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How does a Credit Default Swap Spread volatility impact the Z-Score Models? A case study approach on Eurostoxx50

Francisco Soeiro da Cunha Barreto

Lisboa, Julho de 2018

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Proposta de Dissertação submetida ao Instituto Superior de Contabilidade e Administração de Lisboa para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Análise Financeira realizada sob a orientação científica de Mestre Especialista José Nuno Teixeira de Abreu de Albuquerque Sacadura, professor adjunto de Finanças.

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DEDICATION

I dedicate this work, to all the hours I've spend woken up , to all the study and determination and work I made , I dedicate this to all the people who believed in me , to all the people that made me push myself forward. I dedicate this work to My Vision and most of All I dedicate this work to Me.

EPIGRAPH

"Sweat equity is the most valuable equity there is. Know your business and industry better than anyone else in the world. Love what you do or don't do it." --Mark Cuban

ACKNOWLEDGES

I want to thank My Parents, My brother and My Aunt Iria for all the efforts they made and for helping me achieve all my successes and this step in the stairway of life.

I want to thank my master's Mentor, not only for believing in my work but for accepting me as a mentee and for being demanding and for making me pushing myself even forward not only in the masters but in life.

I want to thank all my true Friends, which whom I've study and talked, laugh and were there for me and saw me rising up.

RESUMO

Esta dissertação documenta a relação entre os models Z-score e o CDS Spread no Eurostoxx50.

Foi estudada a relação entre o Z-score e o CDS no Eurostoxx50, devido ao facto de a maioria da literatura se focar nos mercados Asiatico e Americano , existindo pouco enfase no mercado Europeu. Outro fator preponderante deste estudo , foi o gap existente de estudos que estabeleçam uma relação direta entre com os modelos de Z-Score e a valorização de CDS. Foi também estudada de igual modo a relação entre a Saúde financeira das empresas e os modelos de Z-Score , recorrendo ao Health Score como variável dependente , reforçando aqui uma vez mais a ligação entre os Modelos Z-Score e a notação de Rating , parte integrante do Health Score.

Relativamente a variáveis explicativas foram usadas como variáveis o CDS Spread , a Volatilidade do CDS Spread e a Performance do CDS Premium . Como variáveis dependentes foram utilizados os modelos Z-Score (1968), Z-score'(1983) , Z-Model (1993) e o Modelo O-Score(1980).

A amostra utilizada é constituída pelas empresas cotadas no Eurostoxx50 , durante um período de 10 anos , fazendo um total de 50 empresas e 5000 observações.

Os Resultados mostraram que os modelos Z-Score e as variáveis Volatilidade do CDS Spread e a Performance do CDS Premium apresenta, uma forte relação entre os modelos.

A variável CDS spread apresentou resultados inconclusivos.

Palavras-chave: *CDS Spread, Z-Score, Eurostoxx50, Probabilidade falência, Volatilidade CDS, Health Score, Rating*

ABSTARCT

This dissertation thesis documents the relationship between the Z-Score models and the CDS Spread in the Eurostoxx50.

We examine the Eurostoxx 50 and the Z-Score connection, due to the fact that the majority of the literature focuses in the Asian and American markets, having little emphasis in the European markets. The other main factor was the lack of studies that explain a direct connection between the CDS valuation and Z-Score models. We also studied the relationship between the Z-Score and the financial health of the companies, exploring the relationship between the Z-Score and Health Score reinforcing therefore the link between the Z-Score and the credit Ratings which the health score uses.

With that our main explanatory variables are the CDS spread , CDS Spread Volatility and CDS premium Performance , regarding the models that we test we used the Z-score (1968) , the Zscore' (1983) , Z-model (1993) and O-Score (1980) as dependent variables.

Our Sample was comprised of the companies listed on the Eurostoxx50 , over a 10 year period , making a total of 50 companies and 5000 observations .

Our Findings show a strong relationship between the Z-Score models and the CDS spread volatility and also the CDS premium performance. The CDS spread presented mixed results.

Key words: CDS premium, Z-Score, Eurostoxx50, Default Probability, CDS Volatility, Health Score, Rating

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LIST OF ABBREVIATIONS AND SYMBOLS

CDS- Credit Default Swaps

MDA- Multi Discriminant Analysis

OTC- Over The Counter

BIS- Bank of international Settlements

ISDA- International Swaps and Derivatives Association

FDIC- Federal Deposit Insurance Corporation

LASSO- Least Absolute Shrinkage and Selection Operator

EBIT- Earnings Before Interest and Taxes

EMS- Emerging Markets Score

S&P- Standard and Poor's

FE- Fixed Effects

RE- Rando Effects

GS- Grade Score

GNP- Gross National Product

SD- Standard Deviation

IRD- Interest Rate Derivatives

1.INTRODUCTION

A Credit Default Swap is a contract that provides insurance against the risk of default of a company or sovereign state. In this type of contract, the Buyer is known as the insurance buyer and the company is labelled as reference entity.

The use of this contract is common in financial markets, as this type of derivatives can be used as a tool not only to hedge positions in securities, reduce exposure on investment strategies, anticipate risk of default and, therefore, reducing financial leverage which can lead to decrease in credit risk.(J. Liu & Zhong, 2017)

The importance and impact of this type of contracts and securities can be seen in the financial crisis of 2007, which was due to mortgage backed securities. It was aggravated not only due to the type of loans associated with securities but with a mismanagement of the risk and the type of assets associated with that securities .("It's 2007 Again for Commercial Mortgage Bonds, Moody's Says - Bloomberg," n.d.; "Moody's - credit ratings, research, tools and analysis for the global capital markets," n.d.)

Liu and Zhong (2017) associate risk to a CDS contract and all the uncertainties, not only political but also financial , either by the form of its CDS spread (L. Liu, Zhang, & Fang, 2016), or establishing the link between the Swap markets and stock markets and the probability of default (Tolikas & Topaloglou, 2017).

Authors like Reisz and Perlich (2007) used the Log function of the Z-score, (Altman 1968a), to develop in conjunction with the Black-Scholes model (Black and Scholes, 1973) a market-based methodology to predict bankruptcy using the Z-Score method as a main basis of this framework.

Other authors used machine learning models, support vector machines, bagging boosting methods and MLP neural networks to assess and predict default of firms(Barboza, Kimura, & Altman, 2017; Hernandez Tinoco & Wilson, 2013). All these studies compare the results to the Z-score developed by (Altman 1968a) and conclude that the Z-Score, despite its' age, it is considered the most relevant and the benchmark to other models.

Reviewing the literature, we find a gap, as the majority of the studies linked default prediction to firm performance (Al-Kassar & Soileau, 2014; Goto, 2010; Rim & Roy, 2014), stock market behavior and valuation (Tolikas & Topaloglou, 2017) and even CDS spread. But in the CDS spread studies, very few connect the CDS spread premium and the MDA models such as Altman's Z-Score (1968), Z-Score' (1983) and Z-Model (1993) and Ohlson's O-Score (1980) in a European environment

In this master thesis we aim to study the relationship between the Z-score Models and the CDS spread, CDS premium volatility and the CDS premium performance.

The majority of the studies focuses on the Chinese (Lin, Lo, & Wu, 2016), Japanese (Tian & Yu, 2017), and American markets (E. Altman, 1968a; E. I. Altman, 1984; Barboza et al., 2017; Lin et al., 2016; Rim & Roy, 2014) focusing less in the European markets and mentioning the Europe market most commonly within a global overview of the global market.

We build our sample and tested the models on all the companies listed in Eurostoxx50 with a 10-year period to assure robustness and relevance to the study.

Our sample comprises 50 companies across 8 different European countries from 2006 to 2016.

This master dissertation thesis is organised as follows: section 2 will provide the research methodology focusing on the literature revision, section 3 will explain the data methodology, how the sample was gathered and the problems associated with it. Section 4 will provide a CDS market overview. The regression analysis and findings between the relation of the Models and the CDS explanatory variables will be described in section 5. Section 6 will summarize and present the conclusion of this paper.

2.RESEARCH AND METHODOLOGY

2.1 DEFINITION OF CDS

The Credit Default contracts are a form of contract that provides insurance against the risk of default by a particular company. The company is here known as the reference entity and the credit event is what the default is labeled. The buyer of the insurance is the one o attains the rights to sell bonds issued by the companies at their face value when the credit event occurs. The seller of the insurance agrees to buy the bonds at their face value when the credit event occurs. The total face value of the bonds that can be sold is known as the CDS Notional Principal. Regarding the financial transactions, the CDS buyer makes periodic payments to the seller until the maturity of the CDS or the default occurs. These periodic payments are made in arrears usually every quarter but this are not limited to it, there are deals where payments are made every semester or in every twelve months period. These payments can sometimes be made in advance.

Many different countries and companies are considered as reference entities for CDS contracts, in these reference entities payments are made in quarterly arrears, and the most popular maturities are the five-year period contract. However shorter maturities of one to three years and longer maturities up to ten years are not out of the ordinary. In terms of the settlement in the event of the default, the settlement can be made via the delivery of the cash, or the physical delivery of the bond. As previously mentioned, a key aspect of the CDS contract is the definition of a credit event (occurrence of the default). A credit event is usually defined as the failure to make payment as it becomes due, restructuring of the debt or bankruptcy. In situations where the yield of the company is high the restructuring of the debt is excluded this situation is specially regarding the Norths American Contracts.

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2.1.1 PURPOSE OF THE CDS CONTRACT

The effect of the CDS contract is to convert the corporate bond into a risk-free Bond , so that the investor can use the CDS contract to hedge a position in a Corporate Bond. By doing that the investor is then able to exchange the bond for its face value , and this face value can therefore be invested at a risk-free rate for the remainder of years until the maturity. (Hull, 2015)

2.1.2 CONCERNS ABOUT SWAPS AND CREDIT RISK.

Since the credit default swap contract is a contract usually traded in the OTC (over the counter) market it raises the question the incentives to default of the counterparty side of the contract, according with the Bank for International Settlements (BIS)the growth of the OTC market regarding the swaps was one of the major factor motivating the imposition of the Risk-Based capital requirements in 1993. Due to the fear that in a long-term Swap-contract in the OTC market the out of the money counter party would have incentives to commit default therefore deterring future and current losses. According with Saunders & Cornett (2008) , the BIS requirement imposed for the depository institutions a capital Ratio requirement against holdings regarding both the interest rate , currency swaps and credit swaps.

These capital requirements are viewed by some investors as a cost or something similar to a market tax on the participants.

In terms of regulation, when comparing the Futures market and Options Market to the Swap Markets, the latter is regulated by very little regulations, in part due to the lacking of no central governing body to oversee the Swap Market.

So there is not a proper regulation of the Swap Market (Saunders & Cornett, 2008).

The International Swaps and Derivatives Association (ISDA) is a global trading organization that sets standards for the Swap markets for over 68 countries having over 875 members.((isda.org) "International Swaps and Derivatives Association," n.d.)

Besides ISDA also developed guidelines, which were settled by the Basel Committee regarding the capital adequacy of the financial Institutions. Due to the major Swap dealers being commercial banks, the Swap market is therefore subject indirectly to the regulations of the Board of Governors of The Federal Reserve (FDIC) and all the other regulatory agencies that are responsible for monitoring the bank-risk. However, in most recent years the bigger players in the Swap markets have changed, the Investment Banks and Insurance Companies have become the bigger players and due to the lack of regulation of these players it is crucial both the regulators and the market participants possess an acute awareness of the credit risk regarding this type of contracts. If the transaction is not well studied and carefully structured, it may pass unintended risks that expose the market participants to higher, more frequent and severe losses when compared to other participant with an equivalent position. (Saunders & Cornett, 2008)

Regarding the sources of default risk, the Moody's investor service defines three distinct sources, that are as follows:

1-Any missed or delayed payment of interest and /or principal

2-Bankruptcy or Receivership

3-Distress exchange , where the borrower offers debtholders a new security that amounts to a diminished financial obligation, or the swap dealer has the apparent purpose of helping the borrower avoiding default. (moodys.com "Moody's - credit ratings, research, tools and analysis for the global capital markets," n.d.)

With the sources of risk well identified , the heavy participants of the swap market such as Merril Lynch and J.P. Morgan in order to perform successfully and maintain the market share , and in order to keep their roles as intermediaries acting as a counterparty guarantors of both fixed and floating sides of the market , it is necessary for them to always get an high if not the highest credit rating increase as a requirement. (Saunders & Cornett, 2008)

2.2 RATING DEFINITION

With the previous explanation of the Swap markets and with reference of the rating and its effect on the behalf of the participants of the market, it is important to know and understand the basics of What is the Rating notation and how it affects the bond markets and the yields.

