs and benefits.

2.2.1 The Modigliani-Miller Theory

The earnest ploy on corporate finance research works has been initiated by the impressive contribution of Modigliani and Miller (hereafter known as M&M, 1958). They assume that the market value is uncorrelated with capital structure in perfect capital markets. By a perfect market they demonstrate a market in which there are no taxes, no agency and transaction costs, no asymmetric information and are also complete. J.M. Gordon (1989) argues that Miller and Modigliani‘s theory is true in this perfect market without mentioned imperfections. Three distinct propositions

have been emerged from M&M theory which deals with the firm's value, cost of equity treatment, and the additional investment cut-off rate. In the following we briefly discuss these issues:

i. They state in "proposition 1" the market value of corporations is not determined by capital structure and the real assets are the determinants of value of a firm. Therefore, there is no optimum capital structure and minimum weighted average cost of capital (Constantinides, 2003). This proposition is based on two important factors, homemade leverage and arbitrage. The former one states that individuals have a corporate leverage as an alternative for homemade leverage when they move across different firms to make risk and returns unchanged. And the later one demarcates that the performance of two firms with a different capital structure should be same.

ii. The M&M's proposition 2 declares that the value of a firm depends on three factors:

1. Rate of return on assets (r_A)
2. Rate of return on debt (r_D)
3. Ratio of debt to equity ($\frac{D}{E}$)

These factors are related as the following formula:

$$r_E = r_A + (r_A - r_D)\frac{D}{E} \tag{2.1}$$

From equation (2.1) one can see that there is a direct relationship between debt to equity ratio and expected return on equity (r_E) which means that as

long as the debt is risk free the expected return on common stock increases by increasing the debt to equity ratio (Prasad et al., 2001). In other words, the increase in expected rate of return on equity is offset exactly by the increase in benefits generated by using more debt.

According to the proposition two the profits that are generated from firm's assets is an indicator of firm's value. In other words, the firm's value and performance is determined by the profits that are created from its assets (Megginson, 1997). The following graph shows the proposition two more clearly:

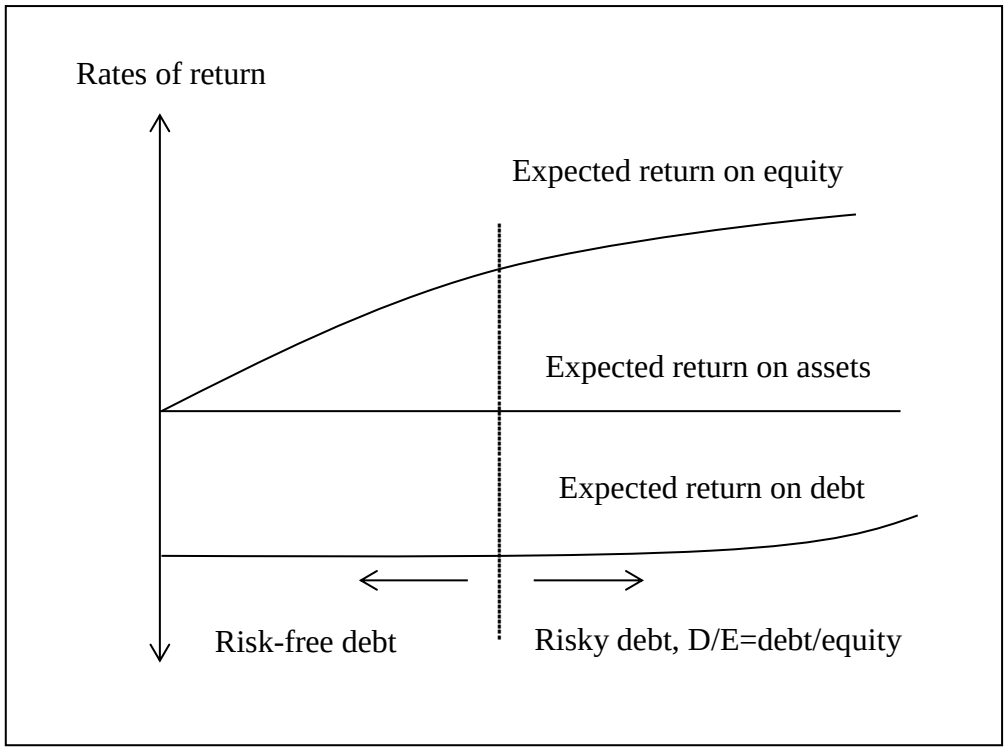


Figure 2.1: Miller and Modigliani Proposition 2, (Brealey and Myers, 2000)

As we see in figure 2.1, at low debt levels the bonds are risk free and the expected return on debt is constant. Thus the expected return on equity

increases linearly by increasing the debt to equity ratio. When the firm continues its borrowing, the probability of default and risk of debt will increase which makes debtholders to require more return. According to the proposition 2 the increase in expected return on debt slows down the increase in rate of expected return in equity.

Since (Miller and Modigliani, 1958) theory is based on assumption of perfect market it leads to the irrelevancy of the capital structure, however, it really leads to investigate existing market imperfections which change the financing decisions such as bankruptcy costs, taxes and etc.

iii. M&M's Proposition III (M&M and Taxes) is a developed version of first proposition. In this proposition Miller and Modigliani corrected their 1958 paper by taking into account the corporate income taxes in their 1963 study on corporate valuation. They state that:

$$\begin{aligned} \textit{Value of a levered firm} &= \textit{value of an un-levered } (\textit{all equity}) \textit{ firm} \\ &+ \textit{discounting the tax benefits from interest} \\ &\quad \textit{payments on debt} \end{aligned} \tag{2.2}$$

So the main difference between theories with and without taxes is the benefit of debt that comes from tax shield of interest payments. Since the M&M irrelevancy theory does not consider the taxes, therefore, these benefits are not included, while in the presence of taxes these benefits are recognized. Thus, with M&M irrelevancy theory the proportion of debt and equity does not affect the value of a firm, but with

consideration of taxes the firm with more debt will have more value because of the tax shield characteristic of debt.

It seems that these benefits from debt will encourage managers to use debt until the hundred percent levels; however, according to Green et al., (2001) this cannot be true because if a firm is all-debt-financed it would be totally bankrupt.

Furthermore, Solomon (1963) introduced an optimal point for debt assuming a state where the marginal cost of borrowing of a company equals to the average cost of capital of that company.

Following graph illustrate the relationship between debt and cost of capital:

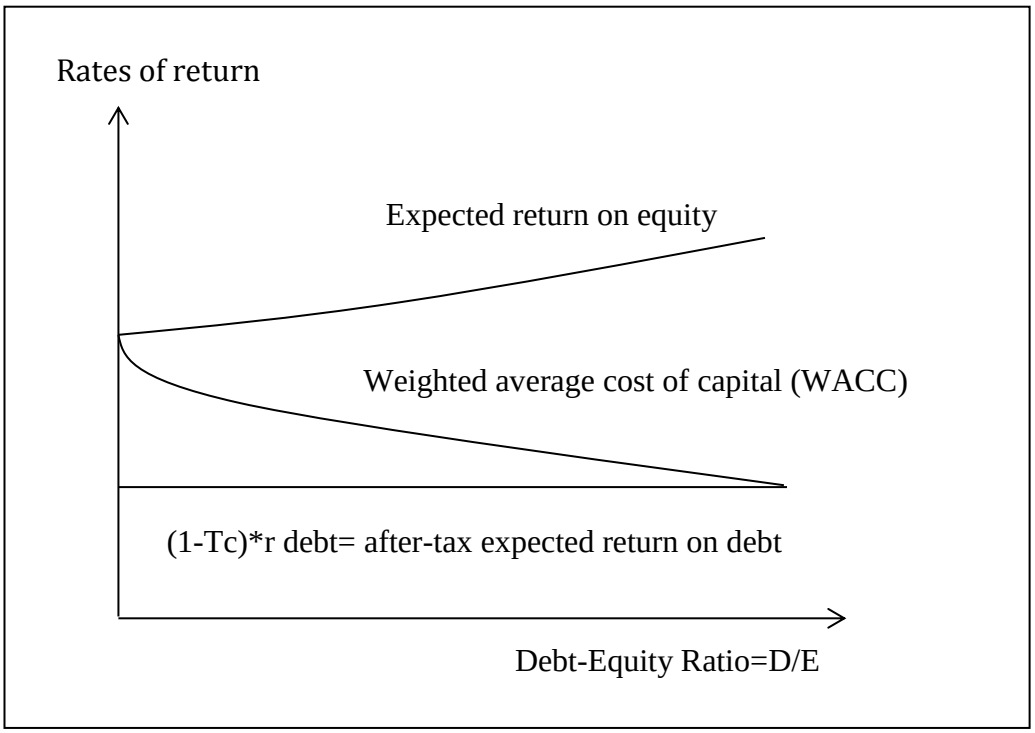


Figure 2.2: Cost of Capital and Debt, (Brealey et al., 1999)

In a world without corporate taxes, the weighted-average cost of capital would not be affected by borrowing. But when the corporate taxes exist because of interest tax shield benefit of debt, the weighted average cost of capital will be reduced. It is seen from the figure 2.2, as a debt-equity ratio of a firm increases the expected return on equity increases with assuming the constant after-tax cost of debt and the weighted-average cost of capital decrease.

According to Miller (1977), because of tax-deductibility benefits of debt, firms has an incentive to borrow more, however, it might be continued until the additional borrowing increases the interest rates up to the point where the tax-deductibility advantage of using debt becomes completely offset by higher rates. Thus, when the income tax rates are equal for both bonds, i.e., the debt and stocks which are equity instruments, the benefits of debt are zero and the value of a firm is independent of the way of financing being consistent with M&M's proposition one.

2.2.2 Financial Distress (Bankruptcy) Costs

Besides taxes, there are other factors which affect the capital structure and one of the most important one among them is the bankruptcy. Financial distress cost has a significant impact on defining the optimal capital structure. It happens when a firm cannot afford its financial obligations to the creditors which sometimes trigger the firms towards the bankruptcy. Financial distress exposure increases when a firm has more liquid assets, high fixed costs and revenues which are sensitive to economic depression.

The value of a levered firm which may bankrupt is calculated as follows as stated by (Brealey, Myers and Allen, 2000):

$$Value\ of\ firm = value\ of\ un-levered\ firm + PV\ (tax\ shield) - PV\ (financial\ distress\ costs) \quad (2.3)$$

Financial distress brings some costs with itself which are classified in two direct and indirect costs. Direct costs of bankruptcy are easy to measure and fast to add up which are related to lawyers, accountants, courts, consultants, experts, legal and administrative expenses.

However, there are some indirect costs which are almost impossible to measure but substantial evidences have shown their importance. These sorts of bankruptcy costs are the ones which have not cash expenses for the firms but it has economic losses. These indirect costs are like, loss of customers, loss of suppliers, loss of employees (Megginson, 1997), loss of receivables, fire sales of assets, delayed liquidation and costs to creditors. Redouane Elkamhi et al., (2009) state that the companies usually expose to these indirect costs before than becoming financially distressed.

Francis A. Kwansa and Min-Ho Cho (1995) show that the role of indirect costs is critical and substantial even rather than direct costs. The average direct cost of bankruptcy is about 3% to 4% of market value of total assets while that of the indirect cost approximately 10% to 20% of pre-bankruptcy value of a firm.

As we noted before the tax benefits of the debt is an incentive for companies to use debt in their financing choices. But by increasing the debt, the exposure to financial distress increases. Therefore, financial managers should keep a balance between tax

shield of debt and the probability of bankruptcy (Baxter, 1967). The figure 2.3 shows that the excess leverage increases the cost of equity that can in turn reduce the firm value.

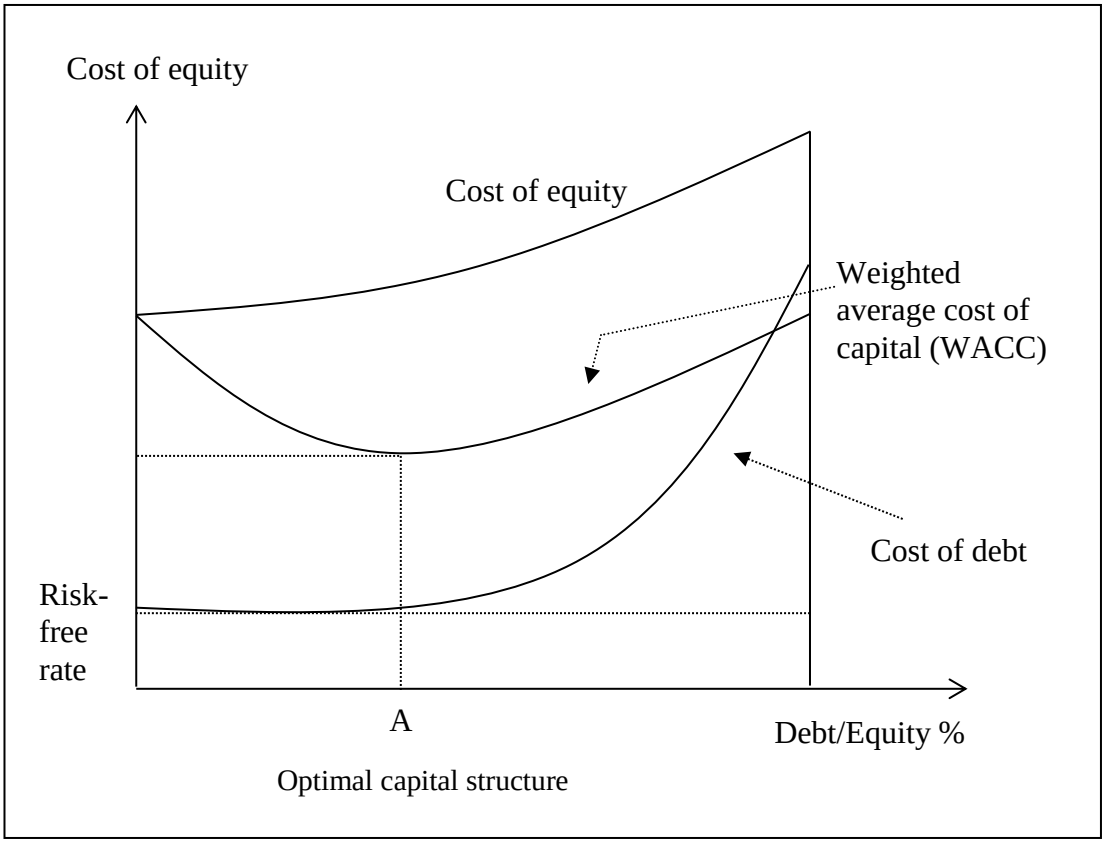


Figure 2.3: Cost of Capital and Optimal Capital Structure, (Copeland and Weston, 1992)

Point A is optimal capital structure where the benefits from debt are equal to the present value of the losses from bankruptcy (Copeland and Weston, 1992).

