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# **The effects of Financial Distress on the Value of the companies that make up the DAX index.**

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I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the sources according to the Regulations set in the Student's Handbook.

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## Abstract

Financial distress has become an increasingly important subject to stakeholders of any company, because it can lead a company to bankruptcy and finally to a potential collapse. The essence of this study is to establish if financial distress influences the value of companies listed at the DAX or else the DAX 30 index, which is made up by the 30 largest by market capitalization and most liquid companies, that trade on the Frankfurt Stock Exchange (FSE) in Germany. The specific objective of the study is to determine if financial distress has a notable impact on the value of companies listed at the Dax index covering the years from 2015 to 2018. Data collected from the annual financial reports of each company and analyzed using the Microsoft Excel spread sheets and the E-Views version 10.

In order to determine the exact relationship between the dependent variable (value of companies) and the independent variable (financial distress), correlation and regression analysis tests were conducted. The model that has been developed for the purposes of this study, except from the independent variable of financial distress, also included quality of assets, profitability and leverage as three more independent variables. The study revealed a strong positive relationship between the value of companies (measured by the market capitalization) and financial distress (measured by Altman's z-score) and a negative relationship between the value of the companies and leverage (measured by debt to equity ratio). The relationship between market capitalization and profitability seems to be very weak as well as with the quality of assets. Also, the study revealed a positive beta value of 0.68 between the value of the companies and financial distress, indicating that if the financial distress variable (measured by the Altman's z-score model) increases one unit, this fact would lead to 0.68 increase on the value of companies (measured by the log of market capitalization), or in actual values \$1.07 billion, holding other factors constant.

Keywords: financial distress, value of companies, Altman's z score, bankruptcy, leverage

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## Abbreviations

EBIT	Earnings Before Interest and Taxes
FSE	Frankfurt Stock Exchange
NSE	Nairobi Securities Exchange
OLS	Ordinary Least Squares
ROA	Return on Assets
ROE	Return on Equity
WACC	Weighted Average Cost of Capital



## Chapter One - Introduction

### 1.1 Introduction

Business failure refers to companies that are unable to make a profit or do not bring enough revenue in order to cover their expenses. Even large companies which have been profitable for a number of years can fail, if they reach a point that they are unable to generate enough cash flows in order to meet their expenses. High interest rates, wars, high taxation, recessions and poor management are some of the reasons that can lead a company to a failure. (Ucbasaran et al., 2013)

Andrade & Kaplan (1998) found out that the company's level of borrowing is a primary cause of financial distress in many companies they have investigated. If the company's level of borrowing is very high, the probability of financial distress is also very high. This fact can provide a negative impact on the value of the company.

Liquidity is considered to be a key component of any type of business in order to success. Lack of liquidity can drive a business to default on its obligations and then financial distress becomes evidence. On other words, a lot of times the lack of liquidity can provide the same negative impact on the value of the company, as the very high level of borrowing.

A lot of researches agree with the Trade-off Theory and have shown that a lot of companies prefer to be levered because they have tax shield advantage comparing to other companies that are not levered. However, the management of these levered companies has to ensure that the companies are optimally levered in order to avoid the effects of financial distress, that would reduce the shareholders' wealth. (Pandey, 2010)

### 1.2 Value of Firm

Firm valuation is one of the most important determinations because it reflects the performance of the companies (Keys & Biggs, 1990).

There are different valuation techniques that can be employed. The simplest one is the book value technique. This method is widely used but it has some disadvantages. The

biggest disadvantage is that it depends on the historical prices of the assets without taking into consideration the expected future cash flows that will be generated by the assets in the future. This fact, can lead to values that are different from the real ones (Beaver & Ryan, 2000).

A second technique is the estimation of the present value (PV) of the expected future cash flows that will be generated by the assets, fact that ignores the previous technique, discounted at a reasonable level of discount rate. (Parker, 1993)

Another valuation method is called market valuation. It is a very simple way that is used from a lot of researchers in order to value all the publicly traded firms and especially large corporations listed on stock exchanges. It is very easy to extract information from such companies, because they are required to publish their financial annual reports. In order someone to determine the value of a publicly traded company, has to calculate its market capitalization. This is achieved by multiplying the number of outstanding shares of the company by the company's stock price at the moment that someone wants to calculate it.

Once someone calculates the value of a company, by simply calculating its market capitalization, he finds out the price to which the company can be sold, but sometimes a company can be sold for either a premium (a value higher than the market value) or a discount (a value lower than the market value). (Thayikulwat, 2014)

### 1.3 Financial Distress

Financial distress is a burning issue to almost all markets all over the world and the last years has become a very important topic to stakeholders of any business. It is a situation when a company reaches the point that is unable to fulfill its financial obligations to the third parties, especially to its creditors. This problematic situation arises from bankruptcy or distorted business decisions before bankruptcy and can lead to the total bankruptcy of the business. (Andrade and Kaplan, 1998)

If the status of a company is classified as financially distressed, the company has minimum cash flows and maybe this fact will not allow the company to make timely payments or stop making payments at all. (Andrade and Kaplan, 1998)

There are also many other definitions about the financial distress. Lau (1987) defines financial distress as an evidence of missed dividend payments, restructurings or layoffs for a number of consecutive periods. Whitaker (1999) interprets financial distress as the condition when a company continues to operate with negative working capital.

Platt and Platt (2002) conducted a study investigating companies that said to be in a financial distress condition. For the purposes of their research, they used a multidimensional approach and tried to determine whether the companies were in a financial distress condition by checking if they have reported negative earnings before some special items such as tax, depreciation, interest and amortization. The findings of their study showed that the companies that were very often in a financial distress condition, reported losses from their key operational activities.

Sudarsanam and Lai (2001) said that there is a way for the companies that face financial distress problems to get out of this difficult situation. They noted that there are many turnaround strategies such as hiring experts, downsizing, working capital cycle improvement, creating product lines and disposal of unproductive assets. So, if a company wants to get out of the financial distress position, it can follow one or more of the above turnaround strategies depending on the size and the activities of the company.