When an investor acquires a Bond, he becomes a bondholder. As a bondholder the most that a bondholder expects to receive are the cashflow promised by the acquired bonds. However due to credit risk the cashflow expected to be received can be less than the expected when compared to a default-free bond. Due to the risk component of the bonds the investors pay less for the bonds with credit risk than the default-free bonds.
The yield to maturity for the bonds is calculated based on the promised cashflows that can be attained, due to this the yield of bonds with credit risk will be therefore higher than the ones considered default-free .(Berk & DeMarzo, 2014)

Several entities rate the creditworthiness of the bonds and made this information available to the investors in the form of Rating. Due to the inefficiency and impracticality for every investor to privately investigate the default risk of every bond , the investors take these Rating notations of the bonds and assess a particular issue of a bond. (Berk & DeMarzo, 2014)

With the previous statement its concluded that the Ratings encourage the widespread investor participation on the markets and its relatively liquidity of this markets (Berk & DeMarzo, 2014).

2.2.1 RATING NOTATIONS

Moodys defines its rating Bonds into two groups, Investment Grade debt and Speculative Bonds. The Investment Grade debt ranges from the AAA , AA, A and BBB rating notations , the Speculative Bonds ranges from BB, B, CCC, CC, C;D rating notations. ("Moody's - credit ratings, research, tools and analysis for the global capital markets," n.d.)

According to Berk & DeMarzo (2014) bonds in the top four categories are referred to as Investment Grade bonds because of their low default risk. the bottom five categories are usually denominated as Speculative bonds, Junk Bonds or high-yield Bonds due to their high likelihood of default.

The rating notation is dependent of both the default risk and the bondholder's ability of claiming the firm's assets in case of bankruptcy. So, with that debt issues a low priority claim in bankruptcy will have a lower rating when compared to higher priority debt issues of the same company. This high priority debt titles can also be backed by a specific asset such us a building or a plant.(Berk & DeMarzo, 2014)

2.2.2 CORPORATE YIELD AND CREDIT CRISIS

The yield curve can be constructed for the corporate bonds just like it is done for the treasury securities. In case of the corporate bond yields and the treasury Yields the difference between them is referred as the default or credit spread. This credit spread fluctuates according to the perceptions regarding changes in the probability of default. Usually the credit spread is high for low-rating bonds , therefore corresponding to a greater likelihood of default (Berk & DeMarzo, 2014)

Regarding the US Financial Crisis of 2008, it originated as a Credit Crisis due to problems in the mortgage lenders. This situation caused a downgrading of the bonds and a reassessment of the risk from the investors side regarding all the other bonds of their portfolios. This resulted on the partaking for safer US treasury securities , this natural movement by the investors led to an increase of the spreads of the AAA bonds , causing higher borrowing costs as well as increasing the cost of capital raising for the firms.
This Financial crisis had an impact on the European debt crisis that followed , due to the uncertainty left , leading to the spread increase in the beginning of the European crisis.(Berk & DeMarzo, 2014)

2.3 DEFAULT PREDICTION MODELS

As previously mentioned the default and bankruptcy and the respective risk associated with these events are both linked to the CDS contracts as explained by Hull (2015) as well the swap uncertainties and respective misconducts that might arise as well as the increase risk of this type of contracts mentioned by Saunders & Cornett(2008). Since the CDS contracts are used to hedge positions on bond titles (Hull, 2015) and bond titles are also affected by the default probabilities and respective yields and ratings associated with them (Berk & DeMarzo, 2014) it is therefore important to use methods that predict with accuracy the default probability of the companies that are listed on the markets .

A variety of models were developed to predict the default probability , such asReisz & Perlich (2007) that used the Black-Scholes method along with the Z-Score Model (E. Altman, 1968a) to develop a market base model to predict bankruptcy using the Z-Score as a main basis. Other papers such as Barboza, Kimura, & Altman(2017) and Hernandez Tinoco & Wilson(2013) use Machine learning models , support vector machines , bagging boosting to assess and predict the default probability of the firms. However in both studies they compare the results to the Z-Score model developed by (E. Altman, 1968a).

Other method used to predict default was the LASSO method (least absolute shrinkage and selection operator) employed by Tian & Yu (2017) on the Japanese market. They used the Z-score model as benchmark for firm performance, and concluded that the LASSO model is more effective in terms of default predictability than Z-Score (E. Altman, 1968a). However, this was only valid for the Japanese market, due to the inconsistent results attained when the model was tested in other regions such as the United Kingdom, Germany, France and some other countries from Europe.

Due to the investors gathering information regarding the companies and titles that they are keen to invest and since the majority of the financial information is account based this is why the Z-score uses this type of information (E. Altman, 1968a).

In conjunction with the statistical significance of each ratio and the judgment of the analyst and its main aim when it was developed the Z-Score was built to provide a tool for the investor, and the managers and all the shareholders to predict bankruptcy and if possible avoid it by making changes and taking measures using a well-constructed model. This methodology has been being updated over time (E. I. Altman, Haldeman, & Narayanan, 1977a; E. Altman & Rijken, 2010)

Due to academic reasons and due to constraints in terms of testing the other models based on machine learning algorithms, in this paper it is going to be testing the Z-Score model of 1968 and 1983 the updated version of Z-score model 1993 and(E. Altman, 1968a; E. I. Altman et al., 1977a; E. Altman & Rijken, 2010) and it is also going to be testing the Ohlson Valuation Model (Ohlson, 1980).

The following section provides an explanation of the models previously mentioned as well as providing a brief explanation of the M-Model (Beneish, 1999) that regards earnings manipulation and it is also provided some of the latest examples of other models based on the z-score as well as the different sectors that these models have been applied.

2.3.1 ALTMAN Z-SCORE (1968)

The Z-score model is a method based on a Multiple Discriminant Analysis (MDA), this is used as the main statistical approach of this model. MDA is a technique used to statistically classify an observation into several prior defined groupings depending on the individual characteristics of the observation in question.(E. Altman, 1968a)

This technique is used to classify and make predictions in problems where the variables appear in a qualitative form, in this case bankrupt or non-bankrupt . (E. Altman, 1968a)

By using this previous method, its then attained the discriminant function of Z-Score, this function can be divided into Discriminant Coefficients and Independent variables (financial ratios). The ratios used in the Z-Score function were selected according to the statistical significance of each individual ratio , it was also considered the inter-correlation between variables and its respective evaluation as well as the observation of predictive accuracy of the various profiles and the judgement of the Analyst.(E. Altman, 1968a)

Therefore, the resultant function and variables are as follows:

X1= Working Capital /Total Assets

X2= Retained Earnings /Total Assets

X3= EBIT /Total Assets

X4= Market Equity Value/ Book Value of Total debt

X5= Sales / Total Assets

$$Z\text{-Score}=1.2*X1+1.4*X2+3.3*X3+0.6*X4+0.999X5 \quad \textbf{\textit{(1)}}$$

According to E. Altman (1968) in order to assess and to identify the firms state in terms of default or non-default as well its default probability it was defined three zones that after the application of the model a firm can be placed on.

The Zones are as follow , according to E. Altman (1968) :

(i) "Safe" Zone: $Z > 2.99$, where a company is considered out of the default probability, therefore considered a non-Bankrupt firm;

(ii) "Grey" Zone: 1.80 < Z < 2.99, where a company is not yet defined as being in danger of bankruptcy or default but its financial situation is not yet as solid as the previous zone.

(iii) "Distress" Zone: Z < 1.80; in this area the company is in danger of default and bankruptcy and can be considered to be in financial distress.

Through the years the Altman's Z-score have been revised, and other models have been developed by Altman in order to maintain the relevance of the model but to guaranty the predictability and application of the Z-Score methodology

2.3.2 ALTMAN Z-SCORE AND Z-MODELS

In 1983 it took place the reassigning of the book value of equity as variable replacing the market value of equity in order for this model to be applied to private manufacturing firms as well as changing the various Z-Score zones regarding this model as mentioned by Rim & Roy(2014) on their paper.

With that mentioning the revised model of Z-score (1983) for manufacturing companies is the following:

Z'= 0.717*X1+0.847*X2+3.107*X3+0.420X4+0.998*X5 ***(2)***

X1= Working Capital /Total Assets

X2= Retained Earnings /Total Assets

X3= EBIT /Total Assets

X4= Book Equity Value/ Total Liabilities

X5= Sales / Total Assets

The new Z-Score zones are as follow , as mentioned in (Rim & Roy, 2014)

(iv) "Safe" Zone: Z > 2.9, where a company is considered out of the default probability, therefore considered a non-Bankrupt firm;

(v) "Grey" Zone: $1.23 < Z < 2.90$, where a company is not yet defined as being in danger of bankruptcy or default but its financial situation is not yet as solid as the previous zone.

(vi) "Distress" Zone: $Z < 1.23$; in this area the company is in danger of default and bankruptcy and can be considered to be in financial distress.

In 1993 the methodology of the Z-Score was revised again and the Z-Model was developed , as mentioned by Rim & Roy (2014) and in this model the fifth variable was dropped due to its tendency of being comparatively higher for retail and service firms when compared to manufacturing firms . The book value of the equity is used as the fourth variable for this model.

As explained by Rim & Roy(2014) the new model formula, variables and zones are as follow :

Z-MODEL= 6.56*X1+3.26*X2+6.72*X3+1.05*X4 ***(3)***

X1= Working Capital /Total Assets

X2= Retained Earnings /Total Assets

X3= EBIT /Total Assets

X4= Book Equity Value/ Total Liabilities

The Z-MODEL zones are as follow :

(vii) "Safe" Zone: $Z > 2.9$, where a company is considered out of the default probability, therefore considered a non-Bankrupt firm;

(viii) "Grey" Zone: $1.23 < Z < 2.90$, where a company is not yet defined as being in danger of bankruptcy or default but its financial situation is not yet as solid as the previous zone.

(ix) "Distress" Zone: $Z < 1.23$; in this area the company is in danger of default and bankruptcy and can be considered to be in financial distress.

2.3.2.1 THE ZETA TM ANALYSIS

In 1977 it was developed by (E. I. Altman et al., 1977a) a model of bankruptcy and classification model which incorporated comprehensive inputs of discriminant analysis and which utilized a sample of bankrupt firms ranging from 1969 to 1975. In This model all the financial statement data were transformed according to the security analysis to enable comparability between companies.

The main reasons to construct this model were according to E. I. Altman et al.(1977) not only to improve and extend upon the statistical models previously published , the other reasons that backed this model development were the following:

-the change in size of the companies' bankruptcy and the change of the financial profile of the business failures;

-the need of a having a current model that can be applied with the temporal aspect of the data;

-to create an equal basis of analysis with the manufacturing companies, due to past models having instead concentrated either on board classification of the manufacturers or on specific industries;

-having a relevant model not only to the present situation but to the past and future failures and the respective data associated with.

The ZETA model presents itself with an accuracy range of five years prior to the firm failure , not being affected by the inclusion of other type of companies like retail , for example .This model outperforms alternative bankruptcy classification strategies and its linear structure outperforms the quadratic model in terms of validity.(E. I. Altman et al., 1977a)

In order to reducing outliers some variables were logarithmized , the type of variables taking into account in this model were the Profitability, Coverage and other earnings, liquidity , capitalization ratios, earnings variability and miscellaneous measures. (E. I. Altman et al., 1977a).

All the variables were selected following and iterative process which resulted on a 7 variable model with the following variables : (E. I. Altman et al., 1977a)

X1- EBIT / Total Assets

X2- Standard error of (EBIT / Total Assets)

X3-log10 (EBIT / Total interest payments)

X4- Retained Earnings / Total Assets

X5- Liquidity current ratio = Current Assets / Current Liabilities

X6-Capitalization ratio = Common Equity / Total Capital

X7- Size – Total assets of the firm.

All the variables were tested and it was used the linear structure classification for each variable.

$$X'^{\Sigma_1^{-1}(U1-U2)-\frac{1}{2}}(U1+U2)'^{\Sigma_2^{-1}(U1-U2)\geq} \ln P \quad \textit{(4)}$$

Where X is the variable vector, U1 and U2 are the mean vector of the group 1 and group 2 and ∑1 ; ∑2 are the dispersion matrices of groups 1 and 2 . Group 1 – bankrupt firms ; Group 2- Non Bankrupt firms (E. I. Altman et al., 1977a)

Assuming a multinormal population and common covariance matrix and in order to minimize the cost of misclassification the optimal cutoff score for ZETA is obtained using the following formula:

$$ZETA = \ln \frac{q1C1}{q2\ Cn} \quad \textit{(5)}$$

Where:

q1- Prior probability of bankruptcy

q2- Prior probability of non-bankruptcy

C1-Cost of Type 1 Error

Cn- Cost of Type 2 Error

Type 1 Error -accepted loan that defaulted

Type 2 Error- rejected loan that would have resulted in a payoff

After the specification of this model (E. I. Altman et al., 1977a) the Expected Cost of ZETA can be used in order to compare efficiency of the ZETA bankruptcy model with other models

$$EC_{ZETA} = q_1 \left(\frac{M_{12}}{N_1}\right) C_1 + q_2 \left(\frac{M_{21}}{N_2}\right) C_n \quad (6)$$

Where:

M12 –Observed type 1 error (misses)

M21- Observed type 2 error (misses)

N1- number of observations in the bankrupt

N2- number of observations in the non-bankrupt

The range of the correct estimate of q1/q2 is the [0.01-0.05] range in terms of probability of going bankrupt in the future. (E. I. Altman et al., 1977a).