2.2.3 Agency Costs and Capital Structure

Owners who are also responsible for managing a company will not face with any conflict of interest, because they work for themselves. In case of good performance, they will gain and in case of poor performance they will lose also themselves. So their performance's results have a close relationship with firm's value.

In the large companies management is separated from ownership and it is possible for managers to act in a way which is not in the interest of shareholders (Jensen and Ruback, 1983). Sometimes managers may be tempted to increase their wealth instead of maximizing shareholders wealth, and since they worry about their positions and jobs rather than maximizing shareholder value, they do not pay attention to risky projects but profitable. These sorts of problems which are derived from conflicts between managers' and shareholders' interests are called the agency costs.

According to Jensen and Meckling (1976) agency cost which is a key determinant of firm performance define as a summation of monitoring costs which incur by shareholders to constrain managers, bonding costs and loss in shareholders' value regarding the conflict between principal and agent. They show that these conflicts are represented in three different forms. First of all, since managers want to improve their reputation quickly, they prefer to invest in short-term projects rather than long-term ones which are more profitable. This is in contradiction with maximizing the shareholder value. Secondly, is related to the bankruptcy costs which are derived from high portion of debt that has a tax benefits for managers. On the other hand, in order to reduce the possibility of bankruptcy they prefer to invest in less risky projects with lower return. And the third one may happen when there is an adverse interest between shareholders and managers regarding the operating decisions (Stulz, 1990).

Two types of agency costs which are agency costs of equity and debt are explained in the following paragraphs.

Jensen and Meckling (1976) state that there is no separation of ownership and management when the firm owns by entrepreneurs. Agency cost of equity incur once the ε fraction of the company is bought by outside investors and rest 1- ε will remain for entrepreneur. As the control of the firm by managers decreases they will prefer their benefits to the shareholders' benefits. They also avoid from investing in profitable projects which will reduce the firm performance.

Agency cost of debt incurs as a result of adverse interest between shareholders and debtholders. High proportion of debt to equity in capital structure will expose debtholders to more operating and business risk, but still managers and shareholders have the control of firm's governance and operating decisions. Thus managers have power to transfer wealth to shareholders in many ways like giving dividends and etc. and leave debtholders as empty handed. Debtholders by increasing interest rates or making some covenants will prevent the managers from transferring wealth to shareholders or debtholders.

According to Jensen and Meckling's model, managers in order to avoid the agency cost of debt, start from all equity. But on the other hand, by continuing the process the agency cost of equity will rises with ascending rate. So debt will substitute for equity until the point (optimal capital structure) where the marginal agency cost of adding one unit of debt balances with marginal agency cost of eliminating one unit of equity.

Figure 2.4 shows the agency cost and optimal capital structure.

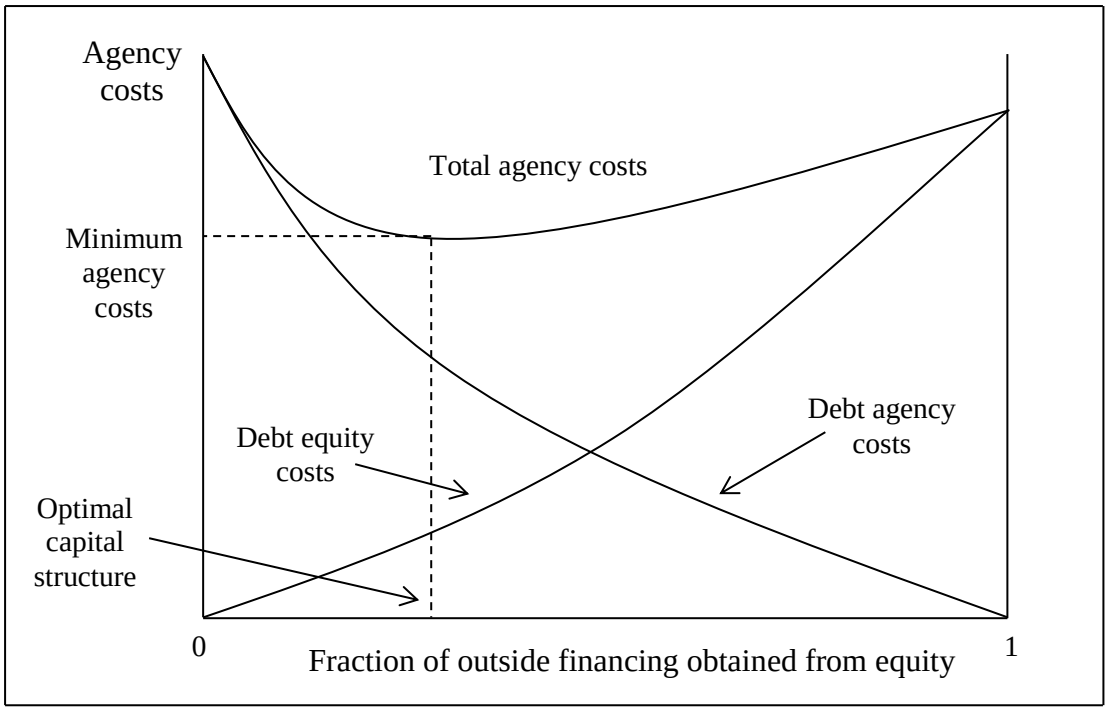


Figure 2.4: Total Agency Cost and Optimal Capital Structure, (Jensen and Meckling, 1976)

2.2.4 The Trade-Off Theory

As a result of these imperfections that are discussed above, (e.g., the tax, the bankruptcy and agency costs), the trade-off theory of capital structure has been emerged. Brigham and Houston (2004) according to this theory the optimal capital structure occurs when the benefits of debt which are tax-savings and the cost of debt like bankruptcy costs and agency costs are balanced. Sheikh and Wang (2011) explain that according to trade-off theory the firms borrow until a point where marginal tax benefit of additional unit of debt creates financial distress costs. Therefore according to trade-off theory moderate and cautious borrowing is suggested. The idea behind this theory is graphically illustrated in figurer 2.5.

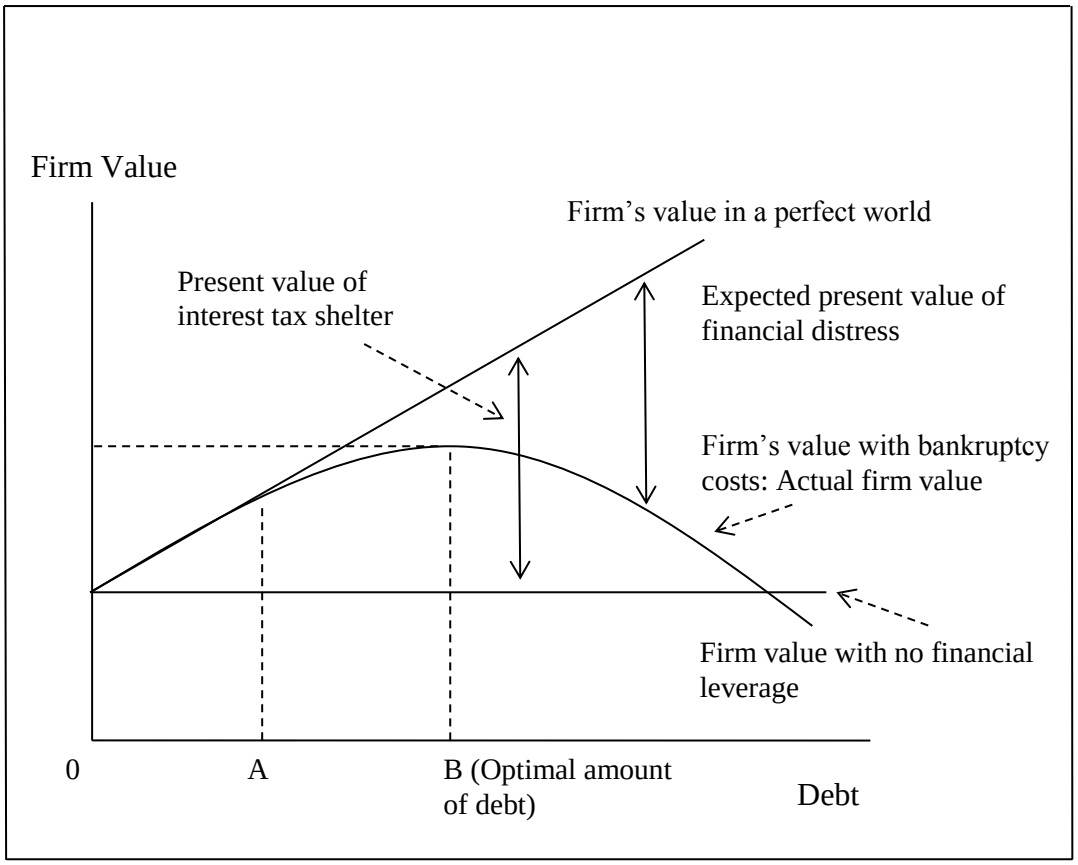


Figure 2.5: The Trade-off Theory of Capital Structure, (Brigham and Houston, 2004)

The figure 2.5 shows that point B is an optimal level of debt where the firm value is maximized. In a perfect world we expect that the firm's value increases monotonically (with constant slope) which is defined as the change in firm value to the change in debt value up to asymptotically infinite point. The straight line shows this, in an efficient market without any imperfections as the amount of debt increases the value of the firm increases, respectively. In existing of bankruptcy costs the straight line does not represent the firm value and it turns to the curved line. By starting from zero debt and go forward until point A where present value of financial distress costs is dispensable, the firm value is increasing as far as borrowing more. From point A to point B the distress costs arise but not as much as tax-shield, so still firm value increases as debt increases but with decreasing rate. The point B where

the tax-benefits of debt are offset by bankruptcy costs is an optimal point denoting the maximum value of the firm. After point B the financial distress costs dominate tax sheltering of debt and this will decrease firm value as leverage increases. Therefore, as noted before, the value of levered firm is equal to the value of all-equity firm plus the value of tax benefit of debt, minus the present value of bankruptcy costs (Brealey and Myers, 2000). Therefore, moderate borrowing is appropriate for the firms according to the trade-off theory.

According to Damodaran (1997) debt is cheaper than equity because of tax deductibility of interest and also debt creates tax savings. As a result, as long as a firm uses more debt its value will be high. The summary of the advantages and disadvantages of debt is shown in Table 2.1.

Table 2.1: Advantages and Disadvantages of Borrowing

Advantages of borrowing	**Disadvantages of borrowing**
Tax benefits: higher tax rates = higher tax benefits	Bankruptcy costs: Higher business risk = higher the costs
Added discipline: Greater the separation between managers and stockholders = greater the benefit	Agency costs: Greater the separation between managers and lenders = higher the costs

Sources: Damodaran (1997)

2.2.5 The Pecking Order Theory

In contrast to the trade-off theory, pecking order theory gives the priority to the internal funds rather than to the external financing choices. According to the pecking order theory, there is a priority in financing sources. Firms prefer internal financing

whenever it is depleted, and then they use debt as an external fund and at last they will issue equity (Myers and Majluf, 1984). They state that because of adverse selection, firms rely on retained earnings then to the debt and in some rare situations they finance their investments by equity.

The key idea regarding adverse selection is that the owners and managers of the firm have information advantages and are aware of the true value of the firm rather than new investors who have just some guesses about this value. Issuing equity by the managers is a signal of overvalued firm, and then the outside investors will ask an additional premium on new equity (Myers and Majluf, 1984) and (Cadsby et al., 1990).

Therefore pecking order theory is based on four hypotheses that were suggested by (Myers 1984) including:

1. Firms prefer internal financing rather than externals, because regarding the asymmetric information the outside investors will require higher rate of return on new capital investment which cause more cost for the firm to finance that investment.

2. When there would be a need for external financing, firm at first will issue more safe securities like debt then convertible bond as and hybrid security, and at the last chance the equity will be issued.

3. Despite the dividends are sticky, the dividend payout ratio is targeted by investment opportunities which will change the target dividend payout ratio, suddenly.

4. Managers tend to pay stable dividend regardless of profit volatility. Sometimes, firm's profits are more than their capital expenditure and in this case they can pay off their debt or invest these cash flows in the market instead of increasing dividend payments. On the other hand, when capital expenditures exceed cash flow generated by internal financing, firms will issue securities rather than cut their dividends.