For the purposes of this study, Altman's z-score used as an indicator of the level of financial distress. The companies that provided a z-score lower than 3, considered to be financially distressed.

#### 1.4 Determinants of Value of Firm and Financial Distress

There are a lot of factors or causes that can lead a company to financial distress. Pandey (2010) divides these factors to endogenous and exogenous. Endogenous factors are linked with the company's internal characteristics. This kind of factors, are in company's control and can affect its performance and thus its value. Mismanagement of the company's resources and poor corporate governance, both of them endogenous factors, are considered to be two main contributors that can drive a company to financial distress and affect negatively its value.

On the other hand, exogenous factors that can lead a company to the financial distress status have to do with macroeconomic influences that are not in the control of the company. These exogenous factors, or else external risk factors, can generally affect all the companies of the same industry because the entire market is affected. High inflation, exchange rates, high and unfavorable interest rates and legislation are some of the external risk factors that can influence every company in the same industry and lead some of them to financial distress. Also, it is notable that these factors do not depend on the management of any company and have to do only with the market. (Kanelis and Prakash, 1987).

### 1.5 Country and index information

Germany is one of the biggest economic forces in Europe (Owen-Smith, 2012). The recent global financial crisis hit hard the Europe and especially the German economy, but the successful economic management along with its strong competitiveness and dependence on exports, made Germany stronger than before. (Storm and Naastepad, 2015).

The DAX 30 or DAX Index, is a German stock market index that represents the 30 largest, by market capitalization and most liquid companies, that trade on the Frankfurt Stock Exchange (FSE). It is considered to be a very strong measure of the German and also of the European economic health.

### 1.6 Research problem

Whether financial distress resulting in bankruptcy or not, has many direct and indirect costs on the company. Direct costs of financial distress can contain management costs, legal fees and other payments. Indirect costs of financial distress can influence the behavior of many sections of the company. It is very difficult to calculate with certainty these indirect costs of financial distress. Also, direct costs of financial distress can be limited but on the other hand indirect costs of financial distress cannot be limited.

The main objective of this study is to create a model, with a set of variables, in order to determine the effects of the financial distress on the value of the companies that make up the DAX 30 or else the DAX Index.

So, the main hypothesis is, if financial distress and other related factors can affect the value of the 30 largest German companies that make up the DAX Index.

### 1.7 Importance of the study

A lot of research projects about the financial performance, financial position and adaptability of many firms and stock indexes have been conducted over time.

The truth is that the research around the subject of financial distress is relatively a young topic and there is not a decent pool of knowledge yet. In each one of the limited number of studies that have been conducted, there is a unique set of variables used in order to forecast a company's distress or failure. For this reason, there is not a generally accepted list of variables to forecast a financial distress or the failure of a company.

A lot of stakeholders can benefit from this research study, using either the results or the model that will be developed in order to predict if financial distress and other variables that will be used, can affect the financial performance of a company and finally the value of a company.

Banks that provide short-term and long-term loans to the companies examined, can determine a potential scenario of one of their clients, to default a payment.

Analysts and investors can figure out how the company's share price can be negatively affected if a company is under the financial distress status.

Suppliers can use the model or the results of the companies that have been examined, to negotiate the payment terms. If financial distress is observed for one of the companies, the supplier may ask the company to negotiate the payment terms or request the company to proceed to the payment immediately in order to avoid a default in a payment.

Moreover, employees can use the model or the results of the examined firms to negotiate their annual wage.

Finally, this study and especially the model that will be developed, can be helpful for a firm's management and other stakeholders, in order to determine if a company is in a financial distress status or not and how this fact can influence their personal wealth.

## Chapter Two – Literature Review

This chapter examines the relevant literature relating to financial distress. Section 2.1 presents the theoretical literature review, giving emphasis to Capital Structure, Credit Risk, Trade-off and Pecking Order Theories, while Section 2.2 presents the empirical literature from international studies. Finally, Section 2.3 draws a summary of the literature review.

### 2.1 Theoretical Literature Review

#### 2.1.1 Capital Structure Theory

Capital Structure Theory, also known as the Modigliani-Miller Theory or MM Theory, was introduced by Modigliani and Miller in 1958. This theory supports that the value of any firm is not affected by its choice of capital structure. When the firms pay taxes, the capital markets function well and do their job. That keeps firms from increasing their value by changing their capital structure. (Miller and Modigliani, 1961)

David Durand in 1959 said that if there is a change in financial leverage, this can lead in a change in the cost of capital. He explained that if debt ratio increases, the capital structure increases as well and the weighted average cost of capital (WACC) decreases. This fact can increase the value of the company.

This approach of Durand contradicts the Net Income Approach theory. In the Net Income Approach theory, the weighted average cost of capital (WACC) remains constant. If new tax information is provided, the WACC decreases if debt financing increases. This can lead to an increase in the value of a company. It is notable that in this approach an optimal capital structure is assumed. This optimal capital structure implies that there is the minimum cost of capital, certain debt and equity ratios and the value of companies is at maximum.

### 2.1.2 Credit Risk Theory

Credit Risk Theory, otherwise is known as the Structural Theory, was first developed by Merton in 1974. It has to do with the risk associated with the default on a debt and arises from the borrower's side, when is unable to make the required payment and a default in a payment follows.

The loss for the lender may be complete or partial. In a theoretical efficient market, higher borrowing costs may be associated with higher levels of credit risk. If a lender wants to reduce his credit risk, a credit check at the potential borrower is required. The borrower hat to present an appropriate security over some assets or a guarantee from a third party. In general, the higher is the risk, the higher will be the interest rate that the lender will provide to the borrower. (Lando, 2009)

### 2.1.3 Trade-off Theory

Trade-off Theory developed by Kraus & Litzenberger in 1973. It is based on the trade-off between the advantage of the tax-shield on interest expense, arising from the debt financing and the actual distress costs of debt. (Mokhova and Zinecker, 2013)

The value of any firm can be calculated by the following formula:

Value of firm	=	Value if all-equity- financed	+	PV of tax shield	-	PV of costs of financial distress
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Figure 1. (Brealey et al., 1988) below shows the relationship between the tax benefits and the costs of financial distress, that could determine the optimal capital structure.