In order to assess the cost of the errors mentioned before it is followed the following expression to evaluate that question (E. I. Altman et al., 1977a) :

$$C_1 = 1 - \frac{LLR}{GLL} \ (7); \ C_n = r - i \ (7)$$

LLR- amount of loan losses recovered

GLL- gross loan losses (charged-off)

r- effective interest rate on the loan

i-effective opportunity cost for the bank

After proceeding access the distribution of The ZETA score of 1 year prior to bankruptcy those were the zones identified by these tests (E. I. Altman et al., 1977a):

Bankrupt Zone: [-11.0; -1.45]

Overlap Zone: [-1.45; 0.87]

Non-Bankrupt Zone: [0.87; 11.0]

The comparison between this model and other predictive model shows an improvement in terms of accuracy and improvement, according to E. I. Altman et al. (1977) the ZETA Model is far more accurate in bankruptcy classification in the 2-5 years' time gap , however compared to the Z-Score of 1968 this model shows to be more accurate for the classification of non-bankruptcy firms in the 2 years' time gap when compared directly .

According to E. I. Altman et al.(1977) the ZETA Model dominates every year , but it was noticed that this model with 7-variables , is in some years slightly more accurate than the 5-variable model when the data is adjusted for comparison reasons.

The other model developed by Altman that continued the work laid by the z-score model was the Z-Metrics Methodology developed in 2010 by E. Altman & Rijken (2010).

2.3.2.2 Z-METRICS METHODOLOGY

As previously mentioned, in 2010 Altman partnered up with Risk Metrics group and the result was the Z-Metrics methodology to estimate company credit ratings and Default risk probabilities. The Z-Metrics Approach combines the Risk Metrics leadership and knowledge of the market risk and credit risk with the Z-score and the most recent analysis accuracy and timing of rating agencies performance.(E. Altman & Rijken, 2010)

This approach has the objective of assess the credit risk using an up to date credit scoring method for non-financial firms. The Z-Metrics method was the solution that resulted from this partnership.(E. Altman & Rijken, 2010)

The Z-Metrics employed a multivariate logistic regression to assemble the models, and it uses the credit event (also known as bankruptcy or default) occurrence to divide the companies into two groups , considering a time horizon of 1 to 5 years. (E. Altman & Rijken, 2010) .

The groups are as follows:

-Distressed – companies which have had a credit event during the 1 to 5-year period

-Non-distressed - companies which didn't have a credit event during the 1 to 5-year period.

This methodology assessed over 50 fundamental variables covering all the majority of the performance characteristics such as : Solvency , Leverage, Size, Asset Quality ; Investment, Profitability, Interest coverage , Liquidity , Dividend Payout and Financial Results , this fundamental variables were all analyzed in term of their trends , and it resulted in the addition of more variables such as Equity Market Price , Equity market Return and volatility patterns adjusted to the market movement.. All the variables in were adjusted for macro stress on world economies via the use of macroeconomic measures. (E. Altman & Rijken, 2010)

In order to avoid outliers transformations were made to the variables , those transformations were the logarithmic transformation of the functions , the first differences tests and the inclusion of dummy variables. (E. Altman & Rijken, 2010)

The variables used to create the public and private firm models were the following:

Regarding firm fundamentals:

1)Interest / EBIT

2)Retained Earnings / Total Assets

3)Market Value of equity / Total Liabilities

3)Book Value of equity / Total Liabilities *

*Variable used on the model for small companies

Regarding macro-economic variables

1)GDP growth

2)Unemployment

3)Credit Spreads

4)Inflation

This resulted in a 12 variable model for large public US / Canadian Firms but it was also developed a model for private firms , which in essence resulted in the substitution of the market value of equity for the book value of the equity , which strips away the influence of the market and isolates the firms fundamental operating and financial performance .(E. Altman & Rijken, 2010)

The Z-Metrics Model was based on the standard logit-regression in order to estimate the credit Scoring model. In order to guarantee a fair comparison, the credit scores are converted to an Agency equivalent and this was achieved by matching the distribution exactly with the rating of the Agency. (E. Altman & Rijken, 2010)

With that The Z-Metrics Model is presented as follows (E. Altman & Rijken, 2010):

$$CS_{i,t} = \alpha + \sum \beta X_{i,t} + \varepsilon_{i,t} \quad \textbf{(8)}$$

$$CS_{i,t} = Z\ metrics\ credit\ score\ of\ a\ company\ i\ ant\ time\ t$$

$$\beta = Variables\ parameters\ (\ weights)$$

$$X_{i,t} = firms\ fundamentals\ ;macro\ economic\ variables\ ,market\ based\ variables\ for\ each\ firm$$

$$\varepsilon_{i,t} = error\ terms$$

$$PD_{i,t} = \frac{1}{1+e^{(CS_{i,t})}} \quad \textbf{(9)}$$

$$PD_{it} = Probability\ of\ default\ of\ CS$$

This Z-metrics Model was compared to the Z"-Score model (1995) by E. Altman & Rijken (2010) due to the fact that this Z-score model was used to assess the default risk of non-manufacturers and its considered by Altman to be a more generally applicable version of z-score.

In terms of criteria selection of these variables, it was taking into consideration regarding the Accuracy ratios for both Type 1 (correct default prediction) and Type 2 (correct non-default prediction) , the comparison between this ratios and existing models of both the rating agencies and Altman Z-score models and Sample and out of the sample results. (E. Altman & Rijken, 2010)

Regarding the discriminatory and the explanatory factors, it was considered for the discriminatory factors an entire spectrum of ratings divided into High-grade ; Mid-grade and Low grade for an 1 to 5 year period , and for the explanatory factors it was considered a cross sectorial and over time parameters for non-financial firms . (E. Altman & Rijken, 2010)

After comparing results for the five-year period models the Z-Metrics was considered to be superior than the original Z-Score (1968) and the Z"-Score (1995) and provides a superior and considerable different results than the rating Systems and the Z-Score models.

2.3.3 OHLSON MODEL (1980)

As Stated in the work developed by Smaranda (2014) the Z-score model has multiple variations and applications and it was the first MDA function built , however in 1980 Ohlson created the OS-Model as a means of incorporating conditional probabilities into financial distress models. (Ohlson, 1980)

Ohlson (1980), used nine financial ratios combined into a model to assess the probability of bankruptcy. This model characterized of having cut-off value of 0.038 . Compared to the MDA models the big difference is that this value can be directly interpreted as a probability , meaning that this cut-off represents a 38% probability of default.(Smaranda, 2014)

With that said the OS-Model and its variables are represented as follows (Ohlson, 1980) :

X1=ln (Total Assets/GNP Price Level)

X2= Total Liabilities /Total Assets

X3= Working Capital / Total Assets

X4= Current Liabilities / Current Assets

X5= Net Income/ Total Assets

X6= Operational Cash flow / Total Liabilities

X7= 1 if net income negative for last 2 years, 0 otherwise

X8= 1 if Total Liabilities > Total Assets, 0 otherwise

$X9 = (NI_t - NI_{t-1})/(|NI_t| + |NI_{t-1}|)$ *;* NI – Net Income ***(10)***

$OS = -1.33 - 0.407X1 + 6.03X2 - 1.43X3 + 0.076X4 - 2.37X5 - 1.83X6 + 0.285X7 - 1.72X8 - 0.521X9$ ***(11)***

As mentioned in other works by Liao, Chen, & Lu (2009) this model takes into account the real earnings management and documents a significant prediction power.

According to Jayasekera (2017) it is claimed that using a logit regression becomes important for forecasting purposes due to the fact that a firm may file doe bankruptcy after the fiscal year and by neglecting this the back/casting might occur.

The use of this logit regressions makes these factors such as Firm Size, measure of financial structure and measure of the firm's performance relevant and significant for predicting the default occurrence. (Jayasekera, 2017)

It is also stated that the predictive models and their prediction power seem overstated due to the fact that the information collected is most often gather after the occurrence of default than prior the default, therefore easing the prediction.(Jayasekera, 2017).

2.3.4 BENEISH M-MODEL (1999) OVERVIEW

As mentioned in the paper developed by (Razali & Arshad, 2014) the Beneish M-Model is similar to Z-Score and it is used to estimate the probability of manipulation rather than Bankruptcy prediction . As Stated Both by (Beneish, 1999; Razali & Arshad, 2014) the M-Score predictive Model is greater if the company has a score of – 2.22 it gives a red flag indicating that the company has an high probability of results manipulation with that said the cut off of this Model is 0 meaning that there is no risk of manipulation and 1 otherwise (Beneish, 1999) .

The M-Score was developed due to the suggestion of a systematic relationship between the financial statements, its variables and the probability of manipulation.(Beneish, 1999)

The aim of that model as previously implied in its used is to distinguish between Manipulated from non-Manipulated firms regarding its earnings / results. (Beneish, 1999)

Earnings manipulation is defined by Beneish,(1999) as the violation of the GAAP (General Accepted Accounting Principles) in favor of the firm financial reports.

With that said The M-score and its variables developed by Beneish,(1999) is as follows :

$$M_i = \beta' X_i + \varepsilon_i \quad \textit{(12)}$$

Mi-dichotomous variable coded "1" for manipulators and "0" for non-manipulators

Xi-Matrix of explanatory variables

ε_i- vector for Residuals

Regarding the Variables used in this model matrix, it's here by presented the variables employed with a brief explanation:

DSRI -Day's Sales in Receivables Index

SGI- Sales Growth Index

GMI- Gross Margin Index

AQI – Asset Quality Index

DEPI – Depreciation Index

SGAI- Sales, General Administrative Expenses Index

LVGI- Leverage Index

TATA – Total Accrual to Total Assets

In Order for this Model to be considered as a classification tool regarding the Manipulation of reports or not, it had to face the issues of misclassification , so therefore it were identified two types of errors , Type 1 – Misclassification of a company as a Non-Manipulator , Type 2- Misclassification of a company as a Manipulator.(Beneish, 1999).

With these errors in mind it was calculated the probability cut-offs of the expected costs of misclassification. And It was concluded by Beneish, (1999) that the accounting information is useful to provide an assessment of the reposting reliability and via the use of M-Score model , being cost effective, and the exploiting of eventual distortions that might occur from manipulation or not of the results.

However It was identified some limitations of this model, such as it cannot be used on private held companies , and the understatement of results was not entirely approached due to the fact that the focus of the model was more driven to assess the overstatement of results.(Beneish, 1999).

Despite the limitations this Model is used in other papers to evaluate the likelihood of fraudulent reports and assess an audit quality , with conjunction with the z-score it provides a strong source of information and a great tool of measurement an increasing the financial reports as demonstrated by Razali & Arshad,(2014).

2.3.5 APPLICATIONS OF Z-SCORE MODEL

Since the creation of the Z-score in 1968 by E. Altman, (1968) and its continuous evolution through time by Altman , like mentioned before , other models based on the work developed Altman followed. For example a model developed by Taffler in 1982 to study the default prediction in the UK as shown in the paper of Almamy, Aston, & Ngwa, (2016); the Z-score was also used to create a model of default prediction for construction companies in China (Thomas Ng, Wong, & Zhang, 2011) and as previously mentioned the Z-score was used assess the manipulation and quality of the financial reports(Razali & Arshad, 2014) , therefore assessing the audit risk in conjunction with other models (Giroux & Cassell, 2011).

Some refinements worth mentioning in the Z-Score model and its application were the application of the logarithmic function on the Z-Score (Lepetit & Strobel, 2015) , the inclusion of the real earnings management into the original Altman Z-Score (1968) developed by Lin, Lo, & Wu,(2016) and the development of the EMS Score by E. I. Altman,(2005) which is the application of a credit scoring model for the emerging markets.

With all those applications and due to the relevance of the Z-Score model (1968) and its Updated version in 1993 by Altman , and its variety of uses like previously mentioned , that is why along with the O-Score (Ohlson, 1980), which was the first model to apply the conditional probabilities, were chosen to be studied and tested on the Eurostoxx50 assessing not only their relevance , application and their results against the rating Notation and CDS evolution , as well as the corporate governance performance indicators.