In summary, pecking-order theory explains some important issues. First the theory shows that since more profitable firms have easier access to internal financing they will have less debt in comparison with those with less profitability which tend to external financing. Second, regarding the external financing it is better to start with safe securities like bond which are less risky and then to issue the equity as a last resort. Finally, regardless of profit volatility, managers mostly prefer to follow the gradual dividend policies.

However, in reality it fails to explain all the aspects of capital structure like agency problem, bankruptcy costs and information asymmetric problem. Also it fails in some situation when the firm wants to choose between convertible and straight debt, since it compares only debt vs. equity as the financing choices (Cadsby et al., 1998).

2.2.6 Asymmetry Information and Signalling Theory

Asymmetry information comes out from pecking order theory which states that managers have information advantages rather than outside investors specially the new ones. If the information power of insiders over outsiders is supposed to be true, so the investors will apply an additional risk premium on new equity issuance which causes to make it undervalued. Therefore, the reason of why managers prefer less

risky form of financing is because of this asymmetric information problem. Since the external debt is less risky than external equity so there is a borrowing preference which affects the market value of the firm. This borrowing preference is used as a positive and optimistic signal to the outsider about the future of the market value of the firm (Megginson, 1997).

An increase in debt issuance is a good signal about the future of the firm and corresponding better performance; however the issue of equity is a signal of bad news (Copeland and Weston, 1992 and Megginson, 1997). Finally the firm's value is affected by capital structure.

2.3 Significant Determinants of Capital Structure

As we noted before the capital structure is a very complicated function of the respective variables. The number of these variables might be very high and the way of dependence on these variables or determinants might be remarkably complicated. In generic case the function might be nonlinear and finding an analytic solution for even limited number of determinants might be impossible. However, one may consider the simplified models which can predict the state of approximate solutions in such a way that take into account a limited number of determinants and possibly in a linearized regime. Obviously, one should consider the relatively significant determinants that might affect the capital structure function. Thus introducing the appropriate determinants and characterizing their priority are the most important part of any modeling procedure. Different models are considered in different studies (Rajan and Zingales, 1995; Titman and Wessels, 1988; Shyam-Sunder and Myers, 1999; Fama and French, 2002; Frank and Goyal, 2003; Gaud et al., 2005; Flannery and Rangan, 2006; Sheikh and Wang, 2011). In this research work we consider the

following determinants and try to explore their relative impact on the capital structure using an optimization procedure.

2.3.1 Profitability

Different definitions for profitability are proposed by different authors in the literature (see for example Harris and Raviv, 1991; Rajan and Zingales, 1995; Bevan and Danbolt, 2000; Huang and Song, 2006). Here we follow the nomenclature given by Huang and Song (2006) as:

$$Profitability = \frac{Earning\ before\ interest,\ tax\ and\ depreciation}{Total\ asset} \tag{2.4}$$

The impact of this determinant on the capital structure is not known exactly yet and its positive and negative role depends on the theory that one chooses to interpret a given data. For example, from the point of view of the pecking order theory the role of this determinants emerges to be negative while it has a positive impact using the trade-off theory, that is the more leverage will be upon the corresponding more profit.

2.3.2 Size

Another very important determinant of the capital structure is the firm size. Rajan and Zingales (1995) conclude that the larger and diversified is the firm the less prone is made to the bankruptcy. They also believe that due to the credit ratings the larger firms are encouraged to get non-bank debt and thus show a positive relationship between corporate size and debt ratio. On the other hand Sheikh and Wang (2011) argue that for large firms the corresponding outgoing information is more and this causes that they should issue less debt and therefore has lower leverage ratio. Also

since the larger firms have an opportunity to have more retained earning according to the pecking order theory the larger firms have lower leverage (Frank and Goyal, 2009).

At most of the empirical studies the proxy of size is the logarithm of total assets or sales. In this study the logarithm of total asset is considered as a proxy of size.

2.3.3 Tangibility

Tangibility is defined as the ratio of the fixed asset to the total asset:

$$Tangibility = \frac{Fixed\ asset}{Total\ asset} \tag{2.5}$$

By fixed asset we mean that the property, plant and equipment.

Tangible assets can be used as collateral which provide security for investors. This reduces the cost of debt and ultimately increases the leverage of the firm. It is argued by Antoniou et al., (2002) and Buferna et al., (2005) that the tangibility has a substantial positive impact on the firm leverage ratio.

In contrast, there are still authors that suppose a negative relationship between the tangible asset and capital structure. Titman and Wessels (1998) argue that the possibility of corporate managers to capture more funds than the optimal value causes this negative impact. However, the overall look to this determinant seems to give it more positive weight than negative.

2.3.4 Non-debt Tax Shield

According to Prasad et al., (2001) and Moore (1986), there is a positive relationship between the non-debt tax shield and capital structure. They argue that this might be

due to the security of debt caused by tangible asset arising from the large non-debt tax shield of the firms. In addition they proposed that in order to reduce the tax bills, the firms prefer to take advantage of interest payments utilized for tax payments.

DeAngelo and Masulis (1980) noted that there is an inverse relation between non-debt tax shielding and the extra saving emerging from the additional debt. In other words, the former one increase as the later one declines which causes the firms total tax liability to be minimized.

Total annual depreciation, amortization and tax credit is used as a proxy of non-debt tax shield frequently in order to consider the tax rate which is not because of interest on debt payment. In this study also the ratio of total annual depreciation, depletion and amortization to total asset is used.

2.3.5 Liquidity

The positive impact of liquidity of assets in a firm has its own complaints and dissidents. From the point of view of the trade-off theory, the liquidity of assets has a negative effect on capital structure. The existence of more liquid asset in a firm prohibits the managers borrow to finance new investments and encourages them more to utilize the interior investments for coming and foremost opportunities. Furthermore, Liquidity has different inference for different investors. Some investors look at the high liquidity as an encouraging factor for a firm due to the fact that a firm with huge liquid assets can overcome to their scheduled commitments and responsibilities. While, the others receive a negative signal from the firms with high liquid assets because it might inhibit the managers to agree on long-term investment

decisions and implement mostly on current opportunities. Liquidity is calculated as current assets to current liability.

2.3.6 Growth Opportunities

The growth opportunities as a determinant of capital structure are looked upon by different authors on the shade different theories and empirical insights. Sheikh and Wang (2011) using the agency theory claim that the growth opportunities unexpectedly has a negative impact on the firm leverage. The reason is that the higher opportunities potentially makes the firms to be more flexible to ploy asset substitution and guide the debt holders to poverty while moving wealth towards the stockholders. The inverse relationship of growth opportunities manifested as an intangible asset is argued by the same authors from the trade-off theory point of view as well. They are reasoning that greater growth opportunities persuade the firms to use more internal equities than borrowing debts as external fund resources.

Other researchers think in different way and attribute a positive conditional impact to the future growth opportunities. For example Green et al., (2001) propose that the reason upon which the growth opportunities are always looked as negative factor on capital structure is that the time interval for implementations are not noted correctly and the long term and short term debt are not distinguished properly. They conclude that nevertheless the long term debts forces the firms with future growth opportunities to have a negative behavior, the short term debts, on the other hand, have a positive impact on the firms leverage. As an overall looking, it seems the growth opportunities force the managers to have more equity than debt.

The proxy for growth opportunities is a company's market-to-book ratio, which reflects investment opportunities.

2.3.7 Firm Risk

The dominant idea on the firm risk as a relatively well know determinant is that there is a directly proportional relation between the firm risk and debt and therefore a direct impact of increasing of firm risk and bankruptcy (DeAngelo and Masulis, 1980). Increasing the firm risk makes the leverage condition more unstable and tolerant which in turn obscures the prediction of the earning level by the investors. In other words the time scales of earning variations are not enough for the investors to decide on the appropriate information and implement reliably. The firm risk makes the leverage unattractive and inhibits the investors to act as an agent that increases the firm values optimal level.

Still there are a few authors that argue on firm risk as a determinant having a positive influence on the capital structure. Klock and Theis (1992) propose that high risky firms to be sustained have to support the long term loan and do not assist any plan upon the short term debts.

2.4 Global Financial Crisis of 2008

Here we review some studies regarding the various financial crisis and its effects on capital structure in different economies. Deesomsak et al., (2004) examined the effects of East Asian financial crisis of 1997 on the capital structure. According to Deesomsak et al. the important determinates of capital structure during and after crisis are liquidity, firm size and non-debt tax shield, while tangibility and earnings volatility are not so important. Balsari et al., (2010) have investigated the impacts of financial crisis of Turkey in 1994 and 2001. They have shown that 1994 crisis

decreases the leverage of the Turkish firms while in crisis of 2001 they increased short-term debt in order to offset liquidity problem. Another research work which has done by Voutsinas and Werner (2011) state that credit supply conditions play an important role in companies financing decisions by testing Japanese firms in banking crisis of 1998 and asset bubble burst in 1989.

However, there are limited numbers of studies regarding the investigating the effects of recent global financial crisis on capital structure and its related determinants (see for example Liu and Mello, 2008; Fosberg, 2012; Fosberg 2013). Therefore, it is reasonable to consider and investigate the impacts of the global crisis on the different determinants of the capital structure especially on the German firms which is believed has a distinguished position among the European countries.

Global financial crisis of 2008 is also known as the US Subprime Mortgage Crisis as well as the liquidity crisis. It was one of the worst financial crises during the past 8 decades, i.e., after the great depression of the 1930s. It is known as subprime mortgage because it is happened as a result of increasing numbers of loans to the people and companies with higher probability of default due to lower interest rate (Bernanke et al., 1996). When the Federal Reserve Bank increased the interest rates (Goodhart, 2008) they could not afford to give the loans back, finally as a results the value of the houses that were used as a collateral for the loans, decreased and created the housing bust (Taylor, 2008). Consequently the banks faced with liquidity problem (Berg, and Kirschenmann, 2010). Therefore, a substantial number of the banks which were relied on the support of the central banks and third parties were bankrupt or took over. This correspondingly, extended to the other firms and finally

appeared as a global crisis very similar to the interaction of the dynamical systems that are not believed to be isolated.

After the financial markets insecurities, which was created in September 2008, when Lehman Brothers collapsed (Kwan et al., 2008), firms started to renew critically their evaluations of their financing decisions of their companies. The incertitude in the financial markets and the sudden bankruptcy of large firms made ambiguity in the credit quality of companies by the investors and less willingness of the investors to invest, and this resulted in credit tightening by the banks (Fosberg, 2012).

In the next chapter after clarifying the behavior of the different determinants of capital structures by investigating a reliable sample data obtained from the German firms, we will implement to study the effects of the mentioned global crisis on these firms as well as their subsequent reactions.

2.5 Capital Structure of Germany

Germany as a developed country has been considered in different comparative studies in regards to capital structure. (Rutherford, 1988; Rajan & Zingales 1995; Weinstein and Yafeh, 1998; Antoniou et al., 2002; Jong et al., 2008; Feld et al., 2013).

Germany follows the *Germanic* tradition where universal banks and financial holdings take corporate decisions and restructuring are made by them. In addition, capital markets are not as effective as in the *Anglo-Saxon* tradition and there are relatively fewer listed companies (Antoniou et al., 2002). Also they state that lenders of German firms, especially the banks, are frequently represented in the supervisory

board of the companies and work in close contact with the management. Thus, the lenders are likely to be fully aware of the quality of investment opportunities. This minimizes information asymmetry which in turn affects the borrowing ability of the firms and the risk premium demanded by the lenders. Aggregate debt levels are higher for Germany as a more bank-oriented approach than in the market-oriented countries such as U.S. and U.K (Rutherford, 1988). Since banks extract rent from their corporate customers, bank dependence can lead to a higher cost of funds for firms, (Weinstein and Yafeh, 1998).

Jong et al., 2008 found that many industrialized countries have a median leverage ratio of less than 10% (e.g., Australia, Austria, Belgium, France, Germany, Greece, Italy, Japan, The Netherlands, Sweden and the UK). However, large countries like the US, Japan or Germany indeed tend to have higher tax rates (Feld et al., 2013), so they prefer debt financing rather than equity because of tax savings benefit of debt.

Chapter 3

RESEARCH DATA AND METHODOLOGY

In Chapter 2, a literature review on capital structure theories, important determinants of capital structure and their mutual relations were presented. There are reasonable amount of studies that have investigated the capital structure determinants and have tried to design and estimate an optimal capital structure for a better fulfillment of corporations. This study beside those efforts try to analyze the startup, evolution and current activity conditions of number of German companies and to show that whether the global financial crisis in 2008 affects their capital structure or not.

In this regards, we implement to make a comparison of capital structures which were carrying on before and after the global financial crisis. The study starts with a research design and then the relevant data and sample will be introduced. Furthermore, the descriptive and correlation analysis will be explained. At last, the required model and manipulation techniques will be identified.

3.1 Research Design

Patel and Davidson (1994) stated that the research design is actually an important part of any study. Yin (2003) says the research design is logic rather than logistic that ensures the researchers that the data which are collected have a meaningful link with research initial questions and assumptions.