At medium levels of debt, where the tax advantages are huge and the PV of costs of financial distress is small, the probability of financial distress is insignificant. But, if the borrowing increases, the PV of cost of financial distress starts to decrease the firm value. A firm can reach a theoretical optimum, when the PV of tax savings caused by additional borrowing, is just offset by increases in the PV of costs of financial distress.



So, as the trade-off theory suggests, the managers should choose the debt ratio that is able to maximize the firm value.

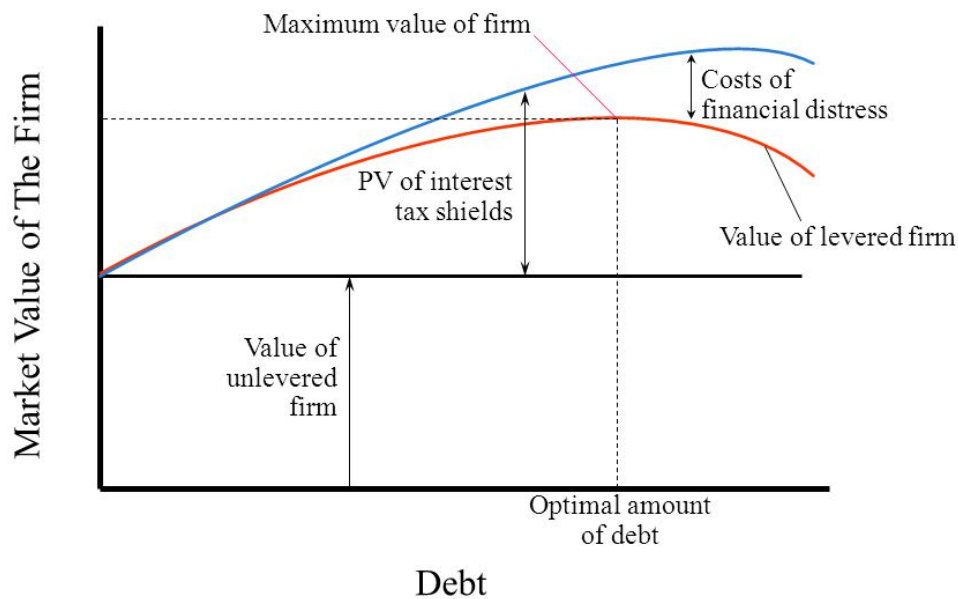


Figure 1. Optimal amount of debt that maximizes the value of firm. (Brealey et al., 1988, pp. 447)

#### 2.1.4 Perking Order Theory

Perking-order Theory initially suggested by Donaldson and then modified by Myers & Majluf in 1984. It supports that firms generally prefer the internal finance, while setting targets about the payout ratios and avoiding changes in dividends.

The internal generated cash flows may be more or less than the capital expenditure. If the internal generated cash flows are more than the capital expenditure, the company prefers to pay off debt or to invest in marketable securities. If the internal generated cash flows are less than the capital expenditure, then the first thing that the company does, is to sell marketable securities. If there is a need of external finance, there are two ways to achieve it, debt and equity. The firms generally prefer the debt way, because is cheaper and take the decision to follow the equity way, if the do not have any other choice. The equity way is the costliest way for the firms and acts like a “last resort”. (Brealey et al., 1988)

## 2.2 Empirical Literature Review

In this section will be reviewed studies on financial distress which are relevant to this study.

Theodossiou and Kahya (1999) analyzed factors that can influence an investor's decision when he wants to acquire a financially distressed company. They found out that the firm's size and growth, profitability, financial leverage and managerial effectiveness are very important explanatory variables in order to construct a financial distress model.

Simpson & Gleason (1999) investigated the financial distress in banking companies. They tried to investigate how the probability of financial distress fluctuates when the CEO and the chairman of the board is the same person. They explored a sample of 300 banking firms and found out that if the CEO and the chairman of the board is the same person, the probability of financial distress is lower and also the value of the bank can be higher. This is because if the CEO and the chairman of the board are not the same person, they may pursue their own interests and that would mean more risk for the bank.

Karbhari and Muhamad Sori (2004) developed a model in order to predict the potential failure of the financially distressed firms in Malaysia during the Asian Crisis in 1997. The data that he used has been evaluated by Altman's Z-Score and found out that assets' turnover, cash to total assets, inventory to total assets, total liabilities to total assets and finally sales inventory are 5 significant financial ratios to predict the distress.

Pitardo et al. (2006) tried to investigate how does the financial distress affect a sample of 402 small Portuguese firms, for the years 1990 to 1999. It is worth noting that during the period selected and especially from 1992 to 1997, Portuguese economy faced a period of recession and the firms that have been analyzed, were affected by financial distress. The study has two main conclusions. First, the determinants between the short-term and long-term debt ratios, differ a lot in the small firms. The long-term debt is positively affected by the firm fixed assets' liquidation value, while the short-term debt, is strongly affected by growth. Second, the small distressed and non-distressed firms, differ a lot. Specifically, the distressed firms seem to be confused when they make a decision about their financial structure.

Fitzpatrick (2011) tried to investigate how financial distress influences US publicly traded non-financial firms. He run a sparing model in order to measure the firms' financial condition. He tested 3.689 firms in 1988, 3.910 firms in 1993 and 4.777 firms in 1998. The results shown that the financially distressed firms issue equity more than they issue debt.

Tan (2012) studied the relationship between financial distress and financial performance during the Asian Financial Crisis of 1997 to 1998. He used a sample of 277 firms. The results from this study show that the low financial leverage firms, tend to outperform the high financial leveraged firms. Also, he found out that there is a negative relationship between financial distress and financial performance. During a crisis, the high financial leveraged firms experience a worse performance, that can lead them to financial distress and reduction of their value.