2.3.6 HEALTH SCORE

In order to established a correlation between the use of the Z-score and the respective Rating grade the following health Score. The health score is an indicator developed and available in the Bloomberg and its used to assess the financial health and soundness of the companies.

The calculation is z-score + x, where:
x = 1.5 if S&P credit rating is AAA
x = 1 if S&P credit rating is between AA+ and AA-
x = 0.5 if S&P credit rating is between A+ and A-
x = 0.25 if S&P credit rating is between BBB+ and BBB
x = 0 for S&P credit ratings below BBB

The sum of the Z-score and S&P credit rating translate into the following health grades:
grade = 8 or A+ if the sum is greater than 20.00
grade = 7 or A if 20.00 is greater than or equal to the sum greater than 3.00
grade = 6 or B+ if 3.00 is greater than or equal to the sum greater than 2.50
grade = 5 or B if 2.50 is greater than or equal to the sum greater than 2.00
grade = 4 or C+ if 2.00 is greater than or equal to the sum greater than 1.25
grade = 3 or C if 1.25 is greater than or equal to the sum greater than 1.00
grade = 2 or D if 1.00 is greater than or equal to the sum greater than 0.75
grade = 1 or F if the sum is less than or equalto0.75
Regarding the fluctuation of the Health Score it's as follows:

There is a downgrade if the earnings (either Retained Earnings or EBIT) are negative. If one of them is negative, the downgrade is of size 1. If the ratio of (Retained Earnings + EBIT)/Tangible Assets is less than zero, then an additional downgrade can take place if the credit rating is below A- (downgrade of 1) or BB+ (downgrade of 2). A further downgrade of 1 occurs if the (Retained Earnings + EBIT)/Tangible Assets ratio is between -0.75 and -0.40; of 2 if the ratio is between -1 and -.75, or 3 if the ratio is less than -1.
There are two other criteria that can change the grade:
If the grade is less than 3, but earnings are positive, and Sum (grade 8, Z-score + x) is greater than 1, the grade is set to 3.
If the grade equals 8, but the credit rating is not AAA, the grade is changed to 7

2.4 REGRESSIONS AND STATISTICAL TESTS EMPIRICAL BACKGROUND

Regarding the correlation tests between the variables and models, the Pearson correlation test was used to evaluate the correlation between all the variables (Agarwal & Taffler, 2008; Razali & Arshad, 2014).

Using a Kernel density estimation with the overlaying of an normal distribution , it was assessed the skewness and the effects of the outliers as well as the distribution and density behavior of the MDA models following the theory explained by (Brooks, 2008)

Following the work of Lee, Koh, & Kang (2011) we tested the heteroscedasticity of the models and the data in order to provide a more concrete data and results.

Using the regressions of Random effects , fixed effects , regressions with the robustness adjusted we tested the models and their variables either their control variables and explanatory variables(Ahmed & Elshandidy, 2017; Aktas, Bodt, Lobez, & Statnik, 2012; Alexeev & Kim, 2008; Elnahas, Hassan, & Ismail, 2017; Park, Yang, & Yang, 2017). It was also performed the Hausman Test between fixed effects and random effects correlation , the t-test and the Shapiro-Wilk and Shapiro-Wilk tests for normality using panel data regressions (Dalnial, Kamaluddin, Sanusi, & Khairuddin, 2014; Nam & An, 2017).

After previously identifying the type of regressions that were performed in this paper the following paragraphs will serve as a brief explanation of each regression as well as the statistical tests that were taken part.

Fixed Effect Regression

Fixed effects regression (FE) are used when the interest is to analyze the impact of a variable over time and at the same time to assess the relationship between the predictor variables and the outcome variables within the same dependent variable/entity. (Torres-Reyna, 2007)

When the FE is used it is assumed that the dependent variable has an impact either in the predictor or in the outcome variables and it is necessary to assure control for this effect. So therefore, it is assumed that the correlation between the variables is the reason for the fixed effects to have relevance, specially the correlation between the errors term and the predictor variables of the dependent variable.(Torres-Reyna, 2007)

The FE removes the effects of the time variant predictors. However in order to assess the good use of the Fixed Effects regression or the Random Effects regression the Hausman test must be used. (Torres-Reyna, 2007)

$$Y_{it} = B_i X_{it} + a_{it} + U_{it} \quad (13)$$

$Y_{it} - dependent\ variable$

$i - entity$

$t - time$

$B_i - coeficient\ for\ the\ independet\ variable$

$X_{it} - independent\ variables$

$U_{it} - error\ term$

The previous equation, represents the fixed effects regression model

Random Effects Regression

The Random Effects regression (RE), unlike the FE model , in the RE model the variation across entities is assumed to be random and uncorrelated, with the predictor or the independent variables included in the model.(Torres-Reyna, 2007)

The distinction between FE and RE is basically to see whether the unobserved individual effect embodies elements that are correlated with the regressors in the model. An advantage of the RE is that time invariant variables can be included in the model.(Torres-Reyna, 2007)

The RE model assumes that the dependent variable/entity error is not correlated with the predictors, and it allows to generalize influences and inferences beyond the sample. However in the RE model it is necessary to specify the individual characteristics that may or may not have an influence in the predictor variable.(Torres-Reyna, 2007)

$$Y_{it=}BX_{it} + a + U_{it} + \varepsilon_{it} \quad \textit{(14)}$$

$U_{it} - Error\ between\ entity$

$\varepsilon_{it} - error\ within\ entity$

Equation of the Random effects regression model

Random vs Fixed Effects

The FE estimator will always give consistent estimates, but they may not be the most efficient, for instance, if the RE is the proper model for the regression then the RE will be the most efficient and appropriate model, however if the RE is inconsistent then the most appropriate model is the FE model.(Torres-Reyna, 2007)

In order to assess which model is the most appropriate it is necessary to perform the Hausman test.

Hausman Test

The Hausman test, evaluates the difference between the FE and RE estimates in order to see if there is a significant difference between them.

According with Torres-Reyna, (2007) this test, can be used in time varying statistical regressors. The Hausman test uses a Chi-Square distribution with the degrees of freedom equal to the number of parameters of the time-varying regressors

After running this test, if this test is significant the FE must be used, if on the other hand the test is insignificant the RE is therefore used.

2.5 HYPOTHESIS DEVELOPMENT

Some Authors have connected the use of Z-Score and securities market, more precisely the Z-Score and the Credit Default Swap. Diallo & Al-Mansour,(2017) for instance, establish a connection between the Z-Score and the securities in the form of the logarithmic function of the Z-Score ,(E. Altman, 1968a), which was concluded that it can be used as a tool to measure the financial stability of firms with CDS contracts.

Other works use the Z-Score developed by (E. Altman, 1968a) to measure the capital adequacy of a company regarding the credit and securities market , focusing on the Credit Default Swap Spread and the risk of default prediction.(L. Liu et al., 2016).

Tolikas & Topaloglou, (2017) also conclude that the Z-Score can be used as a measure of financial distress but instead of focusing only on securities the author focused and established the link between the Z-Score and the Stock market and the CDS market, focusing the majority of his research on the Stock market exploring there more profoundly the connection between the Z-Score and Stock market per say.

We identified a gap in the literature regarding the connection between the Z-Score Models and the Credit Default Swaps, due to the fact that there is not a direct link studied between the CDS valuation and the Z-Score models.

Following this as a line of thought , we define as the dependent variables the ZSCORE1(E. Altman, 1968a), the ZSCORE2(Rim & Roy, 2014) , The ZMODEL (Rim & Roy, 2014) and the OSCORE (Ohlson, 1980), the we use the variables that assemble the models as the control variables and as explanatory variables we use the CDSPX , LOGCDS and VOLACDS, which will be defined in the following section.

Regarding the CDS and the MDA models we aim to answer the following questions:

a) How does a CDS impact the MDA models and what is the correlations between the models and the CDS volatility, CDS spread, CDS performance?

b) What signal does the relation between the variables and the models have?

Regarding the Risk and the Z-Score Models we hypothesize that there is a positive relationship between the Risk notation and the Z-score. However, in order to study this Hypothesis, we use the variable Grade Score (GS) which is an indicator developed by Bloomberg that evaluates the financial health of the companies linking the risk perception of the companies. We use this model due to the fact that it takes into consideration both the rating notations of the companies regarding its credit worthiness and the Z-Score model of E. Altman, (1968a) into its structure.

With this said we aim to answer the following question regarding the Grade Score:

c) Is the Grade Score positive correlated with the Z-score models, namely ZSCORE1, ZSCORE2 and Z-MODEL, and does it perceive a correct perception of both the Risk and Financial Health of a Company?

3.METHODOLOGY

3.1.DATA AND SAMPLE CONSTRUCTION

3.2.CDS DATA

In order to build our sample, we retrieved information from Bloomberg regarding the firms quoted in Eurostoxx50, covering a total of 50 companies from 8 different European countries.

The Gross National Product (GNP), which is a variable necessary to build the O-Score model (Ohlson, 1980), the data was gathered from Reuters DataStream for each 8 different countries.

Our Data sample is composed by annual observations and the period of analysis is from 2006 to 2016 covering a 10-year interval and making 550 observations of the 50 companies.

Table 1) presents the description of the sample, including the companies analysed, the period of the sample, the country of origin of each company and the super sector of each company.

TABLE 1) SAMPLE DESCRIPTION

Description of the sample including Period of analysis, country of origin and Super sector of activities All data from this table was collected from the Bloomberg terminal and all companies here refenced were quoted in The Eurostoxx50 during the period of analysis and the during the making of this paper

Name	Super sector	Country	Period
ADIDAS	Personal & Household Goods	DE	2006-2016
AHOLD DELHAIZE	Retail	NL	2006-2016
AIR LIQUIDE	Chemicals	FR	2006-2016
AIRBUS	Industrial Goods & Services	FR	2006-2016
ALLIANZ	Insurance	DE	2006-2016
ANHEUSER-BUSCH INBEV	Food & Beverage	BE	2006-2016
ASML HLDG	Technology	NL	2006-2016
AXA	Insurance	FR	2006-2016
BASF	Chemicals	DE	2006-2016
BAYER	Health Care	DE	2006-2016
BCO BILBAO VIZCAYA ARGENTARIA	Banks	ES	2006-2016
BCO SANTANDER	Banks	ES	2006-2016
BMW	Automobiles & Parts	DE	2006-2016
BNP PARIBAS	Banks	FR	2006-2016
CRH	Construction & Materials	IE	2006-2016
DAIMLER	Automobiles & Parts	DE	2006-2016
DANONE	Food & Beverage	FR	2006-2016
DEUTSCHE BANK	Banks	DE	2006-2016
DEUTSCHE POST	Industrial Goods & Services	DE	2006-2016
DEUTSCHE TELEKOM	Telecommunications	DE	2006-2016
E.ON	Utilities	DE	2006-2016
ENEL	Utilities	IT	2006-2016
ENGIE	Utilities	FR	2006-2016
ENI	Oil & Gas	IT	2006-2016
ESSILOR INTERNATIONAL	Health Care	FR	2006-2016
FRESENIUS	Health Care	DE	2006-2016
GRP SOCIETE GENERALE	Banks	FR	2006-2016
IBERDROLA	Utilities	ES	2006-2016
INDUSTRIA DE DISENO TEXTIL SA	Retail	ES	2006-2016
ING GRP	Banks	NL	2006-2016
INTESA SANPAOLO	Banks	IT	2006-2016
L'OREAL	Personal & Household Goods	FR	2006-2016
LVMH MOET HENNESSY	Personal & Household Goods	FR	2006-2016
MUENCHENER RUECK	Insurance	DE	2006-2016
NOKIA	Technology	FI	2006-2016
ORANGE	Telecommunications	FR	2006-2016
PHILIPS	Health Care	NL	2006-2016
SAFRAN	Industrial Goods & Services	FR	2006-2016
SAINT GOBAIN	Construction & Materials	FR	2006-2016
SANOFI	Health Care	FR	2006-2016
SAP	Technology	DE	2006-2016
SCHNEIDER ELECTRIC	Industrial Goods & Services	FR	2006-2016
SIEMENS	Industrial Goods & Services	DE	2006-2016
TELEFONICA	Telecommunications	ES	2006-2016
TOTAL	Oil & Gas	FR	2006-2016
UNIBAIL-RODAMCO	Real Estate	FR	2006-2016
UNILEVER NV	Personal & Household Goods	NL	2006-2016
VINCI	Construction & Materials	FR	2006-2016
VIVENDI	Media	FR	2006-2016
VOLKSWAGEN PREF	Automobiles & Parts	DE	2006-2016

Table 2) presents the variables taking into consideration in this paper regarding the credit default swap tests and regressions as well as their respective abbreviations.