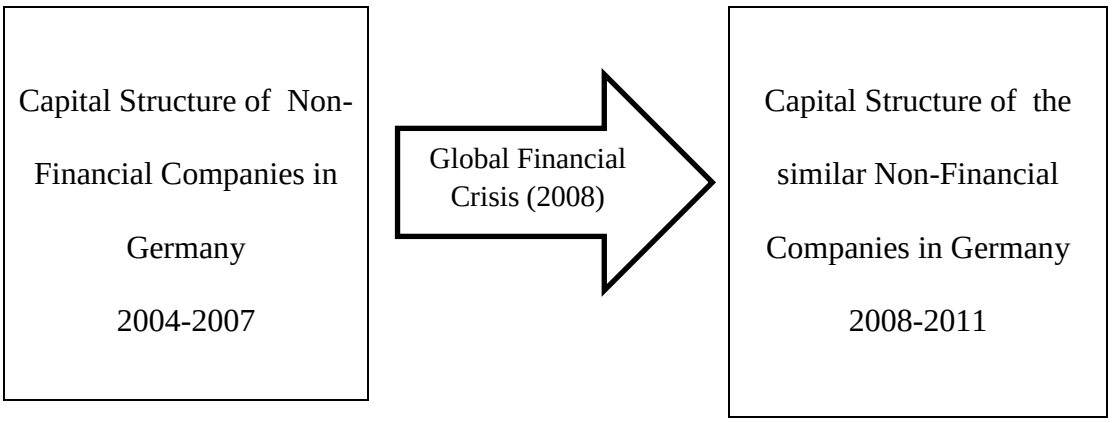
This study is being designed to follow two main objectives: firstly, it tries to test the impact of different determinants of capital structure which are discussed in chapter 2 based on the capital structure theories and empirical analysis, and secondly it checks to what extent the global financial crisis affects capital structure of non-financial firms in Germany.

Since the data used here are for different sectors which denotes the cross-section pattern, and the time interval of 2004 to 2011 which shows the time-series characteristics, it seems that the panel data analysis better fulfills this study. The panel data which is also called pooled data, longitudinal data, micro panel data and event history analysis increases the sample size and contains considerable and wide range of information about the economy (Gujarati, 2003). Since panel data is the combination of time series and cross-sectional data, it enables the researchers to have the opportunity to examine both cross-sectional and time series data, simultaneously (Greene, 2007).

Using the panel data gives considerable advantages. For example, to gain more information about the examined area in both time dimensions and individual dimensions and to examine the dynamical properties of obtained data plays an important role in the area of capital structure. However, there are still some disadvantages of panel data which are due to the computational challenges and violations of assumptions related to standard OLS regression analysis (Baltagi, 2005).

Since the aim of the present study is to see how crisis affects the capital structure, the panel data is divided into two separate domains including before crisis (2004-2007) and after crisis (2008-2010).

The main idea of the study is demonstrated as follows:



3.2 Data Collection

The data used in this study is a kind of secondary data which are collected from Thomson Reuter's DataStream database. In this database, the market equity of majority of companies is available. The balance sheet, profit and loss, cash flow statement and key account ratio of most of the countries are provided.

Since the ratios that are related to the capital structure are not directly calculated in this database, the present study calculates the relative ratios by using the financial report of targeted companies. In the following, we discuss the ratios which are used for finding the variables in the applied model and their corresponding governing formula.

In addition, there is a considerable diversity regarding the age of companies used in this research. Some of them are so young and some of them are mature. According to this issue the starting year of our data is 2004 and the ending year is 2011.

3.3 Research Sample

Here we use the annual financial reports for a time interval of 2004 to 2011 for 43 German non-financial companies. The sample data are collected from those companies that are randomly selected among five different sectors. This selection rule, which is defined as a simple random sampling, is based upon the assumption that the mechanism of choosing each individual sector is equally probable. This technique will decrease the probability of bias problem and the sample selected by this mechanism will be an appropriate representation of target population and the ultimate result will be reliable (Yates et al., 2008). The sample is classified and listed in Table 3.1.

Table 3.1: Summary of the Sample

Number	**Sector**	**Number of Firms**	**% of total**
1	Alternative Energy	9	21
2	Automobiles & Parts	10	23
3	Electricity	6	14
4	Gas, Water & Multiutilities	7	16
5	Technology Hardware & Equipment	11	26
	Total	43	100

The sample excludes those financial institutions with different nature of capital structure regarding the regulatory requirement. Also as Rajan & Zingales 1995 argued the debt of these financial institutions like insurance and bank are different from the debt which is issued by non-financial companies.

As shown in Table 3.1, the Technology Hardware & Equipment sector with 26% of the whole sample is placed in the first position, while 23%, 21%, 16%, 14%, specifies the subsequent positions located by Automobiles & Parts, Alternative Energy, Gas, Water & Multiutilities and Electricity sectors, respectively.

3.4 Variables

As indicated before, the main objectives of the present study is to investigate the capital structure as a function and the impact of significant determinants as the corresponding variables. The variables are inherently divided into dependents and independents variables and are listed in Table 3.2.

Table 3.2: The Determinants Classified and Tabulated as Dependent and Independent Variable

Variables	**Dependent**	**Independent**	**Abbreviation**
Total debt	×		TD
Short-term debt	×		STD
Long-term debt	×		LTD
Profitability		×	PROF
Liquidity		×	LIQ
Age		×	AGE
Tangibility		×	TANG
Size		×	SIZE
Non-debt Tax Shield		×	NDTS
Market to Book Value		×	MV/BV

All above variables are calculated by the relative ratios and are listed in Table 3.3.

Table 3.3: The Variables and Measurement

Variables	Proxy	Measurement
TD_{it}	The ratio of total debt to total asset	$\frac{TD}{TA}$
STD_{it}	The ratio of short-term debt to total asset	$\frac{STD}{TA}$
LTD_{it}	The ratio of long-term debt to total asset	$\frac{LTD}{TA}$
$PROF_{it}$	The ratio of earnings before interest and tax to total asset	$\frac{EBIT}{TA}$
LIQ_{it}	The ratio of current assets to current liabilities	$\frac{CA}{CL}$
AGE_{it}	Present year minus year of foundation	$T_p - T_f$
$TANG_{it}$	The ratio of fixed assets (Property, Plant and Equipment) to total assets	$\frac{FA}{TA}$
$SIZE_{it}$	Natural logarithm of total asset	$Ln(TA)$
$NDTS_{it}$	The ratio of total annual depreciation, depletion and amortization to total assets	DDA/TA
MV / BV_{it}	(Total Liabilities + Market value Equity) / (Total liabilities + Equity);	(TL+MVE)/(TL+E)

3.5 Descriptive Analysis

By descriptive analysis we mean describing the subject in terms of the mean, maximum, minimum and standard deviations. According to Zikmund (2003) descriptive analysis is the process of transforming the data into the format which is easier to interpret and understand.

All the important variables regarding the capital structure which are introduced and discussed in the literature part are considered and their corresponding values are shown in the following tables. Since the objective of this study is to investigate the

effects of financial crisis on capital structure of German non-financial companies, the analysis is divided into two distinct parts which are before and after crisis. However the descriptive statistics for entire the sample is presented in table 3.4 in order to give an overview of general results without considering the financial crisis. As it is seen in table 3.4 the mean of long-term leverage is 0.1347 which means 13.47 percent of capital of selected firms is long-term debt and short-term leverage is .0678 which means the 6.78 percent of total assets of the sample firms contains short-term debt. Therefore, it is concluded that the long-term debt is about two times more than short-term debt and totally 20.25 percent of the total assets of the selected non-financial firms in Germany is financed with total debt.

Table 3.4: The Descriptive Statistics in Time Interval of 2004-2011

Variables	Observations	Mean	Median	Maximum	Minimum	Std. Dev.
TD	344	0.2025	0.1748	0.7601	0.0000	0.1798
LTD	344	0.1347	0.1215	0.6119	0.0000	0.1325
STD	344	0.0678	0.0338	0.4850	0.0000	0.0834
TANG	344	0.2668	0.2602	0.6880	0.0000	0.1590
SIZE	344	13.1763	12.6291	19.3261	0.0000	3.0562
PROF	344	0.0233	0.0636	0.4581	-4.7123	0.3167
NDTS	344	0.0437	0.0352	0.3084	0.0000	0.0331
MV/BV	344	2.3031	1.6050	47.3100	-4.7300	3.9654
LIQ	344	2.2534	1.5854	81.5000	0.0000	4.5237
AGE	344	46.0407	23.0000	174.0000	0.0000	46.8992

In table 3.5 the descriptive analysis of both pre and post crisis are shown in order to investigate the effects of financial crisis on the variables by comparative study. As the table 3.5 shows the total leverage (TD) of the related non-financial companies in Germany has increased by 22.52 percent as result of financial crisis. The increase in leverage due to the global financial crisis is consistent with empirical evidence reported by Richard H. Fosberg (2012). And also consequently the both long-term

and short-term leverage of these firms has increased by 21.91 and 23.76 which also supported by Richard H. Fosberg (2013) who stated that financial crisis forces the firms to increase their amount of short-term debt.

Table 3.5: The Descriptive Analysis for Pre (2004-2007) and Post Crisis (2008-2011)

Variables	**Observations**	**Mean (2004-2007)**	**Mean (2008-2011)**	**Percentage change**
TD	172	0.1820	0.223	22.52
LTD	172	0.1214	0.148	21.91
STD	172	0.0606	0.075	23.76
TANG	172	0.2661	0.267	0.33
SIZE	172	12.9150	13.438	4.04
PROF	172	0.0117	0.035	199.14
NDTS	172	0.0453	0.042	-7.28
MV/BV	172	2.2575	2.349	4.05
LIQ	172	2.0392	2.467	20.97
AGE	172	44.0465	48.035	9.05

However, for impose the industrial descriptive analysis the following tables from table 3.6 to table 3.10 for each five sectors are represented. By the following tables, one can see that except the Technology Hardware & Equipment sector the leverage of the non-financial companies increase by 71.89%, 18.24%, 11.21% and 9.26% for Alternative Energy, Automobiles & Parts, Electricity and Gas, Water & Multiutilities respectively.

Table 3.6: Alternative Energy

Variables	Mean (2004-2007)	Mean (2008-2011)	Change %
TD	0.16824	0.2892	71.89
LTD	0.1065	0.175462	64.70
STD	0.06171	0.113757	84.32
TANG	0.17618	0.268169	52.20
SIZE	11.2643	12.46153	10.62
PROF	0.00752	-0.0321	-526.35
NDTS	0.03681	0.045854	24.54
MV/BV	3.42972	2.275556	-33.65
LIQ	2.26377	1.941235	-14.24
AGE	9	12.94444	43.82

Table 3.7: Automobiles & Parts

Variables	Mean (2004-2007)	Mean (2008-2011)	Change %
TD	0.24409	0.28861	18.24
LTD	0.14590	0.170146	16.61
STD	0.09818	0.118464	20.66
TANG	0.29196	0.258649	-11.41
SIZE	15.8875	16.32502	2.75
PROF	0.09754	0.072094	-26.09
NDTS	0.06202	0.050606	-18.40
MV/BV	2.0095	1.378	-31.43
LIQ	1.43178	1.340424	-6.38
AGE	89.8	93.8	4.45

Table 3.8: Electricity

Variables	Mean (2004-2007)	Mean (2008-2011)	Change %
TD	0.318957	0.354705	11.21
LTD	0.243272	0.25774	5.95
STD	0.075685	0.096964	28.12
TANG	0.394149	0.364242	-7.59
SIZE	13.46076	13.88493	3.15
PROF	0.000989	0.056418	5604.55
NDTS	0.026989	0.024917	-7.68
MV/BV	2.221667	1.777083	-20.01
LIQ	1.881349	1.663915	-11.56
AGE	25.16667	29.16667	15.89

Table 3.9: Gas, Water & Multiutilities

Variables	Mean (2004-2007)	Mean (2008-2011)	Change %
TD	0.102509	0.111997	9.26
LTD	0.083515	0.089578	7.26
STD	0.018994	0.022419	18.03
TANG	0.360196	0.355165	-1.40
SIZE	12.94979	13.44019	3.79
PROF	0.042544	0.045519	6.99
NDTS	0.036849	0.033141	-10.06
MV/BV	2.298929	5.987143	160.43
LIQ	1.899249	5.240055	175.90
AGE	51.64286	55.64286	7.75

Table 3.10: Tech. Hardware & Equipment

Variables	Mean (2004-2007)	Mean (2008-2011)	Change %
TD	0.112498	0.108442	-3.61
LTD	0.068927	0.082671	19.94
STD	0.043571	0.02577	-40.86
TANG	0.186542	0.166177	-10.92
SIZE	11.24347	11.36557	1.09
PROF	-0.07673	0.03769	149.13
NDTS	0.052275	0.046779	-10.51
MV/BV	1.517045	1.2875	-15.13
LIQ	2.58295	2.596551	0.53
AGE	36.59091	40.59091	10.93

These five tables are provided to see the effects of crisis on capital structure of companies by industry. Percentage change is calculated as a mean value of post-crisis minus the mean value of pre-crisis, divided all by mean value of pre-crisis.

$$\%Change = \frac{Mean(2008-2011) - Mean(2004-2007)}{Mean(2004-2007)}$$

Also, according to the above tables regarding the comparison between short-term leverage (STD) and long-term leverage (LTD) it can concluded the increase in amount of short-debt financing is relatively higher than amount of long-term debt financing which is also the result of financial crisis. Because due to the market disruption of the capital and lending markets firms will increase their short term debt rather than long-term debt financing (Fosberg, 2013).

There is also an interesting point regarding the profitability of the firms. Since the productions of the firms in Automobiles & Parts and Technology Hardware & Equipment sectors in Germany are highly exportable, due to the global financial crisis of 2008 there was a sharp decrease in their profitability which is -26.09%, -149.13% respectively. And for companies in Electricity and Gas, Water & Multiutilities which their productions are classified as a necessity good which we cannot live without them, profitability is not only decrease but also increase with high percentage 5604.55% for electricity and less 6.99% for Gas, Water & Multiutilities sectors.

The complete tables regarding the descriptive analysis results are represented in appendix A.