Madhushani & Kawshala (2018) studied the impact of financial distress on the financial performance for 29 listed nonbanking financial institutions in Colombo stock exchange. They used data for the years 2012 to 2016 and their model had as independent variables the Altman's z-score and the leverage ratio. They found out that is a company is very close to the financial distress situation, that has a very significant impact on its financial performance.

### 2.3 Summary of Literature Review

Even though, the research around the financial distress is a relatively a young topic and there is not a decent pool of knowledge yet, the existing literature tends to identify a positive and a lot of times a strong positive relationship between the value of companies and financial distress. Also, the size of the company plays a big role when a company is considered to be financially distressed. Generally, financially distressed companies tend to have problems facing their capital structure and when they reach the financial distress point, they try to use the last resort solution, to issue more equity than debt.

## Chapter Three – Research Methodology

This chapter highlights the methodology of the study. Section 3.1 describes the research design while section 3.2 describes the initial population and the final sample of the research. Section 3.3 discusses the data collection and the analysis of the data. Section 3.4 presents the analytical model of the research and finally, section 3.5 presents some tests that will follow in the next chapter, Chapter Four.

### 3.1 Research design

The main objective of this study is to determine the effects of financial distress on the value of firms that make up the DAX Index. Taylor et al. (2015) defined research design as the plan to carry out a research project. Research design shows how the research will be conducted, by writing research questions, collecting data, analyze them and finally report the results. A well-organized research design is always important because, it helps the researcher to keep in mind the big picture, throughout the whole research process.

In this study, a correlational research design has been employed and focused on the 30 largest German companies. Based on Fraenkel et al. (2011), correlational research design is used in order to describe the relationship between two or more variables. This association can be positive, negative or neutral. The model that has been developed for this study, involves more than one independent variable and the above technique will be used in order to establish the exact relationship among them and especially between the dependent variable which is the value of the companies and the independent variable of financial distress.

### 3.2 Population and Sample

Population refers to the group of people, objects or institutions to which the researcher is interested in generalizing the findings or outcomes of the study. For the purpose of this study, the 30 largest, by market capitalization and most liquid companies, that trade

on the Frankfurt Stock Exchange and make up the DAX index (or else the DAX 30), where chosen to form the population and are listed in Appendix 1.

Sampling is a process of drawing a representative sample from the population for testing, while ensuring that the selected objects, represent fairly all the characteristics for the whole population and the findings or outcomes can then generalized for the population. (Marshall, 1996). Deutsche Bank was removed from the initial population, because it was considered appropriate to remove all the banking institutions that were in the initial population in order not to influence the results that will come out from the companies. So, this study is focusing on 24 companies out of the initial pool of 30 companies that chosen to be the initial population , because those 24 firms have shown to experience financial distress, for at least one year from 2015 to 2018, as predicted by the Altman's Z-score, providing a Z-score equal or less than 2.99, during the period of 2015 to 2018. These firms make up the sample of this study and are listed in Appendix 2.

### 3.3 Data collection and Data Analysis

The companies that have been investigated are publicly traded companies and for this reason they are required to publish their financial annual reports. This study used secondary data, quantitative in nature with yearly frequency, obtained from the annual financial reports of the companies.

The purpose of the study is to research the effects of financial distress on the values of the companies in a tranquility period without the existence of the effects of the most recent global financial crisis. After a research that has been conducted on the market capitalization of the companies that consist the sample of this research, from 2015 till today, seems to be a tranquility period without any global economic events that could influence their value. As a result, a four-year period between 2015 to 2018 considered to be long enough for this research, in order to provide sufficient findings for the effects of financial distress on the value of firms listed at the DAX Index.

In order to provide the results of the Altman's Z-score model, the data collected for each company related to working capital, retained earnings, EBIT, market capitalization, sales, total assets and total liabilities.

After providing all the Z-scores for each company for the years between the 2015 to 2018, the data collected for the companies that would represent the sample of the research related to net income, average shareholders' equity, total assets and total debt. After that, the data organized and used in order to determine profitability and liquidity ratios such as ROA, ROE and also the Leverage ratio.

The data was analyzed using the Microsoft Excel (MS Excel) and the E-Views version 10 (Econometric Views, a statistical package for Windows). MS Excel and E-Views version 10 were preferred because they provide a great statistical inference and are easy to use.

### 3.4 The model

The empirical model used for the purposes of this study, in order to test the effects of financial distress on the value of the companies that make up the DAX 30 or else the DAX Index is presented as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e$$

Where; Y = The dependent variable (Value of firm)

$\alpha, \beta_1, \beta_2, \beta_3, \beta_4$  = Regression coefficients

$X_1$  = Financial distress (Measured by Altman's Z-score)

$X_2$  = Quality of assets (Measured by ROA)

$X_3$  = Profitability (Measured by ROE)

$X_4$  = Financial leverage (Measured by the ratio of total debt over total equity)

e = Error term

The dependent variable of the model is the value of the companies listed in the DAX Index and the proxy used for the value of the firms is the market capitalization. Market capitalization refers to the total market value of the company's outstanding shares. It is also commonly referred as "market cap" and it is calculated by multiplying the market

price of one share by the total number of the company's outstanding shares at the time someone wants to calculate it. (Kumar and Shah, 2009).

Using market capitalization in order to determine the size and the value of a company, is very important because the company's size plays an important role for the investors who are interested, including risk. For the investors, market capitalization is a very helpful metric, that can help them to determine for which stocks they are interested and how to diversify their portfolio, depending on different company sizes.

Large-cap companies are those which have a market capitalization of \$10 billion or more. Usually, the large-cap companies are preferred for investments over the long run and generally the rewards for the investors are the constant increase on the value of the share and the dividend payments, if the company follows a dividend payout policy.