TABLE 2) VARIABLES DESCRIPTION
Description of the variables and abbreviations

VARIABLES	DESCRIPTION OF VARIABLES
TA	Total Assets
TE	Total Equity
BVL	Book Value of Liabilities
WC	Working Capital
STCKPX	Price of the Stocks
MKTCAP	Market Capitalization
EAR	Earnings
EBIT	Earnings Before Interest and Taxes
RET	Retained Earnings
YIELD	Dividend 12 month Yield
CVENT	Current Value of the enterprise
EPS	Earnings Per Share
GNP	Gross National Product
CDSPX	Premium
LOGCDS	Logarithm of the CDS premium
VOLACDS	Annualized Daily volatility of the CDS
ZSCORE1	Z-Score=1.2*Tt1+1.4*T2+3.3*T3+0.6*T4+0.999T5 ***(1)***
ZSCORE2	Z score'= 0.717*T1+0.847*T2+3.107*T3+0.420T4+0.998*T5 ***(2)***
ZMODEL	Z-MODEL= 6.56*T1+3.26*T2+6.72*T3+1.05*T4 ***(3)***
GSZ1	Grade score build form the Z-Score (1968)
GSZ2	Grade score build form the Z-Score' (1983)
GSZ3	Grade score build form the Z-Model (1993)
TL	Total Liabilities
CA	Current Assets
CL	Current Liabilities
NI	Net Income
OCF	Operational Cash Flow
OSCORE	OS= (-1.33)-(0.407*O1)+(6.03*O2)-(1.43*O3)+(0.076*O4)-(2.37*O5)-(1.83*O6)+(0.285*O7)-(1.72*O8)-(0.521*O9) ***(11)***

Table 3) summarizes the general statistics of the sample namely of the control and explanatory variables of the ZSCORE1, ZSCORE2, ZMODEL and OSCORE models.

TABLE 3) GENERAL STATISTICS

Presents all the general statistics employed in the variables used to explain and control de ZSCORE1, ZSCORE2, ZMODEL and OSCORE.

Stats	Mean	P50	Sd	N	Range	Min	Max	Skewness	Kurtosis
WC	13493,49	1839,55	107885,8	550	1755679	-644881	1110798	2,258715	30,72812
TA	239980,9	71097,5	434242,8	550	2201963	459,559	2202423	2,698537	9,910437
TE	28746,64	22156	22441,64	550	105073,1	146,896	105220	1,026423	3,505617
TL	211234,4	43276,25	419887,9	550	2170223	286,357	2170509	2,759739	10,23935
NI	2769,627	2304	2980,375	550	30910	-9198	21712	0,61346	8,03975
CL	79718,21	16980	190047,2	547	1376476	175,782	1376652	3,804021	17,92993
CA	93619,01	18254,17	199766,7	545	1658162	309,576	1658472	3,814744	21,25171
RET	13611,76	10924	14622,86	550	110824	-38944	71880	0,827147	5,722852
EBIT	4663,707	3647	4295,797	550	32319	-6663	25656	1,456571	6,851678
MKTCAP	42482,02	35403,83	27923,3	549	193921,7	511,9963	194433,7	1,231677	5,558138
BVL	211234,4	43276,25	419887,9	550	2170223	286,357	2170509	2,759739	10,23935
GNP	1909549	2106703	811848,1	549	3057270	139922	3197192	-0,55127	2,348209
OCF	7253,973	4327	12781,75	549	180435	-46972	133463	3,264048	28,86058
EAR	46695,22	39142	37184,05	550	216760,8	506,222	217267	1,468122	5,835909
CDSPX	46,28446	33,2845	41,22155	548	243,467	1,283	244,75	1,618701	5,938159
LOGCDS	-0,000038	-0,00049	0,01607	549	0,130976	-0,06448	0,0665	0,033388	5,003518
VOLDCDS	30,75834	27,2075	11,93122	540	64,208	13,875	78,083	1,281262	4,389221

Table 4) summarizes the general statistics of the sample namely of the explanatory variables of the Grade Scores

TABLE 4) GENERAL STATISTICS OF GRADE SCORE

Presents all the general statistics employed in the variables used to explain and control the Grade Score of the ZSCORE1, ZSCORE 2, ZMODEL models

Stats	ZSCORE1	ZSCORE2	ZMODEL	GSZ1	GSZ2	GSZ3
Mean	2,09626	1,623139	3,166847	4,08	3,523636	4,814545
P50	1,75227	1,401386	2,596875	4	4	6
Sd	1,916435	1,404468	3,44431	2,055017	1,926326	2,362844
Variance	3,672723	1,972531	11,86327	4,223097	3,710734	5,58303
N	549	549	549	550	550	550
Range	13,57214	9,349228	27,31047	6	6	7
Min	-0,56108	0,026648	-4,86857	1	1	1
Max	13,01106	9,375875	22,4419	7	7	8
Skewness	2,430667	2,210386	2,387964	-0,06485	0,23026	-0,53252
Kurtosis	11,60451	10,50706	11,35231	1,802833	2,040383	1,726824

3.3. EMPIRICAL ANALYSIS

For our empirical analysis we chose 3 MDA models developed by Altman (1968, 1983, 1993) and the model developed by Ohlson (1980) which was the first to employ conditional probabilities in the model.

The MDA models developed by Altman and that we selected are present as follows:

ALTMAN MODELS	Z-SCORE (1968)	Z-SCORE (1983)	Z-MODEL (1993)
X1	Working capital / Total Assets	Working capital / Total Assets	Working capital / Total Assets
X2	Retain earnings / Total Assets	Retain earnings / Total Assets	Retain earnings / Total Assets
X3	EBIT/Total Assets	EBIT/Total Assets	EBIT/Total Assets
X4	Market equity value/ book value of total debt	Book Equity value/ total Liabilities	Book Equity value/ total Liabilities
X5	Sales/Total Assets	Sales/Total Assets	_
Safe zone	Z >2.99	Z >2.90	Z >2.90
Grey zone	1.80< Z <2.99	1.23< Z <2.90	1.23< Z <2.90
Distress Zone	Z < 1.80	Z < 1.23	Z < 1.23

Z-Score (Altman 1968) Z =1.2*X1+1.4*X2+3.3*X3+0.6*X4+0.999X5
Z-Score' (Altman 1983) Z'= 0.717*X1+0.847*X2+3.107*X3+0.420X4+0.998*X5
Z-Model (Altman 1993) Z-MODEL= 6.56*X1+3.26*X2+6.72*X3+1.05*X4

The Z-Score Models and Z-score methodology is a method based in Multi Discriminant Analysis (MDA), using this a statistical approach Altman developed these models classifying the observations into groupings according to its qualitative data, namely into bankrupt or non-bankrupt.

Altman (1968a) used this technique in conjunction to the statistical significance of each ratio to select the financial ratios for the model in order to accurately predict default occurrence.

All the models presented in the table above were developed by Altman being the Z-score (1968) the original model that was developed and the Z-Score'(1983) and Z-Model (1993) and are all based in financial account ratios.

However these models were not the only revisions made in the original Z-score (1968) and the Z-Score Mythology, some revisions worth mentioning regarding the Z-score and its applications were , the application of the logarithm function on the Z-score (Lepetit & Strobel, 2015), the inclusion of the real earnings into the Z-Score (1968) as explained and developed by Lin, Lo, and Wu (2016).

Other Application and updated in the Z-Score(1968) was the creation of the emerging market score ,EMS Score, developed by Altman (2005).

In this paper, we define alternatively our Dependent Variables as ZSCORE1 which the Z-score model from is 1968, ZSCORE2 being the Z-Score' (1983) and ZMODEL which is Z-Model (1993).

We use this control models due to the fact that it was conclude (Rim & Roy, 2014) that the Z score'(1983) is a good barometer for assessing credit worthiness and establishing a ranking of a Company and its perceived risk of default following the work of Rim and Roy (2014) who used the Z-score'(1983) to classify the firms regarding its credit worthiness and default probability and rating, we use the same control variables in our sample, which are the financial ratios of models.

However, we use the ZSCORE1, ZSCORE2, and ZMODEL and we aim to study the relationship between this model and the CDS Spread, CDS premium volatility and CDS premium Performance.

Studies like Tolikas and Topaloglou (2017) employ the Z-score (1983 and 1968) to measure the average financial distress of firms worldwide and correlate the results with the stock market and CDS Spread, stating that there is no difference between the models used, despite this none of the studies establish a direct link between the CDS premium and CDS Volatility focusing only either on the Z-Score of 1968 or 1983 (Lepetit & Strobel, 2015; Lin et al., 2016; Tolikas & Topaloglou, 2017)disregarding the Z-model (1993).

Due to the widespread of the Z-Score methodology namely the Z-Score of 1968 and due to its simplicity and applicability this model has a more wide use than the other models and later improvements (Lepetit & Strobel, 2015; Lin et al., 2016).

Despite including not only the ZMODEL and ZSCORE2 we also include in our regression tests the OSCORE which is the Ohlson (1980) O-score Model, based on the model described in the table below.

We computed all the data of the entire sample like we did for the other models previously mentioned and assess the relevance of the OSCORE and its relation with the CDS variables in order to see if we could find a similar conclusion regarding the applicability between Z-Score models and the O-score which was implied to have a similar performance between them.(Lin et al., 2016)

OHLSON (1980)	**O-SCORE MODEL VARIABLES AND MODEL EQUATION**
X1	X1=ln (Total Assets/GNP Price Level)
X2	X2= Total Liabilities /Total Assets
X3	X3= Working Capital / Total Assets
X4	X4= Current Liabilities / Current Assets
X5	X5= Net Income/ Total Assets
X6	X6= Operational Cash flow / Total Liabilities
X7	X7= 1 if net income negative for last 2 years, 0 otherwise
X8	X8= 1 if Total Liabilities > Total Assets, 0 otherwise
X9	NI – Net Income $X9 = (NI_t - NI_{t-1})/(\lvert NI_t \rvert + \lvert NI_{t-1} \rvert)$

$$\boldsymbol{OS = -1.33 - 0.407X1 + 6.03X2 - 1.43X3 + 0.076X4 - 2.37X5 - 1.83X6 + 0.285X7 - 1.72X8 - 0.521X9}$$

3.4.CDS VARIABLES

The data gathered to build the explanatory variables is from the Bloomberg terminal and it regards the period of 2006 to 2016, being all annual data.

The variable CDSPX is the variable that represents the annual quotes for the CDS spread for each company in the sample, covering all the 10-year period.

To measure the volatility of the year we create a variable named VOLACDS that is the Annualized daily volatility of the CDS gathered from Bloomberg terminal. This that covers all the companies and the established time frame, in order to convert the daily volatility to annual we multiply the daily observations by the square root of 252 days, like the formula bellow shows.

$$VOLACDS = Daily\ volatlity\ observations * \sqrt{252} \quad \textbf{\textit{(15)}}$$

In order to Assess the variation of the CDS premium and its behaviour we gather daily CDS premium observations of each Year and we calculated its natural Logarithm for each company attaining in the end the annual logarithm of the CDS premium, here named as LOGCDS.

3.5 HEALTH SCORE

Regarding the control variables and we used the control variables of Rim and Roy (2014) focusing more on the control variables of EBIT earnings before interest and taxes and TA which is the total assets however, we used all of the models financial ratios as control variables we apply the same logic in our paper and regarding both the Z-Score models from Altman (1968,1983,1993). The explanatory variables of the Health Score are all the Z-Scores models previously mentioned.

With that and using the various Z-scores mentioned above we calculated following the health score rules provided by Blomberg and mentioned in the chapter 2.3.6 of this paper, each Grade Score for each Z-score model. This being sad these are the subsequent regressions of each Grade Score with the respective Z-score as an explanatory variable:

$$GSZ1_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 BVL_{i,t} + \beta_6 EAR_{i,t} + \beta_7 ZSCORE1_{i,t} + \varepsilon_{i,t} \quad \textbf{\textit{(16)}}$$

$$GSZ2_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 EAR_{i,t} + \beta_8 ZSCORE2_{i,t} + \varepsilon_{i,t} \quad \textbf{\textit{(17)}}$$

$$GSZ3_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 ZMODEL_{i,t} + \varepsilon_{i,t} \quad \textbf{\textit{(18)}}$$

3.6 CONTROL VARIABLES

Regarding the control variables and using the methodology of Rim and Roy (2014) that used the model financial ratios as control variables we apply the same logic in our paper and regarding both the Z-Score models from Altman(1968,1983,1993) and the O-score from Ohlson (1980).