3.6 Model and Regression Analysis

In the previous section the variables are introduced and prepared in such a way that can be used as the inputs for the statistical methods in order to find the possible answers to the ever-mentioned research questions and concluding the reliable results. In this section the regression models will be outlined and the models which are more compatible with the theme of our study will be introduced.

In the regression analysis, in contrast to the deterministic nature or functional like behavior of the quantities which are investigated presumably in the classical physics, we deal with the statistical and probabilistic relationship between the variables. In statistical treatment, each variable has generally a probability distribution to occur and obeys a random or stochastic procedure. While in deterministic relationship the variables could be exactly determined and measured exactly and without statistical uncertainty.

To shed a light on the concept of deterministic and statistical variables let us give two very simple examples:

1) **Newton's law governing the evolution of a deterministic variable**

   The dynamics of a particle could be exactly obtained by solution of the Newton's law of classical dynamics while the inserted forces and the initial conditions are uniquely specified. Falling a body or the configuration of a projectile in the gravitational field could be exactly predicted by solving these equations and the trajectory of those particles could be exactly determined as a function of time. In other word if the position and velocity of the particle is specified at a given initial time then its position and velocity i. e., the state of motion, could be exactly predicted and determined at any later times using Newton's law. One can measure the state of motion by well-designed instruments and subsequently verify the theoretical justifications. Since the laws of Physics are universal all the observers at any position and time will measure the same result for any given dynamical system and are convinced by the exact solutions.

2) Flower growth as a statistical example

Dependency of the flower growth as a dynamically evolving system on the rainfalls, fertilizer, and sunshine etc., is not as simple as the dynamics of a falling body in an isotropic gravitational field. The number of degree of freedom, the working forces involved, the evolutionary and dynamical processes are extremely complicated. The evolution and prediction of state of such an intricate system could not be interpreted under the umbrella of a simple law as Newton's law for classical mechanics.

At most one can predict the meteorological conditions on probabilistic grounds and argue on the percentage of the realization of the mentioned factors. In other words it is not possible to exactly predict the flowers growth rate for the next spring. Thus, in studying these kind of systems for which the deterministic predictions are not exactly possible, one must resort to statistical arguments to calculate their probably of occurrence using the probability distributions of the related determinants.

The aim of this common and widely used technique dealing with statistical types of phenomena is trying to estimate how one dependent (the regressand) variable is related to one or more independent (the regressor) variables. The regression model with a single independent variable is known as *simple regression model*. However, most often because of complicated nature of economic problems, especially in this study where a single dependent variable is related with more than one independent variable, the *multiple regression* analysis is used (Hair et al., 2006).

The general form of simple linear regression model is expressed by the following equation:

$$Y = \alpha + \beta X , \tag{3.1}$$

Where Y represents the dependent and X is the independent variable, respectively; α is the intercept and β is the slope of the linear function and both are constant.

But in panel data which is the combination of time series and cross-sectional data with more than one explanatory variable the model takes the following form:

$$Y_i = \alpha_i + \beta_{i1} X_1 + \beta_{i2} X_2 + \ldots \beta_{ij} X_j + u_i \quad , \text{i=1, 2, 3, } \ldots \tag{3.2}$$

In Eq. (4) Y_i and X_j stand for all dependent and independent variables; i counts the independent variables and j is a couple of indices representing the cross-sectional and time series dimensions, respectively; α_i are the intercept; X_j are independent variables; u_i is disturbance or error term; and β_i are constant coefficients which represent how strong the dependent variable are related with respective independent variables.

It must be noted that in Eq. (4) the linear approximation for determinants are assumed and the nonlinear dependence is neglected. Due to multivariable nature of the regression analysis the linear regime itself is complicated enough such that the analytical and exact solution for the problem is not accessible. Considering the nonlinear behavior of the functional dependences will make the problem extremely complicated and will not be considered anymore in this study.

Error term in most of the panel data analysis is used as a one-way error model which is representing by:

$$u_i = \mu_i + \nu_i \tag{3.3}$$

Where, μ_i are unobserved firm specific effects which are independent of time, and ν_i represents the remainder random term which varies across the time and individuals.

The regression model for this study according to the above panel data regression will take the following form:

$$TD_{it} = \alpha + \beta_1 PROF_{it} + \beta_2 LIQ_{it} + \beta_3 AGE_{it} + \beta_4 TANG_{it} + \beta_5 SIZE_{it} + \beta_6 NDTS_{it} + \beta_7 MAREKT / BOOK_{it} + u_{it} \tag{3.4}$$

$$STD_{it} = \alpha + \beta_1 PROF_{it} + \beta_2 LIQ_{it} + \beta_3 AGE_{it} + \beta_4 TANG_{it} + \beta_5 SIZE_{it} + \beta_6 NDTS_{it} + \beta_7 MAREKT / BOOK_{it} + u_{it} \tag{3.5}$$

$$LTD_{it} = \alpha + \beta_1 PROF_{it} + \beta_2 LIQ_{it} + \beta_3 AGE_{it} + \beta_4 TANG_{it} + \beta_5 SIZE_{it} + \beta_6 NDTS_{it} + \beta_7 MAREKT / BOOK_{it} + u_{it} \tag{3.6}$$

Note that, as simplifying considerations, we have eliminated any heterogeneity between firms and have assumed the same slope and intercept for all firms considered in this approach (Pooled Ordinary Least Square).

3.7 Hypothesis

3.7.1 Hypothesis for Research Question 1

Following alternative (H_a) hypothesis are used to explore the answer for research question 1 concerning whether the mentioned determinants of capital structure affect the capital structure or not and in what strength and direction?

1. There is a positive relationship between tangibility and total debt, short-term debt and long-term debt ratios.

2. There is a positive relationship between size and total debt, short-term debt and long-term debt ratios.

3. There is a negative relationship between profitability and total debt, short-term debt and long-term debt ratios.

4. There is a negative relationship between non-debt tax shield and total debt, short-term debt and long-term debt ratios.

5. There is a positive relationship between market to book ratio and total debt, short-term debt and long-term debt ratios.

6. There is a positive relationship between liquidity and total debt, short-term debt and long-term debt ratios.

7. There is a negative relationship between age and total debt, short-term debt and long-term debt ratios.

3.7.2 Hypothesis for Research Question 2

Tangibility, size, profitability, non-debt tax shield, market to book ratio, liquidity, and age are more important during the crisis.

3.8 Data Analysis and Technique

At the first step the analysis is started by applying the unit root test to check whether the variables are stationary or not. Then, the three different techniques are used to analyze the panel data which are pooled OLS, fixed effect (FE) and random effect (RE) (Myroshnichenko, 2004).

The pooled OLS estimator ignores the panel structure of the data. Since it neglects the heterogeneity across individuals and assumes the same coefficients for all individuals, those effects which are unique for each individual are all collected in the error term (Stock and Watson, 2011).

Fixed effects method is used in analyzing the effect of variables which vary over the time. FE assumes that something within the individual may affect the predictor or output variables which we need to control them. This effect of time invariant characteristics of those predictor variables is removed by FE. Therefore, we can assess the predictors' net effect (Wooldridge, 2010). Fixed effects models are designed to study the causes of changes within an entity where could not be caused by time invariant specifications.

The third technique, which is called random effect model, believes that unlike FE the variation across entities assumed to be random and correlated with the independent variables in the model. The advantage of this method is the capability of including the time invariant variables and testing the presumption of random distribution of individual firm characteristics in the data sample (Baltagi, 2008).

According to Wooldridge (2010) and Baltagi (2005) to decide between RE and FE, Hausman test should be applied which tests if the unique errors (u_i) are correlated with the regressor. It examines whether the coefficients estimated from the fixed effects estimation and the random effects estimation are statistically significant. A rejection of the test is commonly interpreted as a rejection of null hypothesis which is the random effects model estimation. Also the Breuch-Pagon Lagrange Multiplier (LM) technique can be applied for decision making between FE and RE methods (Wooldridge 2010).

In this chapter we discussed about the data and methodology which is used in this study. We proposed our model and all the determinants of capital structure and their relative proxies. Also the regression analyses with techniques which will be applied have been represented. In the following chapter, the correlation analysis results alongside the regression analysis by using the mentioned data and methodology will be discussed.

Chapter 4

EMPIRICAL RESULTS

4.1 Introduction

In chapter 3 the methodology of research is presented by introducing regression analysis as well as the model and data which are used throughout this study. The required variables and hypothesis were discussed to treat the impact of significant determinants of capital structure and to understand how this capital structure of non-financial companies in Germany is affected by the global financial crisis of 2008. Also the descriptive analysis and corresponding results are discussed and commented on.

In this chapter beside the correlation analysis the regression analysis is applied to our properly adjusted data and proposed models and the corresponding results for the significant determinants are obtained and tabulated. The results of pre and post crisis situations, where the leverage and capital structure determinants are expected to change as a result of the global financial crisis, are compared and discussed. Using the existing empirical studies, which are done recently regarding the effects of financial crisis on capital structure in different economies, we have examined our technique and applied models and ultimately commented on the respective results.

4.2 Correlation Analysis

Correlation analysis has been applied to test the multicollinearity problem. The problem arises when there is a possible correlation between independent variables in multiple regression models. In the case of multicollinearity between independent variables, although the model may fit the sample (high F-test) and independent variables define dependent variable well. These correlated explanatory variables will convey same information which creates the paradoxical result (Bougie and Sekaran, 2010). The multicollinearity problem may be handled in following ways:

1. A common way to reduce the possibility of multicollinearity is increasing the sample size which will reduce the standard errors (all other things equal). This will offset the problem in some extent that high multicollinearity leads to the high standard errors coefficients.

2. The easiest way is to remove one of the correlated independent variables from the regression model. Then, if this variable or variables are the ones that are suggested by theory governing the model, the results will be misguided.

3. The correlated variables can be combined through defining the new proxies by the help of theoretical and empirical studies.

According to Lewis-Beck (1993), as long as the correlations results are not higher than 0.8 the multicollinearity problem will not arise. Therefore, the quantities in the Tables 4.1, 4.2 and 4.3 show that correlation in this study does not lead to multicollinearity. This is also proved by VIF test and tolerance results which are represented in the appendix B.

Table 4.1: Pearson Correlation Coefficient Matrix in Time Interval of 2004-2011

	TD	STD	LTD	TANG	SIZE	PROF	NDTS	MV/BV	LIQ	AGE
TD	1									
STD	0.724***	1								
LTD	0.901***	0.353***	1							
TANG	0.353***	0.071	0.435***	1						
SIZE	0.369***	0.347***	0.282***	0.280	1					
PROF	0.012	-0.024	0.031	0.148**	0.196***	1				
NDTS	-0.007	0.001	-0.010	0.188***	0.056	-0.253***	1			
MV/BV	-0.102	-0.009	-0.133*	-0.117*	-0.070	0.018	-0.120*	1		
LIQ	-0.104	-0.148**	-0.048	-0.037	-0.202***	0.021	-0.003	0.002	1	
AGE	-0.145**	-0.051	-0.165**	0.171**	0.340***	0.127*	0.179**	-0.048	-0.052	1

*Correlation is significant at the 0.1 level

**Correlation is significant at the 0.05 level

***Correlation is significant at the 0.01 level

It can be seen from the Table 4.1 that the tangibility is positively and significantly correlated with TD, LTD, and also the size is also positively and significantly correlated with TD, STD and LTD. Further, the profitability is positively correlated with tangibility, size and age while negatively with non-debt tax shield.

In Tables 4.2 and 4.3 the correlation of pre and post crisis models are represented. The profitability is positively but insignificantly correlated with TD, STD and LTD before crisis, however, after crisis the relationship for the same entity is significant and positive. Tangibility is positively and significantly correlated with non-debt tax shield in both pre and post crisis. Size is positively correlated with TD, LTD and STD in pre and post crisis.

Table 4.2: Pearson Correlation Coefficient Matrix in Time Interval of 2004-2007

	TD	STD	LTD	AGE	LIQ	MV/BV	NDTS	PROF	SIZE	TANG
TD	1.000									
STD	0.724 ***	1.000								
LTD	0.910 ***	0.374 ***	1.000							
AGE	-0.108	-0.002	-0.144 **	1.000						
LIQ	-0.225 ***	-0.296 ***	-0.125 *	-0.084	1.000					
MV/BV	0.024	0.207 ***	-0.091	0.053	-0.007	1.000				
NDTS	-0.099	-0.036	-0.112	0.152 **	0.241 ***	-0.096	1.000			
PROF	0.067	0.033	0.071	0.125 *	0.072	0.087	-0.294 ***	1.000		
SIZE	0.394 ***	0.389 ***	0.296 ***	0.349 ***	-0.280 ***	0.099	0.061	0.222 ***	1.000	
TANG	0.358 ***	0.108	0.416 ***	0.230 ***	-0.094	0.015	0.132 *	0.209 ***	0.374 ***	1.000

*Correlation is significant at the 0.1 level

**Correlation is significant at the 0.05 level

***Correlation is significant at the 0.01 level

Table 4.3: Pearson Correlation Coefficient Matrix in Time Interval of 2008-2011

	TD	LTD	STD	AGE	LIQ	MB/ BV	NDTS	PROF	SIZE	TANG
TD	1.000									
LTD	0.891 ***	1.000								
STD	0.720 ***	0.328 ***	1.000							
AGE	-0.190 ***	-0.194 ***	-0.100	1.000						
LIQ	-0.103	-0.045	-0.145 **	-0.058	1.000					
MV/ BV	-0.164 **	-0.161 **	-0.095	-0.101	0.002	1.000				
NDTS	0.090	0.096	0.041	0.211 ***	-0.061	-0.143 **	1.000			
PROF	-0.157 **	-0.078	-0.208 ***	0.192 ***	0.010	-0.065	-0.228 ***	1.000		
SIZE	0.335 ***	0.257 ***	0.305 ***	0.326 ***	-0.241 ***	-0.168 **	0.059	0.180 **	1.000	
TANG	0.356 ***	0.459 ***	0.038	0.106	-0.031	-0.197 ***	0.252 ***	0.003	0.168 **	1.000

*Correlation is significant at the 0.1 level

**Correlation is significant at the 0.05 level

***Correlation is significant at the 0.01 level

4.3 Regression Results

The results of regression analysis obtained for the TD model described in the previous chapter are shown in Table 4.4. These results are calculated without considering the financial crisis. As the R-squared number shows the independent variables define the dependent variable which is TD by 86.08 percent. Durbin-Watson statistics represents the autocorrelation which always is between 0 and 4. When this number approaches to 0 and 4, it indicates positive and negative autocorrelations, respectively and when it is close to 2 there is no autocorrelation. The results that we have obtained here for Durbin-Watson statistics is 1.14 which is relatively not acceptable, while when the sample is divided into two pre and post crisis periods the Durbin-Watson statistics becomes better and approaches to 2 indicating that the autocorrelation is almost negligible.