Mid-cap companies are those which present a market capitalization between \$2 billion and \$10 billion. Generally, investors expect that these companies can experience a rapid potential growth, but they carry a higher risk than the large-cap companies. For this reason, a lot of times investors earn more by investing in a mid-cap company than investing in a large company, because the risk is higher so the reward can be higher.

As small-cap companies are classified those which present a market capitalization between \$100 million and \$2 billion. Investments in these companies are considered to be high risk investments because the small-cap companies are more sensitive to economic slowdowns (Gajera et. al., 2015).

Generally, the pool of the studies that have been conducted around the subject of the effects of financial distress on the firm value, is small and there is not a unique set of variables that is generally accepted in forecasting that.

The study is limited to four independent variables. Financial distress measured by Altman's Z-score, Quality of Assets measured by Return on Assets (ROA), Profitability measured by Return on Equity (ROE) and Leverage measured by the ratio of Total debt to Total equity.

These four independent variables have been chosen to be the independent variables of the model based on the results of other studies that researched the effects of financial distress on the firm value and the overall financial performance.

Mohamed (2013) created a model in order to predict the bankruptcy of the firms listed at the NSE and he found out that Altman's z score model is a very useful measure in order to predict the level of financial distress in an organization.

McEnally and Todd (1993) investigated the relationship between the financial distress and leverage. They found out that if a company is moving into financial distress, the probability of the leverage to increase is very high. Also, as they mentioned the leverage can influence a company's value.

Moreover, Madhushani & Kawshala (2018) found out that financial distressed measured by Altman's z-score and leverage are two very significant variables in the model they used to investigate if financial distress influences the firm value.

The choice of the other two independent variables, and especially Quality of Assets measured by Return on Assets (ROA) and Profitability measured by Return on Equity (ROE) was a personal choice of the researcher in order to investigate if these two ratios can influence the value of a company and lead a company to financial distress.

Altman's Z-score model used in predicting financial distress on the companies. It is a set of financial ratios and is commonly used in predicting bankruptcy. Altman after examining twenty-two different ratios, finally chose five that provided the best results. (Altman, 2000)

The Altman's Z-score model is presented as follows:

$$Z=0.012 M_1+0.014 M_2+0.033 M_3+0.006 M_4+0.0999 M_5$$

Where;  $M_1 = \text{Working Capital} / \text{Total Assets}$

$M_2 = \text{Retained Earnings} / \text{Total Assets}$

$M_3 = \text{Earnings before Interest and Taxes} / \text{Total Assets}$

$M_4 = \text{Market Capitalization} / \text{Total Liabilities}$

$M_5 = \text{Sales} / \text{Total Assets}$

Firms which provide Z-scores greater than or equal to 3.0, are considered to be safe. Firms with Z-scores lower than or equal to 1.80, have a high probability of default.



There is a “gray area” for the firms that provide Z-scores between 1.81 to 2.99. These firms may be safe but a caution should be taken. (Altman, 2000)

**Table 1. Altman’s z-score possible outcomes**

High probability of default $\leq 1.80$	Gray Area 1.81 to 2.99	Safe $\geq 3.00$
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*Source: Own processing*

Another independent variable is the Quality of Assets, that is measured by Return on Assets (ROA). ROA is defined as the net income over the total assets and it is widely used for measuring the financial performance. A high ROA indicates that the firm utilizes efficiently its assets to generate revenue and is a ratio that all providers of funds care about. (Ahmed, 2009).

Profitability is measured by Return on Equity (ROE). ROE is defined as the net income over the shareholders’ equity and it is also widely used for measuring the financial performance but is a ratio that mainly equity holders care about. (Ahmed, 2009).

Financial Leverage, the last independent variable, is measured as a ratio of total debt over total equity. Financial leverage is the borrowed money or else the debt used in order to finance an investment, expecting that the income or the capital gains from the investments will be more than the borrowing cost.

Researchers have shown that an increase in financial leverage can cause an increase in debt capacity, but there is not a strong evidence that an increase in financial leverage is due to past unused debt capacity. Furthermore, a lot of times an increase in financial leverage can be a benefit for the shareholders, through the tax deductibility that exists because of the interest payments on corporate debt (Ghosh and Jain, 2000).

### 3.5 Tests

Descriptive statistics defined as the procedure by which the initial data set is summarized with the help of some descriptive coefficients. (Oja, 1983). Descriptive statistics used in order to proceed in a brief description of the coefficients that summarize the given data set.

After this brief description of the coefficients with the help of the descriptive statistics, diagnostic tests follow. Correlation Analysis is defined as the method that helps to understand the strength of the relationship between two or more variables (Hüsser, 2017) and used in order to check the strength of the relationship between the value of firms, financial distress, the quality of assets, the profitability and the financial leverage. Regression Analysis, is a very important statistical method that helps to examine how the independent variables influence the dependent variables (Chatterjee and Hadi, 2015). In this study, regression analysis will help in order to investigate in a better way, the if financial distress can influence the value of the companies examined.

Finally, the outcomes of the study will provide the estimated model.

## Chapter Four – Data Analysis, Results, Discussion

This chapter provides the analysis of the data, the results and the discussion of the findings. Section 4.1 highlights the summary statistics while section 4.2 presents the diagnostic tests in order to understand the exact relationship between the dependent and the independent variables. More analytically, section 4.2.1 presents the correlation analysis while section 4.2.2 presents the regression analysis. In section 4.3 there is a summary and discussion of the findings.

### 4.1 Summary statistics

The first step of the analysis of the data is the descriptive statistics. Descriptive statistics, describes briefly the coefficients of the model and summarizes the given data (Parmar et al., 1998). The findings from the descriptive statistics of the firms that consisted the sample of the research and are listed in Appendix 2, are presented in the Table 2. below, from which someone can take useful information about the maximum and minimum value for each one of the coefficients as well as the standard deviation and information about the skewness and kurtosis.