With that for the Z-score models we have the following regression equations below with the control variables:

$$ZSCORE1_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 BVL_{i,t} + \beta_6 EAR_{i,t} + \beta_7 CDSPX_{i,t} + \varepsilon_{i,t} \quad (19)$$

$$ZSCORE1_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 BVL_{i,t} + \beta_6 EAR_{i,t} + \beta_7 VOLACDS_{i,t} + \varepsilon_{i,t} \quad (20)$$

$$ZSCORE1_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 BVL_{i,t} + \beta_6 EAR_{i,t} + \beta_7 LOGCDS_{i,t} + \varepsilon_{i,t} \quad (21)$$

$$ZSCORE2_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 EAR_{i,t} + \beta_8 CDSPX_{i,t} + \varepsilon_{i,t} \quad (22)$$

$$ZSCORE2_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 EAR_{i,t} + \beta_8 VOLACDS_{i,t} + \varepsilon_{i,t} \quad (23)$$

$$ZSCORE2_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 EAR_{i,t} + \beta_8 LOGCDS_{i,t} + \varepsilon_{i,t} \quad (24)$$

$$ZMODEL_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 CDSPX_{i,t} + \varepsilon_{i,t} \quad (25)$$

$$ZMODEL_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 VOLACDS_{i,t} + \varepsilon_{i,t} \quad (26)$$

$$ZMODEL_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 LOGCDS_{i,t} + \varepsilon_{i,t} \quad (27)$$

Regarding the Olson O-score the Regression Equation the equation is the following:

$$OSCORE_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 GNP_{i,t} + \beta_4 TL_{i,t} + \beta_5 CL_{i,t} + \beta_6 CA_{i,t} + \beta_7 NI_{i,t} + \beta_8 OCF_{i,t} + \beta_9 CDSPX_{i,t} + \varepsilon_{i,t} \quad (28)$$

$$OSCORE_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 GNP_{i,t} + \beta_4 TL_{i,t} + \beta_5 CL_{i,t} + \beta_6 CA_{i,t} + \beta_7 NI_{i,t} + \beta_8 OCF_{i,t} + \beta_9 VOLACDS_{i,t} + \varepsilon_{i,t} \quad (29)$$

$$OSCORE_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 GNP_{i,t} + \beta_4 TL_{i,t} + \beta_5 CL_{i,t} + \beta_6 CA_{i,t} + \beta_7 NI_{i,t} + \beta_8 OCF_{i,t} + \beta_9 VOLACDS_{i,t} + \varepsilon_{i,t} \quad (30)$$

The variables used in the regressions are described in the table below:

VARIABLES		DESCRIPTION OF VARIABLES
TA	(5)	Total Assets
TE	(2), (3)	Total Equity
BVL	(1)	Book Value of Liabilities
WC	(5)	Working Capital
EAR	(1), (2)	Earnings
EBIT	(1), (2), (3)	Earnings Before Interest and Taxes
RET	(1), (2), (3)	Retained Earnings
GNP	(4)	Gross National Product
TL	(2), (3), (4)	Total Liabilities
CA	(4)	Current Assets
CL	(4)	Current Liabilities
NI	(4)	Net Income
OCF	(4)	Operational Cash Flow
CDSPX	(5)	CDS Premium
LOGCDS	(5)	Logarithm of the CDS premium
VOLACDS	(5)	Annualized Daily volatility of the CDS

(1) ZSCORE1; (2) ZSCORE2; (3) ZMODEL; (4) OSCORE; (5) ALL MODELS

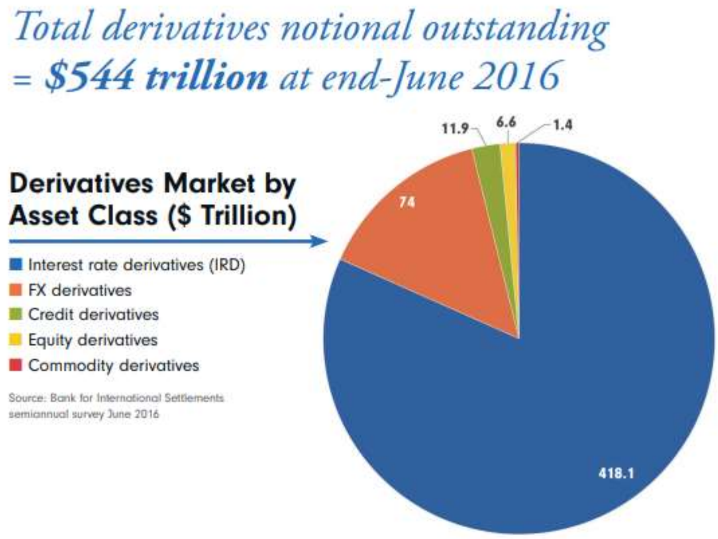
Regarding the assembly of the control variables of the models, all data was gathered from Bloomberg terminal, from the company's financial statements and reports, with the exception of the GNP variable that was gathered from REUTERS DataStream.

4.CDS MARKET OVERVIEW

According to (van der Merwe ,Andria, 2016) there is a false pretentions that the CDS market as contracted due to the use of the portfolios that might reduce some contract numbers due to portfolio compression eliminating redundant positions. This reduction is referring specially to the notional of the contract of CDS, however it is not being considered significant regarding the CDS index products.(van der Merwe ,Andria, 2016)

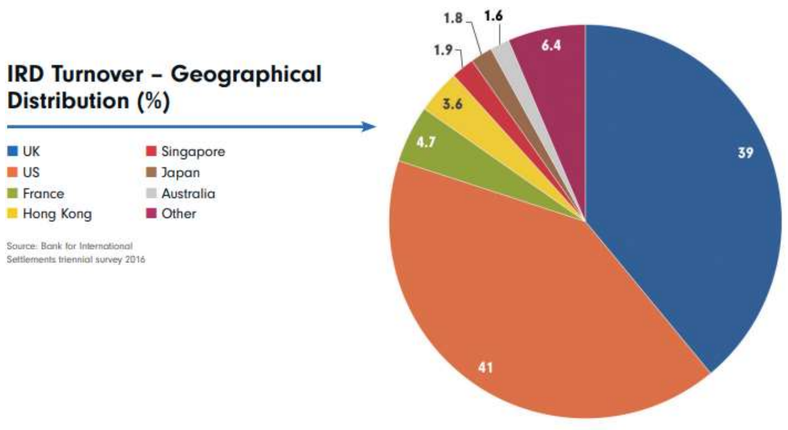
The most popular types of contracts according to (van der Merwe ,Andria, 2016) are Single name CDS which are linked only to a reference entity , asset backed securities CDS which is a type of contract backed by an asset like commercial mortgages for instance and structured financed CDS which have a loan as a reference entity, this types of contracts are vastly and most commonly used and its popularity and use has not shown any decrease through time.(van der Merwe ,Andria, 2016)

As We can see in the graphic below the credit derivatives represent around 11.9 trillion dollars only regarding the notional of the contracts and the numbers around the global markets of derivatives have been rising due to the fact that the importance of covering risk is gaining importance in the investors but also due to the economic crisis and the former period of instability("ISDA".)



Graphic 1- Derivatives Market by asset Class
Source: Bank for International Settlements semi annual survey June 2016

When it comes to the geographic area of the derivatives market it focuses more on the US and UK and the remaining part being diverse, so we can conclude that the Anglo-Saxon regions have a bigger role in the turnover regarding IRD – Interest rate Derivatives as the graphic bellow shows.



Graphic 2- IRD Turnover global distribution (%)
Source: Bank for International Settlements triennial survey 2016

Regarding the CDS market news world-wide there have been a recent turmoil regarding the use of CDS contracts and derivatives, for instance in the US there was news that a trade conflict between a company (Hovnanian) that defaulted part its debt allowing other company(GSO) that had a contract to profit from a separate credit derivative, offering a relative cheap financing to the other party , this is a form of loop hole that are becoming more and more frequent and that its use turns the CDS contract useless due to the fact that this loophole prevents the CDS pay-outs. ("Blackstone, Solus Settle Fight Over Hovnanian CDS Trade," 2018).

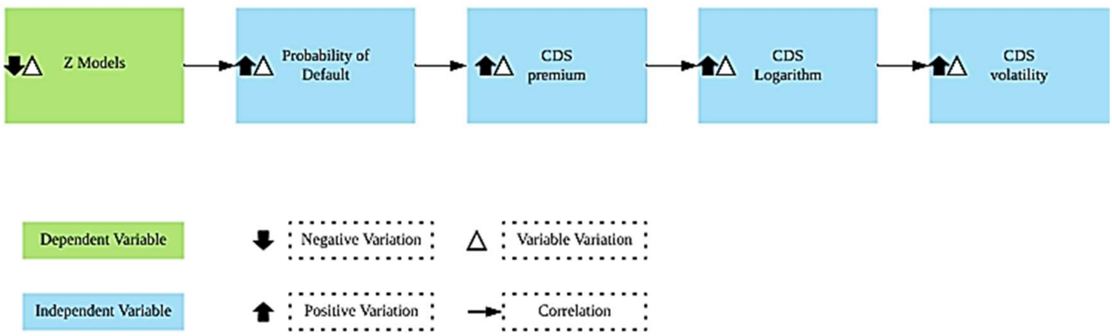
Deutsche Bank has been in a turmoil regarding its short sellers and increase of credit derivatives pilling on it, which signal doubt regarding the company future, even if they have capital reserves to ensure the doubt of investors, this movement on the behalf of the investors is due to the fact that DB bank was mentioned on the US. Regulatory report as being one of the banks present in the regulatory watch list which indicates that the bank might have problems, this led to a decrease of the one level regarding its rating notation and an increase on the Bearish movements by the investors , meaning an increase in CDS contracts.("Deutsche Bank's Slow Bleed Continues as a Pivotal Month Begins," 2018)

In other news political conflicts in Italy is driving chaos regarding the increase in credit risk , increase on CDS spread which has passed even countries considered as being junk rated by the investors such us Brazil, Turkey and South Africa, despite this Italy is still considered an investment country by the rating agencies even if its experiencing political and fiscal Risk. ("Italy Now Troubles Bond Investors More Than Crisis-Ridden Turkey," 2018) this situation led to the pope mentioning that the CDS traders are a form of sinful contract that bet on the demise of others and profit on their default being considered by the Pope as being predatory specially regarding the investors who speculate on the derivatives market. However this view of the Pope is considered short sided due to the fact that the benefits of the CDS contracts and derivatives were not considered such us achieving lesser borrowing costs , and allowing countries to get credit that would be out of reach otherwise("Pope's Beef With CDS Market Is a Beef With All Markets," 2018).

5.EMPIRICAL RESULTS AND HYPOTHESIS

As it was described in the previous chapters the both the CDS contracts and Altman Z-score models are linked to the Probability of default. However we hypothesise that the Z-score models is negative correlated with the CDS premium due to the fact that the and higher Z-score represents a lower likelihood of default (E. Altman, 1968a; Rim & Roy, 2014) and that in the case of the CDS contract and increase of probability of default will increase the risk associated and therefore the CDS premium (Hull, 2015) implying a negative correlation between them as the figure of our null hypothesis shows bellow .

Figure1) Null Hipothesys Diagram



We performed tests regarding the heteroscedasticity, autocorrelation tests and robustness tests in our regressions and sample in order to guarantee the relevance in our tests and results.

Regarding the **Table 5)** it presents the relationship between the selected models and the explanatory variable CDS PX (CDS spread). In this table we denote that this variable presents significant values regarding the Fixed Effects regression and Random Effects regressions both in the ZSCORE2 and ZMODEL not having any significant results regarding the other models. This results might confirm the importance of the update form the original Z-Score and its evolution regarding the updates and the models that we selected ,in this case Z-Score'(1986) and Z-Model (1993), both updates and developed by Atman as stated in chapter 2.3.2 , however regarding the CDSPX variable we were expecting a negative correlation due to its link to risk and default probability (Hull 2015; and how the Z-scores are related to the default probability (E. Altman, 1968a; E. Altman & Rijken, 2010) despite this assumption the results that we got provide a significant correlation with the ZSCORE2 and ZMODEL but with opposite results , this difference in results regarding the signal of the regression of the variable , might be due to the form of how the Z-Score' and Z-model is interpreted in terms of output as seen in E.

Altman, (1968a); Lepetit & Strobel (2015) which denote the importance of the interpretation of the output concluding that it has impact in the results attained.