So according to purpose of this study the pre and post crisis period will be examined. It is noted that all the results are the results of regression analysis by fixed effects model, because after doing Hausman test the null hypothesis which states that the random effects is rejected and alternative approach which is fixed effects model is accepted.

Table 4.4: The Regression Results for TD Model in Time Interval of 2004-2011.

Variable	**Coefficient**	**Std. Error**	**Prob.**
C	-0.493 (-5.586)	0.088	0.000
TANG	0.418*** (6.797)	0.062	0.000
SIZE	0.027*** (5.152)	0.005	0.000
PROF	-0.008 (-0.547)	0.015	0.585
NDTS	-0.118 (-0.644)	0.184	0.520
MV/BV	0.0004 (-0.358)	0.001	0.721
LIQ	0.0004 (-0.438)	0.001	0.662
AGE	0.005*** (2.807)	0.002	0.005

R-squared= 0.8608; F-statistic= 37.1201; Durbin-Watson stat= 1.1474;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

Table 4.5: The Regression Results for STD Model in Time Interval of 2004-2011

Variable	**Coefficient**	**Std. Error**	**Prob.**
C	-0.1052 (-1.5846)	0.0664	0.1141
TANG	0.0628 (1.3596)	0.0462	0.1750
SIZE	0.0114*** (2.9174)	0.0039	0.0038
PROF	-0.0154 (-1.3483)	0.0114	0.1786
NDTS	-0.2170 (-1.5729)	0.1379	0.1168
MV/BV	0.0007 (0.7390)	0.0009	0.4605
LIQ	-0.0009 (-1.1586)	0.0007	0.2475
AGE	0.0004 (0.2597)	0.0014	0.7953

R-squared= 0.6347; F-statistic= 10.4287; Durbin-Watson stat= 1.5303;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

For short-term debt (STD) ratio, which is short-term debt to total assets, the regression results are calculated and shown in Table 4.5. The R-squared with the amount of 0.6347 means that the model fits with the sample by 63.47**%** and with the

value of 1.53 for Durbin-Watson statistics, the autocorrelation problem is not removable. According to Table 4.6, also for long-term debt (LTD) ratio model which is the ratio of long-term debt to total assets the independent variables explain the dependent variables which is LTD by 82.55 percent. The Durbin-Watson statistics is 1.37 for the model.

Table 4.6: The Regression Results for LTD Model in Time Interval of 2004-2011

Variable	**Coefficient**	**Std. Error**	**Prob.**
C	-0.3881 (-5.3246)	0.0729	0.0000
TANG	0.3552*** (6.9965)	0.0508	0.0000
SIZE	0.0153*** (3.5855)	0.0043	0.0004
PROF	0.0071 (0.5650)	0.0125	0.5725
NDTS	0.0987 (0.6514)	0.1515	0.5153
MV/BV	-0.0011 (-1.1063)	0.0010	0.2695
LIQ	0.0004 (0.5240)	0.0008	0.6006
AGE	0.004844*** (3.164215)	0.001531	0.0017

R-squared= 0.8255; F-statistic= 28.3860; Durbin-Watson stat= 1.3733;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

The results of regression analysis for the presented model are getting better when the crisis is considered. The regression results of the model before crisis are illustrated in Tables 4.7, 4.8 and 4.9 for TD, STD and LTD, respectively. Here, the explanatory variables are defining the dependent variables by 89.84, 79.28 and 84.39 percent for TD, STD and LTD models, respectively. And the Durbin-Watson statistics which seems to be more reasonable are 1.77, 2.19 and 1.93 for Td, STD and LTD, respectively.

Table 4.7: The Regression Results for TD Model in Time Interval of 2004-2007

Variable	**Coefficient**	**Std. Error**	**Prob.**
C	-0.0428 (-0.1947)	0.2199	0.8460
TANG	0.3604*** (3.0760)	0.1172	0.0026
SIZE	0.0127** (2.2926)	0.0055	0.0236
PROF	-0.0008 (-0.0446)	0.0169	0.9645
NDTS	-0.4598 (-1.5206)	0.3024	0.1310
MV/BV	0.0113*** (4.0210)	0.0028	0.0001
LIQ	0.0041 (0.7530)	0.0055	0.4529
AGE	-0.0011 (-0.2218)	0.0049	0.8249

R-squared= 0.8984; F-statistic= 20.0396; Durbin-Watson stat= 1.7728;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

Table 4.8: The Regression Results for STD Model in Time Interval of 2004-2007

Variable	**Coefficient**	**Std. Error**	**Prob.**
C	0.1727 (1.2315)	0.1402	0.2205
TANG	0.0319 (0.4274)	0.0747	0.6699
SIZE	0.0034 (0.9762)	0.0035	0.3309
PROF	-0.0083 (-0.7694)	0.0108	0.4431
NDTS	-0.2486 (-1.2893)	0.1928	0.1997
MV/BV	0.0120*** (6.7044)	0.0018	0.0000
LIQ	-0.0050 (-1.4296)	0.0035	0.1554
AGE	-0.00387 (-1.24085)	0.003121	0.217

R-squared= 0.7928; F-statistic= 9.5281; Durbin-Watson stat= 2.1973;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

Table 4.9: The Regression Results for LTD Model in Time Interval of 2004-2007

Variable	**Coefficient**	**Std. Error**	**Prob.**
C	-0.2155 (-1.0631)	0.2027	0.2898
TANG	0.3284*** (3.0416)	0.1080	0.0029
SIZE	0.0092* (1.8120)	0.0051	0.0724
PROF	0.0075 (0.4839)	0.0156	0.6293
NDTS	-0.2112 (-0.7578)	0.2787	0.4500
MVTOBV	-0.0007 (-0.2755)	0.0026	0.7834
LIQ	0.0091* (1.8060)	0.0051	0.0734
AGE	0.002787 (0.617773)	0.004512	0.5379

R-squared= 0.8439; F-statistic= 13.4645; Durbin-Watson stat= 1.9311;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

Table 4.10: The Regression Results for TD Model in Time Interval of 2008-2011

Variable	**Coefficient**	**Std. Error**	**Prob.**
C	-0.591582 (-2.042378)	0.289654	0.0433
TANG	0.298417*** (3.071501)	0.097157	0.0026
SIZE	0.061624*** (3.277708)	0.018801	0.0014
PROF	-0.137157*** (-2.703006)	0.050742	0.0079
NDTS	-0.140191 (-0.569285)	0.246258	0.5702
MV/BV	-0.000738 (-0.460019)	0.001604	0.6463
LIQ	0.001098 (1.127223)	0.000974	0.2619
AGE	-0.001737 -0.395501	0.004392	0.6932

R-squared= 0.923557; F-statistic= 30.08075; Durbin-Watson stat= 1.649966;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

Table 4.11: The Regression Results for STD Model in Time Interval of 2008-2011

Variable	Coefficient	Std. Error	Prob.
C	-0.009349 (-0.037046)	0.252354	0.9705
TANG	-0.153466** (-1.813041)	0.084646	0.0723
SIZE	0.039366** (2.403335)	0.01638	0.0178
PROF	-0.091854** (-2.077756)	0.044208	0.0398
NDTS	-0.167215 (-0.779386)	0.214547	0.4373
MV/BV	-0.000875 (-0.626234)	0.001397	0.5323
LIQ	-0.00005250 (-0.061884)	0.000849	0.9508
AGE	-0.00814** (-2.12728)	0.003827	0.0354

R-squared= 0.747629; F-statistic= 7.375841; Durbin-Watson stat= 2.129434;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

Table 4.12: The Regression Results for LTD Model in Time Interval of 2008-2011

Variable	Coefficient	Std. Error	Prob.
C	-0.582233 (-2.548837)	0.228431	0.012
TANG	0.451884*** (5.897646)	0.076621	0.000
SIZE	0.022257 (1.501135)	0.014827	0.1359
PROF	-0.045303 (-1.13208)	0.040017	0.2598
NDTS	0.027024 (0.139148)	0.194208	0.8896
MV/BV	0.000137 (0.10851)	0.001265	0.9138
LIQ	0.001151 (1.497696)	0.000769	0.1368
AGE	0.006403* (1.848576)	0.003464	0.0669

R-squared= 0.911791; F-statistic= 25.73616; Durbin-Watson stat= 2.342326;
*, **, *** indicates that coefficients are statistically significant at α= 10%, 5% and 1% respectively.

The last three tables, i.e., 4.10, 4.11 and 4.12 represent the regression results of post crisis period which belong to the time interval of 2008 to 2011. The models are fitted

to the sample by 92.35, 74.76 and 91.17 for TD, STD and LTD, respectively. Durbin-Watson statistics are 1.64, 2.12 and 2.34 for TD, STD and LTD models, respectively.

Table 4.13 is prepared for the comparative purpose between pre and post crisis.

Table 4.13: The Regression Analysis Results for TD, STD and LTD Models

	2004-2007 TD model	**2008-2011 TD model**	**2004-2007 STD model**	**2008-2011 STD model**	**2004-2007 LTD model**	**2008-2011 LTD model**
TANG	0.3604*** (3.0760)	0.29842*** (3.071501)	0.0319 (0.4274)	-0.1534** (-1.813041)	0.3284*** (3.0416)	0.4518*** (5.897646)
SIZE	0.0127** (2.2926)	0.06162*** (3.277708)	0.0034 (0.9762)	0.039366** (2.403335)	0.0092* (1.8120)	0.022257 (1.501135)
PROF	-0.0008 (-0.0446)	-0.1371*** (-2.703006)	-0.0083 (-0.7694)	-0.091854** (-2.077756)	0.0075 (0.4839)	-0.045303 (-1.13208)
NDTS	-0.4598 (-1.5206)	-0.140191 (-0.569285)	-0.2486 (-1.2893)	-0.167215 (-0.779386)	-0.2112 (-0.7578)	0.027024 (0.139148)
MV/BV	0.0113*** (4.0210)	-0.000738 (-0.460019)	0.0120*** (6.7044)	-0.000875 (-0.626234)	-0.0007 (-0.2755)	0.000137 (0.10851)
LIQ	0.0041 (0.7530)	0.001098 (1.127223)	-0.0050 (-1.4296)	-0.00005250 (-0.061884)	0.0091* (1.8060)	0.001151 (1.497696)
AGE	-0.0011 (-0.2218)	-0.001737 (-0.395501)	-0.00387 (-1.24085)	-0.00814** (-2.12728)	0.002787 (0.617773)	0.006403* (1.848576)

The numbers in the first line in each part are the coefficient and the numbers in brackets are t-statistics.

4.4 Determinants and Leverage

In this section the relation between all independent variables which are determinants of capital structure and dependent variable which is the debt level will be explained. Furthermore, the consistency of these relations with existing empirical results that are obtained by other studies and theories will be examined.

4.4.1 Tangibility

According to Table 4.13 there is a significant positive relationship between tangibility of assets and total-debt ratio, which is consistent with Harris and Raviv (1991), Rajan and Zingales (1995), Shyam-Sunder and Myers (1999), Fama and French (2002), Frank and Goyal (2003), Gaud, et al., (2005), Frank and Goyal (2009), Jong et al., (2008), Hovakimian and Li (2011), Lemmon, Roberts and Zender (2008).

Positive relationship represents that the firms with high tangible assets have high level of debt. This is supported by Myers and Majluf (1984) who states that firms prefer the debt financing which is secured by tangible assets like property, plant and equipment which have certain values rather than securities. This is also commensurate with the trade-off theory which states that the firms prefer debt financing rather than equity. However, high level of debt increase financial distress costs and firms with high tangible asset means more liquid values are stronger in facing with financial distress.

Time Interval of (2004 2007)

Tangibility for pre-crisis period in TD model is statistically significant at α=1% and when tangibility increases by one unit the TD ratio will increase by 0.3604. It is positively correlated with short-term debt and long-term debt ratios, but it is insignificant in short-term debt model and significant as much as α=1% in long-term debt model which shows that collateral are more important in long-term debt.

Time Interval of (2008-2011)

In post-crisis period the tangibility has also a significant positive relation with TD and LTD, but it has a significantly negative relationship with STD which is

substantially different from the pre-crisis situation. The negative relationship of tangibility with debt level is supported by Titman and Wessels (1988).

During the crisis the importance of tangibility increases, because of the liquidity problem more tangible assets will secure the firms regarding the creditors and it is shown in LTD model where before crisis the value is 0.3284 and after crisis is .4518.