**Table 2. Descriptive statistics**

	Market_Cap.	Altman's z-score	ROE	ROA	Leverage
<i>Mean</i>	24,20594	1,595694	14,76583	3,907604	1,136979
<i>Median</i>	24,35584	1,425262	13,54500	3,790000	1,180000
<i>Maximum</i>	25,69315	3,776487	255,9800	19,64000	2,700000
<i>Minimum</i>	22,44084	0,084381	-106,5800	-9,330000	0.260000
<i>Std. Dev.</i>	0,796997	0,964504	32,47344	3,825786	0.490843
<i>Skewness</i>	-0,382928	0,298375	3,238666	0.268199	0.599683
<i>Kurtosis</i>	2,094578	2,213410	36,65767	7,171803	3,457001
<i>Jarque-Bera</i>	5,625301	3,899332	4699,180	70,76666	6,589304
<i>Probability</i>	0,060046	0,142322	0.000000	0.000000	0.037081
<i>Sum</i>	2323,770	153,1866	1417,520	375,1300	109,1500
<i>Sum Sq. Dev.</i>	60,34443	88,37554	100179.8	1390,481	22,88802

*Source: The data in the table above shows the descriptive statistics of the coefficients of the companies listed at the DAX index from 2015 to 2018.*

The results reveal that for the 96 observations made from the 25 companies examined from 2015 to 2018, the average value of the firms, as measured by the log of market capitalization is 24.21 or in actual values the average value of the firms is around \$38.16 billion.

All the independent variables have positive mean values and especially for the independent variable of the financial distress, as measured by Altman's z-score, the mean value is 1.60. Also, the maximum for the independent variable of the financial distress is close to 3.78, higher than 3 which is the limit for a company to be considered as safe. This is because the companies that constitute the sample, seemed to face financial distress for at least one year for the period of 2015 to 2018. That means that for some companies it was possible that there was a year from 2015 to 2018 that presented a z-score higher than 3 and considered to be safe for that specific year.

## 4.2 Diagnostic Tests

The next step of is to test how strong is the relationship between the value of the companies listed in the DAX and the financial distress. In order to achieve that, section 4.2.1 presents the correlation analysis while section 4.2.2 presents the regression analysis of the dependent and independent variables.

### 4.2.1 Correlation Analysis

Correlation analysis is a statistical evaluation method used to determine how strong is the relationship between two variables. Researchers use correlation analysis in order to determine possible correlation between the variables.

If correlation found between two variables, that shows that if systematic change appears in one variable, this systematic change will also appear in the other variable. The correlation can be positive or negative and always between +1 and -1. A correlation close to +1 or equal to +1 indicates a very strong, and in the case of +1, the strongest positive correlation possible. A correlation close to -1 or equal to -1 indicates a very weak, and in the case of -1 the weakest correlation possible. Positive correlation exists

when the one variable increases simultaneously with the other one. Negative correlation exists when the one variable decreases and the other increases (Ezekiel, 1930).

**Table 3. Correlation Analysis**

	Market_Cap.	Altman's z-score	ROE	ROA	Leverage
Market_Cap.	1.000000	0.946813	0.031413	0.136337	-0.723168
Altman's z-score	0.946813	1.000000	0.028551	0.123830	-0.649512
ROE	0.031413	0.028551	1.000000	0.521022	0.005707
ROA	0.136337	0.123830	0.521022	1.000000	-0.219125
Leverage	-0.723168	-0.649512	0.005707	-0.219125	1.000000

*Source: The data in the table above shows the correlation analysis of the coefficients of the companies listed at the DAX index from 2015 to 2018*

The results as presented in the Table 3 above, declare that there are strong negative and positive correlations between the dependent variable (the value of the companies measured by the log of market capitalization) and the independent variables; financial distress (measured by Altman’s z-score), profitability (measured by ROE), quality of assets (measured by ROA) and leverage (measured by dept/equity ratio). In more detail, there is a very strong correlation of 0.95 between the value of the companies and financial distress, indicating that as the level of financial distress increase, the value of the companies is very likely to decrease.

Moreover, the findings show a high negative relationship of 0.72 between market capitalization and leverage. The relationship between market capitalization and profitability seems to be very week at only 0.03 as well as with the quality of assets with 0.14.

#### 4.2.2 Regression Analysis

This section presents the regression analysis of the model. Regression analysis is a statistical process which is widely used in order to estimate the relationship between a dependent variable and one or more independent variables (Kleinbaum et al., 1988)

For the purposes of this study, the (pooled) Ordinary Least Squares (OLS) method used. OLS is a statistical method of analysis that estimates the relationship between a dependent variable and one or more independent variables, by minimizing the sum of the squares in the difference between the predicted and the observed values of the dependent variable (Hayes and Cai, 2007).

**Table 4. Regression Analysis of the initial model**

Dependent Variable: Market Cap. Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23,48167	0,125015	187,8316	0,0000
Altman's z-Score	0,680654	0,032907	20,68411	0,0000
ROE	0,000439	0,00088	0,498681	0,6192
ROA	-0,003551	0,007647	-0,464346	0,6435
Leverage	-0,311752	0,066395	-4,695408	0,0000
R-square	0,916981		Mean dependent var	24,20594
Adjusted R-square	0,913332		S.D. dependent var	0,796997
S.E. of regression	0,234631		Akaike info criterion	-0,010927
Sum squared resid	5,009708		Schwarz criterion	0,122633
Log likelihood	5,524492		Hannan-Quinn criterion	0,043060
F-statistic	251,2851		Durbin-Watson stat	1,424433
Prob (F-statistic)	0,000000			

*Source: The data in the table above shows the regression analysis of the initial model used for the purposes of this research and include information for the companies that are listed at the DAX index from 2015 to 2018*

The results in the Table 4 above, show that from the four independent variables, only two of them are statistically significant. These two variables are the financial distress (measured by Altman's z-score) and leverage (measured by debt/equity ratio). This is a fact that someone would expect to see, because the findings from the correlation analysis discussed in the previous section, Section 4.2.1 showed a weak relationship between the dependent variable and other two independent variables profitability (measured by ROE) and quality of assets (measured by ROA).