TABLE5) RELATION BETWEEN THE MODELS AND CDS PREMIUM

		ZSCORE1	(SD)	ZSCORE2	(SD)	ZMODEL	(SD)	OSCORE	(SD)
(1)	**CDSPX**	-0,000804	(0,00196)	0,00345***	(0,00118)	0,00856***	(0,00309)	-0,00294	(0,00232)
(2)	**CDSPX**	2,95e-05	(0,00183)	0,00353***	(0,00113)	0,00913***	(0,00297)	-0,000856	(0,00111)
(3)	**CDSPX**	-0,000804	(0,00405)	0,00345*	(0,00188)	0,00856*	(0,00495)	-0,00294*	(0,00171)
(4)	**CDSPX**	2,95e-05	(0,00366)	0,00353*	(0,00186)	0,00913*	(0,00484)	-0,000856	(0,000973)
(5)	**CDSPX**	-0,000804	(0,00405)	0,00345*	(0,00188)	0,00856*	(0,00495)	-0,00294*	(0,00171)
Observations		547		547		547		540	
R-squared		0.160		0.121		0.162		0.175	
Number of firms		50		50		50		50	
(1) Fixed Effects Regression *(4) Random Effects Regression Robust*				*(2) Random Effects Regression* *(5) Fixed Effects Regression VCE(Robust)*			*(3) Fixed Effects Regression Robust* *** p<0.01, ** p<0.05, * p<0.1		

**Full detailed regressions present in attachment Tables 7), 8) 9) and 10)*

Table 6) presents the results between the relationship of the models and the historic daily volatility annualized to match the sample and the data periods. The historic daily volatility was gathered directly form the Bloomberg. This variable VOLACDS represents changes in the CDS premium , and we hypothesize that it has a negative correlation with the models due to the relationship between the risk and Z-score (E. Altman, 1968a; E. Altman & Rijken, 2010). Like the results bellow show, we have highly significant results in all Altman MDA model, more precisely ZSCORE1, ZSCORE2 and ZMODEL. These results confirm our hypothesis and diagram regarding the figure1) that correlates the probability of the and its inverse behavior towards Z-Models , basically confirming that a positive variation of the Z-Models will have a negative impact in the volatility, all because and as conclude by Altman in his works,(E. Altman, 1968a; E. I. Altman et al., 1977a), the higher the Z-Score attained the less is likelihood of default to occur.

With this statement we and now comparing the results we can see clearly why the relationship between the CDS volatility and Z-score models are negative.

With that said all the models with exception to O-SCORE presents significant results with negative correlation in all the regressions made.

TABLE6) RELATION BETWEEN THE MODELS AND CDS VOLATILITY

		ZSCORE1	(SD)	ZSCORE2	(SD)	ZMODEL	(SD)	OSCORE	(SD)
(1)	**VOLACDS**	-0,000276	(0,000171)	-0,000397***	(0,000120)	-0,000897***	(0,000319)	-2,78e-05	(0,000247)
(2)	**VOLACDS**	-0,000301*	(0,000172)	-0,000419***	(0,000120)	-0,000939***	(0,000318)	0,000133	(0,000219)
(3)	**VOLACDS**	-0,000276*	(0,000161)	-0,000397***	(0,000108)	-0,000897***	(0,000297)	-2,78e-05	(0,000203)
(4)	**VOLACDS**	-0,000301*	(0,000157)	-0,000419***	(0,000111)	-0,000939***	(0,000301)	0,000133	(0,000162)
(5)	**VOLACDS**	-0,000276*	(0,000161)	-0,000397***	(0,000108)	-0,000897***	(0,000297)	-2,78e-05	(0,000203)
Observations		549		549		549		542	
R-squared		0.164		0.125		0.162		0.171	
Number of firms		50		50		50		50	
1) Fixed Effects Regression				*(2) Random Effects Regression*			*(3) Fixed Effects Regression Robust*		
(4) Random Effects Regression Robust				*(5) Fixed Effects Regression VCE(Robust)*			*** p<0.01, ** p<0.05, * p<0.1		

**Full detailed regressions present in attachment Tables 7), 8) 9) and 10)*

When it comes to the relation of the Models and LOGCDS in **Table7)** we logarithmized the daily CDS Premium observations and annualized the Logarithm getting therefore the logarithmic evolution for each year, this function is the CDS performance regarding the first quotation until the last quotation of the CDS premium observation. With that we expect to attain a negative correlation between the Z-scores which is a measure of default Probability (E. Altman, 1968a; E. Altman & Rijken, 2010) and the LOGCDS variable which is connected to the risk variation probability (Hull 2015) all this is explained not only by the connection of the risk and Z-Model's but also the way that the CDS contracts are linked to the risk and its valuation and relations towards default.

By looking at the results the ZSCORE1, and ZSCORE2 have significant results in the majority of the regressions and the ZMODEL also presents a significant result once again, the OSCORE model did not show any relevant result.

TABLE7) RELATION BETWEEN THE MODELS AND CDS PERFORMANCE

		ZSCORE1	(SD)	ZSCORE2	(SD)	ZMODEL	(SD)	OSCORE	(SD)
(1)	**LOG CDS**	-3,543*	(1,805)	-2,704**	(1,329)	-6,180*	(3,514)	-3,581	(2,645)
(2)	**LOG CDS**	-3,677**	(1,821)	-2,794**	(1,334)	-6,341*	(3,508)	-3,445	(2,580)
(3)	**LOG CDS**	-3,543**	(1,746)	-2,704*	(1,575)	-6,180*	(3,672)	-3,581	(2,869)
(4)	**LOG CDS**	-3,677**	(1,818)	-2,794*	(1,627)	-6,341*	(3,739)	-3,445	(2,838)
(5)	**LOG CDS**	-3,543**	(1,746)	-2,704*	(1,575)	-6,180*	(3,672)	-3,581	(2,869)
Observations		548		548		548		541	
R-squared		0.166		0.113		0.154		0.175	
Number of firms		50		50		50		50	
(1) Fixed Effects Regression				*(2) Random Effects Regression*			*(3) Fixed Effects Regression Robust*		
(4) Random Effects Regression Robust				*(5) Fixed Effects Regression VCE(Robust)*			*** p<0.01, ** p<0.05, * p<0.1		

**Full detailed regressions present in attachment Tables 7), 8) 9) and 10)*

Regarding the Health Score, the main results of our regressions of each Grade Score as previously explained are given in **Table 8).** The main aim of this regression was to examine and evaluate the Ratings of the companies listed in the public markets, namely the Eurostoxx50 and the link between the Z-Score and the variants of this model that we tested here. With that said we established a relation between the health Score and Z-score models assessing its relevance.

Like mentioned in the chapter 3.6 we built the Grade Score for each the Z-models due to the fact that the original Z-score possesses a role in this model.

We performed the same set of regressions as in the CDS part of this paper, with the aim of not only testing the link between the ratings and Z-score via the Grade Score, which is the last phase of the Health score indicator, but also test the relevance of this indicator. We exclude the OSCORE variable in this part by reason of not having relevant results in the former regressions and also because the variable is not used as an element of the Health Score.

As we can see by the results in the **Table8)** all the models that we selected have relevant and highly significant results in all the regressions. With that we can conclude that the Grade Score is an indicator of the fluctuation of the Rating and the financial health of the companies, and by looking at the results we conclude that it has a strong correlation with the selected Altman MDA models and the Health Score.

Since the mechanism of the Health Score works in conjunction with Z-score we can therefore confirm that the Rating and the Health of a firm and the Z-Score all have a positive relation with each other and by that conclude that they have a negative correlation with the probability of default and bankruptcy risk.

Table8) GRADE SCORE (GS)

		GSZ1	(SD)		GSZ2	(SD)		GSZ3	(SD)
(1)	**ZSCORE1**	0,426***	(0,0412)	**ZSCORE2**	0,679***	(0,0478)	**ZMODEL**	0,255***	(0,0274)
(2)	**ZSCORE1**	0,477***	(0,0371)	**ZSCORE2**	0,767***	(0,0426)	**ZMODEL**	0,274***	(0,0253)
(3)	**ZSCORE1**	0,426**	(0,192)	**ZSCORE2**	0,679***	(0,252)	**ZMODEL**	0,255***	(0,0875)
(4)	**ZSCORE1**	0,477***	(0,175)	**ZSCORE2**	0,767***	(0,226)	**ZMODEL**	0,274***	(0,0841)
(5)	**ZSCORE1**	0,426**	(0,192)	**ZSCORE2**	0,679***	(0,252)	**ZMODEL**	0,255***	(0,0875)
	Observations	549			549			549	
	R-squared	0.404			0.467			0.435	
	Number of firms	50			50			50	
	(1) Fixed Effects Regression			*(2) Random Effects Regression*			*(3) Fixed Effects Regression Robust*		
	(4) Random Effects Regression Robust			*(5) Fixed Effects Regression VCE(Robust)*				*** p<0.01, ** p<0.05, * p<0.1	

**Full detailed regressions present in attachment Tables 11), 12) and 13)*

6.CONCLUSION

After analyzing these regressions and despite the results on the CDSPX variable and the ZSCORE1 (Z-score 1968), this was the model who presented more consistent Results and like the ZSCORE2 (Z-score'1983) (Altman 1968a; Altman 1983) . These previous models are still the most relevant and are often used as benchmarks and are the basis for developing other models and despite the fact that the original Z-score form Altman 1968 being criticized and improved as the results showed it is one of the most reliable models in terms of results. (E. I. Altman, Haldeman, & Narayanan, 1977b; Lepetit & Strobel, 2015; Lin et al., 2016; Rim & Roy, 2014)

With that said since the Z-score is a tool to determinate and assess the default probability as a form of locating the likelihood of default in different zones (E. Altman, 1968a; E. I. Altman et al., 1977a) that might mean that it is not directly correlated with the probability of default .

Whereas the O-score is the tool that provides the direct probability of default straight from its output and direct interpretation as a probability of default , due in part to its cut-off be interpreted in that regard (Ohlson, 1980) , this might explain why the correlation between the CDS Premium and the O-SCORE has a negative signal and why in the Z-SCORE model and its variants regarding the relation between the variables takes a positive signal , all this due to the different approach of the results explaining and corroborating the results found by Lepetit and Strobel (2015) which suggest the reinterpretation of the default probability attained from the Z-score methodology as an odd of insolvency instead .

What might help to corroborate this idea is the Z-metrics Model which is considered to be a better version of the Z-score" (z-score from 1982) (E. Altman & Rijken, 2010), in this model the probability of default is not attained directly from the model output but its calculated after using a probability of default equation / formula (E. Altman & Rijken, 2010), therefore using a the model output as a means to attain the probability of default , not as a direct interpretation of result.

With that said and after analyzing the regressions this might explain the difference between the Models selected and the O-score and the difference in signal of this explanatory variable (CDS PX), cause like mentioned before the CDS has a direct influence in risk and probability of default (Hull, 2015; Saunders & Cornett, 2008) we might conclude that the key difference lies in the interpretation of the results and it has an effect on the regression of the CDS PX.(E. Altman, 1968a; Lepetit & Strobel, 2015; Ohlson, 1980; Rim & Roy, 2014)

Regarding the link between the Rating and Altman MDA models we conclude that there is a strong link between these two components by taking into consideration the Health Score model. Like the results showed we can conclude that the Grade Score is an indicator of the fluctuation of the Rating and the financial health of the companies, and it has a strong correlation with the MDA models and the Health Score.

Due to the fact that the mechanism of the Health Score works in conjunction with Z-score we can affirm that the Rating and the Health of a firm and the Z-Score all have a positive relation with each other and by that conclude that they have a negative correlation with the probability of default and bankruptcy risk.

In summary our hypothesis is in part confirmed cause the results show an inverse correlation with the models and the variables of LOGCDS and VOLACDS which explains the behavior of the Z-score models and the shift and changes in the volatility and Logarithm values of the CDS premium and default probabilities (Hull 2015) but we cannot find any concrete explanation for the signal and the correlation of the CDSPX and ZSCORE2 and ZMODEL .

Despite that in this paper we aimed to explore the connection between the CDS markets in the Eurostoxx50 and the Z-Score models regarding the influence of these models and the CDS premium and Volatility and Logarithm links and evolution to the probability of default and these Tools for predicting default.

REFERENCES

Agarwal, V., & Taffler, R. (2008). Comparing the performance of market-based and accounting-based bankruptcy prediction models. *Journal of Banking & Finance*, *32*(8), 1541–1551. https://doi.org/10.1016/j.jbankfin.2007.07.014

Ahmed, Y., & Elshandidy, T. (2017). Why do over-deviated firms from target leverage undertake foreign acquisitions? *International Business Review*. https://doi.org/10.1016/j.ibusrev.2017.08.005

Aktas, N., Bodt, E. de, Lobez, F., & Statnik, J.-C. (2012). The information content of trade credit. *Journal of Banking & Finance*, *36*(5), 1402–1413. https://doi.org/10.1016/j.jbankfin.2011.12.001

Alexeev, M., & Kim, S. (2008). The Korean financial crisis and the soft budget constraint. *Journal of Economic Behavior & Organization*, *68*(1), 178–193. https://doi.org/10.1016/j.jebo.2008.05.001

Al-Kassar, T. A., & Soileau, J. S. (2014). Financial performance evaluation and bankruptcy prediction (failure)1. *Arab Economic and Business Journal*, *9*(2), 147–155. https://doi.org/10.1016/j.aebj.2014.05.010

Almamy, J., Aston, J., & Ngwa, L. N. (2016). An evaluation of Altman's Z-score using cash flow ratio to predict corporate failure amid the recent financial crisis: Evidence from the UK. *Journal of Corporate Finance*, *36*, 278–285. https://doi.org/10.1016/j.jcorpfin.2015.12.009

Altman, E. (1968a, Setembro). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *The Journal of Finance*, pp. 589–609.