4.4.2 Size

The relation between size and leverage is positive for all three dependent variables TD, STD and LTD in our three models. Higher the size of company represents the firm is more diversified and consequently the default risk exposure is less which is predicted using the trade-off theory.

Since larger companies regarding the size are more famous, the probability of asymmetric information and its corresponding costs is less. Accordingly, larger firms can be able to have an internal financing rather than debt financing which is supported by pecking-order theory (Frank and Goyal, 2009).

The empirical results are also consistent with a positive relationship between size and leverage (Maris and Elayan, 1990), (Dessi and Robertson, 2003), (Cassar and Holmes, 2003), (Deesomsak, Paudyal, and Pescetto, 2004), (Singh and Nejadmalayeri, 2004), (Hovakimian and Li, 2011).

Time Interval of (2004 2007) and (2008 2011)

So the positive relation of size and leverage before and after crisis means the functional behavior of size does not change regarding the financial crisis, but before crisis the size of company is not significant in STD regression model. This is due to

the fact that its probability value is 0.5849 being more than α=10% and after crisis the size of company is not significant in LTD regression model where the probability value of size is 0.1359 again being bigger than α=10%.

During the financial crisis the size of the firms is becoming more important because it is an indicator that firms with larger size are safer for the creditors regarding the credit availability (Berg and Kirschenmann, 2010). This is consistent with our results given in Table 4.13 where the impact of the size increases in all TD, LTD and STD model going from pre-crisis to post crisis situation.

4.4.3 Profitability

Another important factor which is considered in the most of the studies regarding the determinants of capital structure is profitability of the company which is calculated by the ratio of earnings before interest and tax to total assets.

Time Interval of (2004 2007)

The profitability in TD and STD model is negatively correlated with TD and STD and positively correlated with LTD in LTD model. But they are not statistically significant.

Time Interval of (2008 2011)

After crisis the profitability becomes more important since the corresponding coefficients increase according to Table 4.13. The negative relationship with TD, STD and LTD which is consistent with existing empirical studies done by Harris & Raviv (1991), Rajan and Zingales (1995), Shyam-Sunder and Myers (1999), Fama and French (2002), Frank and Goyal (2003), Gaud et al., (2005), Frank and Goyal (2009), Jong et al., (2008), Hovakimian and Li (2011), Lemmon, Roberts and Zender

(2008). The probability of profitability in TD and STD models are equal to the 0.0079 and 0.0398, respectively, which means that the profitability is statistically significant by α=1% in TD model and by α= 5% in STD model. However, it is not statistically significant in LTD model where the probability is 0.2598 corresponding to more than α=10%.

The negative relation of profitability with leverage is supported by pecking-order theory which states that the firms prefer internal financing rather than external ones (Myers and Majluf, 1984; Myers, 1984). In other words, high profitable firms prefer internal financing rather than issuing debt and risky securities.

4.4.4 Non-debt Tax Shield

The results of non-debt tax shield in Table 4.13 state that although there is a negative relationship between non-debt tax shield and leverage except in LTD model after crisis, the study does not provide a relationship between non-debt tax shield and leverage. This is because they are not statistically significant. The insignificant role of tax rate in long-term debt is supported by (Brailsford, Oliver and l'ua, 2002) and (Akhtar, 2005).

The negative relation of non-debt tax shield with debt level is supported by De Angelo and Masulis (1980); Titman and Wessels (1988); Saa Requejo (1996); Fama and French (2002); Flannery and Rangan (2006). This is consistent with trade-off theory which states that as the amount of non-debt tax shield in a firm is higher there would be no need for debt.

The positive relationship of non-debt tax shield with long-term debt after crisis (2008-2011) shown in Table 4.13 is supported by Moore (1986), Harris and Raviv (1991), Prasad et al., (2001), Hovakimian and Li (2011).

4.4.5 Growth (Market to Book Ratio)

Market to book value is used as a proxy of growth opportunities, and when there are more growth opportunities for a firm the usage of debt in capital structure would be less. According to Frank and Goyal (2003) since the firm with high growth has high market-to-book ratios this can be used as a proxy for growth. Whited (1992) shows that there is not a certain relationship between market-to-book ratios with leverage; it can be both positive and negative.

In Pre-crisis period the market to book value is positively correlated with total debt and short-term debt ratios in TD and STD model, as it is shown in Table 4.13. This relationships are statistically significant as much as α=1%. In LTD model the results are not statistically significant and model does not support the relation. The positive relation is supported by pecking-order theory which states that in order to minimize asymmetric information problem, high growth firms should also issue debt.

After crisis the relationship of market to book value with total debt and short-term debt is negative, however the results are not significant. The negative relationship is supported by Barclay, Morellec and Smith (2001) who present a model which shows the high growth firm prefers less debt. Furthermore, in supporting the negative relation Deesomsak et al., (2004) suggests high growth firms will use less debt which brings the restrictions of lenders and it is consistent with debt holder agency theory.

According to the Baily and Elliott (2009) in the case of crisis when there is a decrease in the economy the growth opportunities will be less and consequently, the importance of growth decreases. The decrease in the coefficient of market-to-book value in table 10 in TD and STD model across pre-crisis to post crisis is consistent with this arguments, however this is not the case for LTD model.

4.4.6 Liquidity

According to table 4.13 the liquidity has positive relationship with total debt and long-term debt in both pre and post crisis and negative relationship with short-term debt. Except LTD model, before crisis, others are insignificant regarding the probability values.

The negative relationship is consistent with the empirical study done by (Abdullah, 2005) which states that as the liquidity increases in a firm the tendency of firm to issuing debt decreases. Also the pecking-order theory is supporting the negative relation which states that firm with high liquation value prefer internal financing rather than externals. This is also supported by (Panno, 2003) for the UK and by (Voulgaris et al., 2004) for Greece.

In the positive correlation between liquidity and leverage the trade-off theory is consistent. According to trade-off theory bankruptcy costs for liquidate firms are high so they are limited in obtaining debt.

4.4.7 Age

According to Table 4.13 the age of the companies has the negative relationship with total debt and sort-term debt ratios before and after crisis, and positive relationship with long-term debt ratio. In STD and LTD models the relations are significant but

in the rest the results are insignificant. The positive relationship between age and long-term debt and negative relationship between age and short-term debt is consistent with the empirical studies by (Hall et al., 2004) and (Abor, 2008).

Michaelas et al., (1999) and Hall, Hutchinson and Michaelas (2004) have shown that there is a negative relation between age and leverage for the UK small and medium-sized enterprises. The study of Michaelas (2004) for Germany, Spain, Ireland, Netherlands, Portugal and UK support the existence of a positive relationship.

4.5 Summary

In summary, this chapter discussed the results obtained from regression analysis with fixed effect model and their consistency with the theories which have been introduced in the literature review chapter. The relationship of the determinants of capital structure with the leverage was explained by the comparative study between before the crisis (2004-2007) and after the crisis (2008-2011).

As the results show the determinants such as profitability, tangibility, size and market to book ratios play an important role after crisis while non-debt tax shield and liquidity are not affected by the crisis for the selected non-financial companies operating in Germany. Profitability is negatively correlated with the leverage. Size has a positive relationship with the debt level of the firms. Tangibility is positively correlated with leverage and the relationship of market to book ratio with the leverage could be ether positive or negative. Non-debt tax shield is negatively correlated with the leverage but the relationship is insignificant, while the liquidity has positive relationship and is insignificant.

Chapter 5

SUMMARY AND CONCLUSION

This chapter discusses the results which are obtained from descriptive and regression analysis and their contribution to the German non-financial firms given the effects of financial crisis on the determinants of capital structure of these firms. The main findings of the study regarding the significant determinants of capital structure and their responses to the global financial crisis will be represented. Despite numerous attempts that have been made regarding the defining a comprehensive and unique capital structure theory, still there is no consensus on this topic and it requires more future researches which are discussed in the last part of this chapter beside the recommendation on getting an optimum financing decision during financial crisis to minimize the losses.

5.1 Discussion

This research has investigated the effects of financial crisis on the capital structure and its important determinants which are tangibility, size, profitability, non-debt tax shield, growth, liquidity and age. The study has chosen the non-financial firms of Germany from five different sectors.

According to descriptive analysis which was done in chapter 3 the research shows that the total leverage of the selected firms increases from 18.20 percent to 22.30 percent by the crisis. Also the amount of short-term debt and long-term debt increases by 23.76 and 21.91 percent respectively. This reveals that global financial

crisis forces the companies to increase their debt level. The reason of percent changes in short-term debt is more than long-term debt can be because of market ambiguity as a result of crisis and financial institutions prefer to give short-term loans rather than long-term one.

The introduced determinants of capital structure have been tested by panel data analysis using fixed effect model and the results shows that the important determinants after the crisis are profitability, tangibility, size and market to book while non-debt tax shield, age and liquidity are not important regarding the crisis.

Tangibility has positive relationship with leverage for German non-financial firms which implies that as the firm's tangible assets increases the creditors will rely on ex tangible assets as a collateral especially during the crisis and the firms can issue more debt. Also the increase in issuing debt which is collateralized with these tangible assets will reduce asymmetric information costs. This is supported by trade-off theory which states that when the firm borrows more the possibility of financial distress exposure increases, but these tangible assets which can be liquidated easily will increases the power of the firm facing this distress.

Size is positively correlated with leverage also which is important regarding the crisis. Because large companies like automobile companies in Germany are more diversified and their exposure to the bankruptcy will decrease and creditor lend them safer which is commensurate with trade-off theory.

Another important determinant of capital structure which is more important during the crisis is profitability of the firm. High profitable firm ensures the creditors that

their investments will be paid even in hard situation. More profitable firms prefer internal financing rather than externals which imply the negative relation with leverage which is supported by pecking-order theory.

5.2 Conclusion

The study outlines the effects of global financial crisis of 2008 which was one of the most severe crises after great depression of 1930s on capital structure of some non-financial companies in Germany. Regulating the capital structure of the firms to avoid from being bankrupt should be in first priority for managers. Global financial crisis has had severe impacts on capital markets and some larger firms were bankrupt. Since German economy is very competitive and depends more on exports to most of the countries could recover itself more rapidly rather than other countries.

Further study can divided the time interval to three periods to identify how long takes Germany recover itself after crisis. For example the periods can be 2006 to 2007 as a pre-crisis, 2008 and 2009 during the crisis and 2009 to 2010 post crisis. Particularly, it will be possible to analyze the data sector by sector two examine the impact of crisis on different sectors. Since especially in Germany for example automobile and technology sectors are more competitive and their products are exportable rather than those sectors which are local, the effects of financial crisis will be different in each sector.

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APPENDICES

Appendix A: Descriptive Analysis

Alternative Energy 2004-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.2287	0.225299	0.652169	0	0.169055	72
LTD	0.1409	0.113955	0.55954	0	0.139863	72
STD	0.0877	0.052416	0.485042	0	0.101342	72
TANG	0.2221	0.219616	0.687966	0	0.15048	72
SIZE	11.862	12.10361	14.78255	3.295837	1.940745	72
PROF	-0.0122	0.051571	0.458115	-2.2963	0.331186	72
NDTS	0.0413	0.035157	0.308412	0	0.045102	72
MV/BV	2.8526	1.93	18.81	-1.23	3.514323	72
LIQ	2.1025	1.5346	11.50539	0.675	1.770421	72
AGE	10.972	10	26	0	7.071012	72

Alternative Energy 2004-2007

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.1682	0.14718	0.475186	0	0.14977	36
LTD	0.1065	0.09578	0.364703	0	0.11430	36
STD	0.0617	0.02753	0.353477	0	0.08672	36
TANG	0.1761	0.12375	0.53485	0	0.15449	36
SIZE	11.264	11.5008	14.33766	3.295837	2.28242	36
PROF	0.0075	0.05901	0.458115	-2.2963	0.41709	36
NDTS	0.0368	0.03023	0.252874	0	0.04184	36
MV/BV	3.4297	2.395	18.81	-1.23	4.36653	36
LIQ	2.2637	1.57123	11.50539	0.675	2.07108	36
AGE	9	7.5	22	0	6.79495	36

Alternative Energy 2008-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.289219	0.297427	0.652169	0.007707	0.167381	36
LTD	0.175462	0.136807	0.55954	0	0.155476	36
STD	0.113757	0.088549	0.485042	0.004959	0.109176	36
TANG	0.268169	0.256892	0.687966	0.007565	0.133102	36
SIZE	12.46153	12.3128	14.78255	9.601774	1.301558	36
PROF	-0.0321	0.048931	0.24738	-0.88302	0.218467	36
NDTS	0.045854	0.038489	0.308412	0.003642	0.048307	36
MV/BV	2.275556	1.605	12.71	0.2	2.302628	36
LIQ	1.941235	1.520388	7.813225	0.821935	1.419665	36
AGE	12.94444	11.5	26	3	6.874152	36

Automobiles & Parts 2004-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.26635	0.25386	0.603663	0	0.178089	80
LTD	0.158027	0.177862	0.394428	0	0.103217	80
STD	0.108324	0.082398	0.298214	0	0.091074	80
TANG	0.275304	0.272334	0.521177	0	0.098091	80
SIZE	16.10629	16.64537	19.32608	12.51295	2.305728	80
PROF	0.08482	0.07331	0.262202	-0.04922	0.065073	80
NDTS	0.056313	0.056874	0.128096	0	0.023822	80
MV/BV	1.69375	1.44	4.87	0.35	0.983899	80
LIQ	1.386102	1.295503	2.59112	0.174276	0.394919	80
AGE	91.8	95	140	6	38.85266	80