For this reason, profitability (measured by ROE) and quality of assets (measured by ROA), have dropped from the model and instead of the initial model a new restricted model created.

The new restricted model has as dependent variable the value of the companies (measured by the market capitalization) and as independent variables the financial distress (measured by Altman's z-score) and leverage (measured by debt to equity ratio).

The Table 5 that follows presents the regression analysis of the new restricted model, after removing from the initial model the two statistically insignificant variables and keeping only the two significant variables.

**Table 5. Regression Analysis of the restricted model**

Dependent Variable: Market Cap.				
Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	23,46331	0,115911	202,4251	0,0000
Altman's z-Score	0,681928	0,032524	20,96683	0,0000
Leverage	-0,303895	0,063910	-4,755051	0,0000
R-square	0,916705		Mean dependent var	24,2059
Adjusted R-square	0,914914		S.D. dependent var	0,7970
S.E. of regression	0,232480		Akaike info criterion	-0,0493
Sum squared resid	5,026387		Schwarz criterion	0,0309
Log likelihood	5,364948		Hannan-Quinn criterion	-0,0169
F-statistic	511,7570		Durbin-Watson stat	1,4262
Prob (F-statistic)	0,000000			

*Source: The data in the table above shows the regression analysis of the restricted model used for the purposes of this research and include information for the companies that are listed at the DAX index from 2015 to 2018*

The results of the new restricted model's coefficients show that holding Altman's z-score and leverage to a constant zero, the log of the market capitalization would be equal to 23.46 or in actual values \$36.98 billion.

Financial distress measured by Altman's z-score provides a positive beta of 0.68. This fact indicates that a unit increase in Altman's z-score, the indicator of the level of financial distress, leads to a 0.68 increase in the log of market capitalization or in actual values \$1.07 billion.

On the other hand, the leverage has a negative beta value. This fact indicates that a unit increase in leverage, leads to a 0.30 decrease in the log of market capitalization or in actual values \$0.48 billion.

Furthermore, the overall findings of the regression of the model reveal a very good relationship between the variables of the model, as presented by the R-squared ( $R^2$ ) which is equal to 0.92, close to 1. This is a fact that the model fits well the data.



Also, the F-statistic is equal to 511.76 and the prob.(F-statistic) is equal to zero. The null hypothesis of the F-statistic states that all the coefficients of the independent variables are zero, meaning that the model fits the data with no independent variables in the same way. The alternative hypothesis states that the model fits the data in a better way with independent variables. As a result, the high value of the F-statistic (511.76) in combination with the lowest value of the prob.(F-statistic) (0.00), indicate that the independent variables of the model improve the fit, so the regression model fits the data better than the model without independent variables.

#### 4.3 Summary and Discussion of findings

The findings of the research, showed a very strong relationship between the value of the companies listed in the DAX index and the financial distress (measured by Altman's z-score) and a negative relationship between the value of the companies and leverage (measured by debt/equity ratio).

The results showed a very high positive correlation of 0.95 between market capitalization and financial distress. These findings are in line with the findings of available literature review (Theodossiou and Kahya, 1999, Tan, 2012) that have been conducted on the subject of financial distress. For this reason, it is possible to conclude that the level of financial distress can affect the value of the companies listed in the Dax index, whether arising from exogenous or endogenous factors. As a result, financial distress can cause a reduction in the value of companies and for this reason is a key concern for the managers.

The relationship between the value of the companies and leverage is negative. The results showed a negative correlation of 0.72 between market capitalization and leverage. This finding, is also in line with findings of available empirical literature review (Tan, 2012) as also with the Perking-order Theory that has been analyzed in the section 2.1.4. So, an increase in leverage can cause a reduction in the value of companies and for this reason, leverage, as well as financial distress, is an extra key concern for the managers.

Finally, profitability as measured by ROE and quality of assets as measured by ROA, do not have a significant impact on the value of the companies listed in the DAX index.

## Chapter Five - Summary, Conclusions & Recommendations

This chapter presents the summary of the findings, limitations and recommendations. Section 5.1 provides the summary of the study, while section 5.2 highlights the conclusions of the study. Section 5.3 provides the limitations of the study and finally, section 5.4 presents recommendations for further potential research.

### 5.1 Summary of the study

The study tried to establish the effects of financial distress on the value of companies listed at the DAX index through a model analysis, with independent variables being financial distress (measured by Altman's z-score model), quality of assets (measured by ROA), profitability (measured by ROE) and leverage (measured by debt to equity ratio). The results of the research showed a very strong positive relationship of 95% between the value of the companies listed at the DAX (market capitalization used as a proxy) and financial distress.

The results of this study confirm a number of other empirical studies on the subject of financial distress (Madhushani and Kawshala, 2018, Pitando, 2006, Tan, 2012) which reveal that financial distress and leverage have a very significant impact on the value of the companies that have investigated. The data collected for this study show that the majority of the companies (83%) listed at the DAX index, have reached the status of financial distress and some of them were in a great caution.

### 5.2 Conclusions of the Study

The findings of the study can strongly confirm a number of other studies (Madhushani and Kawshala, 2018, Fitzpatrick, 2011, Tan, 2012) that have been conducted on the subject of financial distress, even though the pool of the studies that have been conducted on the subject of financial distress is very small in number. On the other hand, many researchers faced problems and had difficulties trying to estimate if financial distress has a serious impact on the value of companies. This was the challenge

for this study, to see if the approach with the model that has been used, can confirm the logical findings of other studies.

Overall, the findings of the study show that financial distress has a significant impact on the value of companies listed at the DAX index. However, as Sudarsanam and Lai (2001) and also many others suggest, a company can successfully get out of this problematic situation by executing a number of turnaround strategies.

The 83% of the companies listed at the DAX index, seemed to have faced financial distress for at least one year from 2015 to 2018. For some of the companies, that does not mean that they are one step before bankruptcy, but for some others this fact has a very serious impact for their financial performance.

Moreover, this study informs that a poor management can cause serious problems and drive a company to financial distress.

Furthermore, the study explains that a lot of companies prefer to be levered in order to take advantage for their shareholders, through the tax deductibility that exists because of the interest payments on corporate debt (Ghosh and Jain, 2000). In order to follow this strategy and be successful, a company, first of all needs a strong management and also to be optimally levered. This scenario will help the company to avoid the effects of financial distress, that would have serious negative consequences for the overall financial performance of the company as well as also for the shareholders.

### 5.3 Limitations of the study

The aim of the study was to determine the effects of financial distress on the value of the companies that make up the DAX 30 or else the DAX Index. However, there were several limitations while trying to research the aim of the study.

The study used secondary data, quantitative in nature, with yearly frequency, obtained from the annual reports of the companies for a four-year period between 2015 to 2018. As the judgment in designing accounting policies differ from company to company, the quality and comparability of data, may not be one hundred percent guaranteed.

The results are addressed to the 30 largest, by market capitalization and most liquid companies, that trade on the Frankfurt Stock Exchange and make up the DAX index and may not be generalized to smaller firms and financial institutions because they may face the effects of financial distress in a different way. For this reason, if someone wants to research the financial distress on value of smaller firms or financial institutions, has to proceed with a new research.

Moreover, in each one of the small pool of studies that have been conducted around the effects of financial distress on firm value, there is not a unique set of variables that is generally accepted in forecasting that. The study is limited to financial distress as measured by the Altman's Z-score, quality of assets, profitability and leverage as the independent variables. But there are also other internal and external factors that can affect the value of a firm. Economic growth, government policies, interest rates, cost of capital and the industry segment are some of them.

Also, a strong management team plays a very important role on the value of a firm and the study does not take into consideration the management team of each company and the measures taken by the management's team of each company to reverse the effects of financial distress.

Finally, the regression method that has been used for the purposes of this study, is the (pooled) OLS in a panel. This regression method has as a goal to minimize the differences between the observed responses in a dataset and the responses predicted by the linear approximation of the data, but it is very sensitive to outliers and has low bias and high variance. Also, sometimes it is unable to constrain the estimates of coefficients.

#### 5.4 Recommendations for further research

The study focused on the effects of financial distress on the value of the companies that are listed in DAX 30 index using as independent variables the Financial distress measured by Altman's Z-score, Quality of Assets measured by Return on Assets (ROA), Profitability measured by Return on Equity (ROE) and Leverage measured by the ratio of Total debt to Total equity. Since, there is not a unique set of variables that is generally accepted in forecasting a topic like that, the researcher recommends a

research with a different set of independent variables to find out if they provide a better accuracy than the independent variables that mentioned above and used in this research.

Moreover, the research focused on the 30 largest, by market capitalization and most liquid companies, that trade on the Frankfurt Stock Exchange and did not consider medium or smaller firms and financial institutions. Therefore, there is a need to carry out a focused research on smaller firms and financial institutions, to find out if the results of this research also hold irrespective of the size of the company being considered.

Furthermore, the study used secondary data, quantitative in nature and does not take into account any qualitative aspects of the businesses. So, the researcher recommends a focused research on qualitative aspects of the businesses such as the quality of management, relationships with suppliers and customers, industry growth trends, competitive advantages and a lot more.

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## Appendices

### Appendix 1: Companies listed at the DAX Index

<b>COMPANIES</b>	<b>MARKET CAP.</b>
SAP	132.85B
LINDE PLC	91.69B
ALLIANZ	86.52B
VOLKSWAGEN VZO	75.39B
SIEMENS AG	74.50B
DEUTSCHE TELEKOM AG	71.58B
BAYER	62.47B
BASF	56.45B
ADIDAS	55.55B
DAIMLER	48.58B
MERCK	42.61B
BMW ST	41.01B
HENKEL VZO	40.53B
DEUTSCHE POST	37.58B
MUENCH. RUECKVERS.	31.38B
BEIERSDORF AG	25.86B
DEUTSCHE BOERSE	25.19B
FRESENIUS SE	24.84B
VONOVIA	23.50B
CONTINENTAL AG	23.49B
INFINEON	21.06B
WIRECARD AG	19.44B
FRESENIUS ST	18.78B
E.ON SE	18.45B
RWE AG ST	17.51B
DEUTSCHE BANK AG	14.68B
HEIDELBERGCEMENT	12.79B
THYSSENKRUPP AG	7.61B
COVESTRO	7.58B
LUFTHANSA	6.72B

Appendix 2: Companies sampled for the research

<b>COMPANIES</b>	<b>MARKET CAP.</b>
LINDE PLC	91.69B
ALLIANZ	86.52B
VOLKSWAGEN VZO	75.39B
SIEMENS AG	74.50B
DEUTSCHE TELEKOM AG	71.58B
BAYER	62.47B
BASF	56.45B
DAIMLER	48.58B
MERCK	42.61B
BMW ST	41.01B
DEUTSCHE POST	37.58B
MUENCH. RUECKVERS.	31.38B
DEUTSCHE BOERSE	25.19B
FRESENIUS SE	24.84B
VONOVIA	23.50B
CONTINENTAL AG	23.49B
WIRECARD AG	19.44B
FRESENIUS ST	18.78B
E.ON SE	18.45B
RWE AG ST	17.51B
HEIDELBERGCEMENT	12.79B
THYSSENKRUPP AG	7.61B
COVESTRO	7.58B
LUFTHANSA	6.72B

Appendix 3: Companies with z-score higher than 2.99 for every year from 2015 to 2018

<b>COMPANIES</b>	<b>MARKET CAP.</b>
<b>SAP</b>	<b>132.85B</b>
<b>ADIDAS</b>	<b>55.55B</b>
<b>HENKEL VZO</b>	<b>40.53B</b>
<b>BEIERSDORF AG</b>	<b>25.86B</b>
<b>INFINEON</b>	<b>21.06B</b>