Automobiles & Parts 2004-2007

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.244091	0.194924	0.491748	0.001628	0.169526	40
LTD	0.145908	0.156845	0.357744	0	0.096941	40
STD	0.098183	0.075679	0.2548	0.001098	0.085571	40
TANG	0.29196	0.305972	0.521177	0.101878	0.091451	40
SIZE	15.88755	16.17496	19.10833	12.51295	2.313345	40
PROF	0.097546	0.0773	0.262202	0.014186	0.061411	40
NDTS	0.06202	0.061477	0.128096	0.022277	0.025037	40
MV/BV	2.0095	1.73	4.87	0.62	1.095623	40
LIQ	1.431781	1.295503	2.59112	0.875051	0.4134	40
AGE	89.8	93	136	6	39.04842	40

Automobiles & Parts 2008-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.28861	0.314023	0.603663	0	0.185713	40
LTD	0.170146	0.190143	0.394428	0	0.109004	40
STD	0.118464	0.097627	0.298214	0	0.096273	40
TANG	0.258649	0.259134	0.511537	0	0.102753	40
SIZE	16.32502	17.05116	19.32608	12.85585	2.306376	40
PROF	0.072094	0.063364	0.236289	-0.04922	0.066888	40
NDTS	0.050606	0.050589	0.092763	0	0.021351	40
MV/BV	1.378	1.125	3.92	0.35	0.745679	40
LIQ	1.340424	1.283283	2.133333	0.174276	0.375155	40
AGE	93.8	97	140	10	39.04842	40

Electricity 2004-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.336831	0.355559	0.760083	0.0000602	0.233553	48
LTD	0.250506	0.239748	0.611942	0	0.18335	48
STD	0.086325	0.058539	0.319879	0.0000324	0.081926	48
TANG	0.379196	0.385936	0.660986	0.122458	0.148163	48
SIZE	13.67284	13.29065	17.39295	10.66875	2.08498	48
PROF	0.028704	0.05537	0.130099	-1.046807	0.162356	48
NDTS	0.025953	0.025438	0.044719	0.005171	0.010359	48
MV/BV	1.999375	1.835	9.12	-4.73	1.711456	48
LIQ	1.772632	1.36127	3.927447	0.60219	0.941019	48
AGE	27.16667	12	108	5	35.15034	48

Electricity 2004-2007

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.318957	0.312807	0.710422	6.02E-05	0.223929	24
LTD	0.243272	0.221454	0.610272	2.78E-05	0.186072	24
STD	0.075685	0.044133	0.208421	3.24E-05	0.065815	24
TANG	0.394149	0.371577	0.660986	0.217199	0.149816	24
SIZE	13.46076	12.94266	17.16219	10.66875	2.181598	24
PROF	0.000989	0.050998	0.130099	-1.04681	0.226321	24
NDTS	0.026989	0.027452	0.044719	0.009555	0.010687	24
MV/BV	2.221667	1.805	9.12	-4.73	2.344419	24
LIQ	1.881349	1.439173	3.927447	0.60219	1.108229	24
AGE	25.16667	9.5	104	5	35.47156	24

Electricity 2008-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.354705	0.355559	0.760083	0.000454	0.246282	24
LTD	0.25774	0.243611	0.611942	0	0.184294	24
STD	0.096964	0.072278	0.319879	0.000454	0.095644	24
TANG	0.364242	0.385936	0.578685	0.122458	0.148147	24
SIZE	13.88493	13.47812	17.39295	11.60571	2.007498	24
PROF	0.056418	0.064647	0.096747	-0.01083	0.032258	24
NDTS	0.024917	0.024228	0.039731	0.005171	0.010141	24
MV/BV	1.777083	1.835	3.01	0.62	0.621362	24
LIQ	1.663915	1.312346	3.300897	0.89711	0.746121	24
AGE	29.16667	13.5	108	9	35.47156	24

Gas, Water & Multiutilities 2004-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.107253	0.103968	0.303827	0	0.104571	56
LTD	0.086547	0.080938	0.261827	0	0.088918	56
STD	0.020707	0.007148	0.106186	0	0.027838	56
TANG	0.35768	0.384761	0.647181	0	0.196013	56
SIZE	13.19499	14.05026	18.85627	0	4.313479	56
PROF	0.044031	0.068279	0.206255	-0.406855	0.119949	56
NDTS	0.034995	0.0283	0.110086	0	0.025552	56
MV/BV	4.143036	2.335	47.31	0	8.447112	56
LIQ	3.569652	1.268232	81.5	0	10.82281	56
AGE	53.64286	22.5	124	4	49.1907	56

Gas, Water & Multiutilities 2004-2007

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.102509	0.108913	0.303827	0	0.099615	28
LTD	0.083515	0.081876	0.249515	0	0.08622	28
STD	0.018994	0.001714	0.106186	0	0.026583	28
TANG	0.360196	0.369814	0.647181	0	0.20907	28
SIZE	12.94979	13.97979	18.72919	0	4.656896	28
PROF	0.042544	0.072076	0.195436	-0.355152	0.126501	28
NDTS	0.036849	0.029294	0.110086	0	0.025887	28
MV/BV	2.298929	2.35	6.17	0	1.38828	28
LIQ	1.899249	1.284553	7.701797	0	1.937085	28
AGE	51.64286	20.5	120	4	49.60228	28

Gas, Water & Multiutilities 2008-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.111997	0.077222	0.283434	0	0.110929	28
LTD	0.089578	0.077222	0.261827	0	0.093021	28
STD	0.022419	0.013957	0.103643	0	0.029427	28
TANG	0.355165	0.393007	0.604602	0.006103	0.185855	28
SIZE	13.44019	14.13602	18.85627	7.610853	4.011227	28
PROF	0.045519	0.06355	0.206255	-0.406855	0.115332	28
NDTS	0.033141	0.026027	0.099932	0.005831	0.025548	28
MV/BV	5.987143	2.325	47.31	1.07	11.67773	28
LIQ	5.240055	1.17564	81.5	0.47512	15.1349	28
AGE	55.64286	24.5	124	8	49.60228	28

Technology Hardware & Equipment 2004-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.11047	0.127035	0.29992	0	0.10133	88
LTD	0.075799	0.056375	0.263974	0	0.086676	88
STD	0.034671	0.010158	0.241496	0	0.053158	88
TANG	0.176359	0.148053	0.455817	0.0012	0.118425	88
SIZE	11.30452	11.43283	14.40126	8.468423	1.345915	88
PROF	-0.01952	0.064913	0.346061	-4.71233	0.521621	88
NDTS	0.049527	0.036597	0.227376	0.001543	0.03559	88
MV/BV	1.402273	1.215	4.24	0	0.83819	88
LIQ	2.589751	2.139894	5.9	0.533309	1.176016	88
AGE	38.59091	25	174	10	42.77786	88

Technology Hardware & Equipment 2004-2007

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.112498	0.108856	0.298019	0	0.108559	44
LTD	0.068927	0.035721	0.256505	0	0.083633	44
STD	0.043571	0.010747	0.241496	0	0.063295	44
TANG	0.186542	0.184382	0.455817	0.009837	0.117938	44
SIZE	11.24347	11.32007	14.40126	9.029178	1.261682	44
PROF	-0.076737	0.060467	0.161833	-4.712334	0.727257	44
NDTS	0.052275	0.037722	0.227376	0.00844	0.039262	44
MV/BV	1.517045	1.37	3.09	0	0.686127	44
LIQ	2.58295	2.103717	5.9	1.115474	1.20423	44
AGE	36.59091	23	170	10	42.97826	44

Technology Hardware & Equipment 2008-2011

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
TD	0.108442	0.130945	0.29992	0	0.094768	44
LTD	0.082671	0.060375	0.263974	0	0.09005	44
STD	0.02577	0.005078	0.16721	0	0.039357	44
TANG	0.166177	0.11384	0.413997	0.0012	0.119387	44
SIZE	11.36557	11.8419	14.34742	8.468423	1.437231	44
PROF	0.037698	0.06969	0.346061	-0.301321	0.122069	44
NDTS	0.046779	0.035006	0.121902	0.001543	0.031714	44
MV/BV	1.2875	1.06	4.24	0.28	0.961112	44
LIQ	2.596551	2.192718	5.065726	0.533309	1.161002	44
AGE	40.59091	27	174	14	42.97826	44

Appendix B: Regression and Correlation Analysis

Regression Analysis for TD for Time Interval of 2004-2007

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF	R-square
AGE	-0.001086	0.004895	-0.221783	0.8249	0.000446	2242.152	0.99955
LIQ	0.004135	0.005490	0.753046	0.4529	0.350033	2.856873	0.64996
MV/BV	0.011312	0.002813	4.020992	0.0001	0.453751	2.203851	0.54624
NDTS	-0.459825	0.302404	-1.520565	0.1310	0.217255	4.602886	0.78274
PROF	-0.000753	0.016898	-0.044559	0.9645	0.450633	2.219100	0.54936
SIZE	0.012662	0.005523	2.292575	0.0236	0.072818	13.73286	0.92718
TANG	0.360375	0.117157	3.075989	0.0026	0.05794	17.25923	0.94206

R-squared= 0.898498; Adjusted R-squared= 0.857730; F-statistic= 22.03964

Regression Analysis for STD for Time Interval of 2004-2007

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF	R-square
AGE	-0.003873	0.003121	-1.240852	0.2170	0.00044	2272.727	0.99956
LIQ	-0.005005	0.003501	-1.429620	0.1554	0.345866	2.891293	0.654134
MV/BV	0.012027	0.001794	6.704371	0.0000	0.375529	2.662910	0.624471
NDTS	-0.248597	0.192821	-1.289263	0.1997	0.218397	4.578817	0.781603
PROF	-0.008290	0.010775	-0.769408	0.4431	0.448464	2.229833	0.551536
SIZE	0.003438	0.003522	0.976169	0.3309	0.075366	13.26858	0.924634
TANG	0.031926	0.074703	0.427370	0.6699	0.06234	16.04106	0.93766

R-squared= 0.792828; Adjusted R-squared= 0.709619; F-statistic= 9.528192

Regression Analysis for LTD for Time Interval of 2004-2007

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF	R-square
AGE	0.002787	0.004512	0.617773	0.5379	0.000444	2252.2522	0.999556
LIQ	0.009139	0.005061	1.806006	0.0734	0.342503	2.9196824	0.657497
MV/BV	-0.000714	0.002593	-0.275464	0.7834	0.513566	1.9471694	0.486434
NDTS	-0.211229	0.278726	-0.757835	0.4500	0.220335	4.5385435	0.779665
PROF	0.007537	0.015575	0.483918	0.6293	0.449777	2.223324	0.550223
SIZE	0.009224	0.005091	1.812030	0.0724	0.073964	13.520090	0.926036
TANG	0.328448	0.107984	3.041629	0.0029	0.058033	17.231575	0.941967

R-squared= 0.843942; Adjusted R-squared= 0.781263; F-statistic= 13.46454

Regression Analysis for TD for Time Interval of 2008-2011

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF	R-square
AGE	-0.001737	0.004392	-0.395501	0.6932	0.000526	1901.140	0.999474
LIQ	0.001098	0.000974	1.127223	0.2619	0.602152	1.6607102	0.397848
MV/BV	-0.000738	0.001604	-0.460019	0.6463	0.33725	2.9651593	0.66275
NDTS	-0.140191	0.246258	-0.569285	0.5702	0.356838	2.8023921	0.643162
PROF	-0.137157	0.050742	-2.703006	0.0079	0.452341	2.2107215	0.547659
SIZE	0.061624	0.018801	3.277708	0.0014	0.00689	145.13788	0.99311
TANG	0.298417	0.097157	3.071501	0.0026	0.094634	10.567026	0.905366

R-squared= 0.923557; Adjusted R-squared= 0.892854; F-statistic= 30.08075

Regression Analysis for STD for Time Interval of 2008-2011

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF	R-square
AGE	-0.008140	0.003827	-2.127280	0.0354	0.000508	1968.5039	0.999492
LIQ	-5.25E-05	0.000849	-0.061884	0.9508	0.608405	1.6436419	0.391595
MV/BV	-0.000875	0.001397	-0.626234	0.5323	0.336752	2.9695443	0.663248
NDTS	-0.167215	0.214547	-0.779386	0.4373	0.356013	2.8088861	0.643987
PROF	-0.091854	0.044208	-2.077756	0.0398	0.463045	2.1596173	0.536955
SIZE	0.039366	0.016380	2.403335	0.0178	0.007158	139.70382	0.992842
TANG	-0.153466	0.084646	-1.813041	0.0723	0.099277	10.072826	0.900723

R-squared= 0.747629; Adjusted R-squared= 0.646268; F-statistic= 7.375841

Regression Analysis for LTD for Time Interval of 2008-2011

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Tolerance	VIF	R-square
AGE	0.006403	0.003464	1.848576	0.0669	0.000512	1953.125	0.999488
LIQ	0.001151	0.000769	1.497696	0.1368	0.597439	1.6738110	0.402561
MV/BV	0.000137	0.001265	0.108510	0.9138	0.337802	2.9603140	0.662198
NDTS	0.027024	0.194208	0.139148	0.8896	0.357729	2.7954121	0.642271
PROF	-0.045303	0.040017	-1.132080	0.2598	0.474446	2.1077214	0.525554
SIZE	0.022257	0.014827	1.501135	0.1359	0.007361	135.85110	0.992639
TANG	0.451884	0.076621	5.897646	0.0000	0.079333	12.605095	0.920667

R-squared= 0.911791; Adjusted R-squared= 0.876362; F-statistic= 25.73616