Altman, E. (1968b, Setembro). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *The Journal of Finance*, pp. 589–609.

Altman, E. I. (1984). The success of business failure prediction models: An international survey. *Journal of Banking & Finance*, *8*(2), 171–198. https://doi.org/10.1016/0378-4266(84)90003-7

Altman, E. I. (2005). An emerging market credit scoring system for corporate bonds. *Emerging Markets Review*, *6*(4), 311–323. https://doi.org/10.1016/j.ememar.2005.09.007

Altman, E. I., Haldeman, R. G., & Narayanan, P. (1977a). ZETATM analysis A new model to identify bankruptcy risk of corporations. *Journal of Banking & Finance*, *1*(1), 29–54. https://doi.org/10.1016/0378-4266(77)90017-6

Altman, E. I., Haldeman, R. G., & Narayanan, P. (1977b). ZETATM analysis A new model to identify bankruptcy risk of corporations. *Journal of Banking & Finance*, *1*(1), 29–54. https://doi.org/10.1016/0378-4266(77)90017-6

Altman, E., & Rijken, H. A. (2010). The Z-Metrics™ Methodology For Estimating Company.pdf. Risk Metrics Group. Retrieved from https://www.researchgate.net/publication/215990971_The_Z-Metrics_Methodology_For_Estimating_Company_Credit_Ratings_And_Default_Risk_Probabilities

Barboza, F., Kimura, H., & Altman, E. (2017). Machine learning models and bankruptcy prediction. *Expert Systems with Applications*, *83*, 405–417. https://doi.org/10.1016/j.eswa.2017.04.006

Beneish, M. D. (1999). The Detection of Earnings Manipulation. *Financial Analysts Journal*, *55*(5), 24–36. https://doi.org/10.2469/faj.v55.n5.2296

Berk, J. B., & DeMarzo, P. M. (2014). *Corporate finance* (Third edition). Boston: Pearson.

Blackstone, Solus Settle Fight Over Hovnanian CDS Trade. (2018, May 30). *Bloomberg.Com*. Retrieved from https://www.bloomberg.com/news/articles/2018-05-30/hovnanian-pays-overdue-interest-on-bonds-within-grace-period

Brooks, C. (2008). *Introductory econometrics for finance*. Cambridge [England]; New York: Cambridge University Press. Retrieved from http://dx.doi.org/10.1017/CBO9780511841644

Dalnial, H., Kamaluddin, A., Sanusi, Z. M., & Khairuddin, K. S. (2014). Accountability in Financial Reporting: Detecting Fraudulent Firms. *Procedia - Social and Behavioral Sciences*, *145*, 61–69. https://doi.org/10.1016/j.sbspro.2014.06.011

derivatives-facts-and-figures-fact-sheet-final.pdf. (n.d.). Retrieved from https://www.isda.org/a/sviDE/derivatives-facts-and-figures-fact-sheet-final.pdf

Deutsche Bank's Slow Bleed Continues as a Pivotal Month Begins. (2018, June 2). *Bloomberg.Com*. Retrieved from https://www.bloomberg.com/news/articles/2018-06-02/deutsche-bank-s-slow-bleed-continues-as-a-pivotal-month-begins

Diallo, B., & Al-Mansour, A. (2017). Shadow banking, insurance and financial sector stability. *Research in International Business and Finance*, *42*, 224–232. https://doi.org/10.1016/j.ribaf.2017.04.024

Elnahas, A. M., Hassan, M. K., & Ismail, G. M. (2017). Religion and ratio analysis: Towards an Islamic corporate liquidity measure. *Emerging Markets Review*, *30*, 42–65. https://doi.org/10.1016/j.ememar.2016.09.001

Giroux, G., & Cassell, C. (2011). Changing audit risk characteristics in the public client market. *Research in Accounting Regulation*, *23*(2), 177–183. https://doi.org/10.1016/j.racreg.2011.06.009

Goto, M. (2010). Financial performance analysis of US and world telecommunications companies: Importance of Information Technology in the telecommunications industry after the AT&T breakup and the NTT divestiture. *Decision Support Systems*, *48*(3), 447–456. https://doi.org/10.1016/j.dss.2009.06.003

Hernandez Tinoco, M., & Wilson, N. (2013). Financial distress and bankruptcy prediction among listed companies using accounting, market and macroeconomic variables. *International Review of Financial Analysis*, *30*, 394–419. https://doi.org/10.1016/j.irfa.2013.02.013

Hull, J. (2015). *Options, futures, and other derivatives* (Ninth edition). Boston: Pearson.

International Swaps and Derivatives Association. (n.d.). Retrieved January 25, 2018, from https://www.isda.org/

Italy Now Troubles Bond Investors More Than Crisis-Ridden Turkey. (2018, May 29). *Bloomberg.Com*. Retrieved from https://www.bloomberg.com/news/articles/2018-05-29/italy-now-troubles-bond-investors-more-than-crisis-ridden-turkey

It's 2007 Again for Commercial Mortgage Bonds, Moody's Says - Bloomberg. (n.d.). Retrieved June 13, 2018, from https://www.bloomberg.com/news/articles/2018-06-01/it-s-2007-again-for-commercial-mortgage-bonds-moody-s-says

Jayasekera, R. (2017). Prediction of company failure: Past, present and promising directions for the future. *International Review of Financial Analysis*. https://doi.org/10.1016/j.irfa.2017.08.009

L. Culp,Christopher, & van der Merwe ,Andria. (2016). *Single-name Credit Default Swaps: A Review of the Empirical Academic Literature*. Johns Hopkins Institute for Applied Economics, AF/No.11/September 2016. Retrieved from https://www.isda.org/a/KSiDE/single-name-cds-literature-review-culp-van-der-merwe-staerkle-isda.pdf

Lee, S., Koh, Y., & Kang, K. H. (2011). Moderating effect of capital intensity on the relationship between leverage and financial distress in the U.S. restaurant industry. *International Journal of Hospitality Management*, *30*(2), 429–438. https://doi.org/10.1016/j.ijhm.2010.11.002

Lepetit, L., & Strobel, F. (2015). Bank insolvency risk and Z-score measures: A refinement. *Finance Research Letters*, *13*, 214–224. https://doi.org/10.1016/j.frl.2015.01.001

Liao, H.-H., Chen, T.-K., & Lu, C.-W. (2009). Bank credit risk and structural credit models: Agency and information asymmetry perspectives. *Journal of Banking & Finance*, *33*(8), 1520–1530. https://doi.org/10.1016/j.jbankfin.2009.02.016

Lin, H.-W. W., Lo, H.-C., & Wu, R.-S. (2016). Modeling default prediction with earnings management. *Pacific-Basin Finance Journal*, *40*, 306–322. https://doi.org/10.1016/j.pacfin.2016.01.005

Liu, J., & Zhong, R. (2017). Political uncertainty and a firm's credit risk: Evidence from the international CDS market. *Journal of Financial Stability*, *30*, 53–66. https://doi.org/10.1016/j.jfs.2017.03.006

Liu, L., Zhang, G., & Fang, Y. (2016). Bank credit default swaps and deposit insurance around the world. *Journal of International Money and Finance*, *69*, 339–363. https://doi.org/10.1016/j.jimonfin.2016.06.017

Moody's - credit ratings, research, tools and analysis for the global capital markets. (n.d.). Retrieved January 25, 2018, from https://www.moodys.com/

Nam, H. J., & An, Y. H. (2017). Default Risk and Firm Value of Shipping & Logistics Firms in Korea. *The Asian Journal of Shipping and Logistics*, *33*(2), 61–65. https://doi.org/10.1016/j.ajsl.2017.06.003

Ohlson, J. A. (1980). Financial Ratios and the Probabilistic Prediction of Bankruptcy. *Journal of Accounting Research*, *18*(1), 109–131. https://doi.org/10.2307/2490395

Park, K., Yang, I., & Yang, T. (2017). The peer-firm effect on firm's investment decisions. *The North American Journal of Economics and Finance*, *40*, 178–199. https://doi.org/10.1016/j.najef.2017.03.001

Pope's Beef With CDS Market Is a Beef With All Markets. (2018, May 18). *Bloomberg.Com*. Retrieved from https://www.bloomberg.com/view/articles/2018-05-18/pope-s-cds-criticism-could-apply-to-all-markets

Razali, W. A. A. W. M., & Arshad, R. (2014). Disclosure of Corporate Governance Structure and the Likelihood of Fraudulent Financial Reporting. *Procedia - Social and Behavioral Sciences*, *145*, 243–253. https://doi.org/10.1016/j.sbspro.2014.06.032

Reisz, A. S., & Perlich, C. (2007). A market-based framework for bankruptcy prediction. *Journal of Financial Stability*, *3*(2), 85–131. https://doi.org/10.1016/j.jfs.2007.02.001

Rim, E. K., & Roy, A. B. (2014). Classifying Manufacturing Firms in Lebanon: An Application of Altman's Model. *Procedia - Social and Behavioral Sciences*, *109*, 11–18. https://doi.org/10.1016/j.sbspro.2013.12.413

Saunders, A., & Cornett, M. M. (2008). *Financial institutions management: a risk management approach* (6th ed). Boston: McGraw-Hill Irwin.

Smaranda, C. (2014). Scoring Functions and Bankruptcy Prediction Models – Case Study for Romanian Companies. *Procedia Economics and Finance*, *10*, 217–226. https://doi.org/10.1016/S2212-5671(14)00296-2

Thomas Ng, S., Wong, J. M. W., & Zhang, J. (2011). Applying Z-score model to distinguish insolvent construction companies in China. *Habitat International*, *35*(4), 599–607. https://doi.org/10.1016/j.habitatint.2011.03.008

Tian, S., & Yu, Y. (2017). Financial ratios and bankruptcy predictions: An international evidence. *International Review of Economics & Finance*, *51*, 510–526. https://doi.org/10.1016/j.iref.2017.07.025

Tolikas, K., & Topaloglou, N. (2017). Is default risk priced equally fast in the credit default swap and the stock markets? AN empirical investigation. *Journal of International Financial Markets, Institutions and Money*, *51*, 39–57. https://doi.org/10.1016/j.intfin.2017.09.029

Torres-Reyna, O. (2007, December). *Getting started series: Stata*. Online presentation, Pinceton Edu. Retrieved from https://dss.princeton.edu/training/

ATTACHMENTS

Table 7) Relation Between The Z-score 1962 and the CDS explanatory variables

VARIABLES	(1) ZSCORE 1	(2) ZSCORE 1	(3) ZSCORE 1	(4) ZSCORE 1	(5) ZSCORE 1	(1) ZSCORE 1	(2) ZSCORE 1	(3) ZSCORE 1	(4) ZSCORE 1	(5) ZSCORE 1	(1) ZSCORE 1	(2) ZSCORE 1	(3) ZSCORE 1	(4) ZSCORE 1	(5) ZSCORE 1
WC	8.55e-07**	8.45e-07**	8.55e-07**	8.45e-07**	8.55e-07**	8.76e-07**	8.62e-07**	8.76e-07**	8.62e-07**	8.76e-07**	8.81e-07**	8.73e-07**	8.81e-07**	8.73e-07**	8.81e-07**
	(3.53e-07)	(3.53e-07)	(3.98e-07)	(3.75e-07)	(3.98e-07)	(3.54e-07)	(3.55e-07)	(3.86e-07)	(3.61e-07)	(3.86e-07)	(3.52e-07)	(3.53e-07)	(3.86e-07)	(3.57e-07)	(3.86e-07)
TA	-1.72e-05***	-1.94e-05***	-1.72e-05***	-1.94e-05***	-1.72e-05***	-1.74e-05***	-1.96e-05***	-1.74e-05***	-1.96e-05***	-1.74e-05***	-1.77e-05***	-1.99e-05***	-1.77e-05***	-1.99e-05***	-1.77e-05***
	(5.07e-06)	(4.93e-06)	(6.24e-06)	(6.50e-06)	(6.24e-06)	(5.10e-06)	(4.96e-06)	(6.36e-06)	(6.72e-06)	(6.36e-06)	(5.08e-06)	(4.93e-06)	(6.18e-06)	(6.42e-06)	(6.18e-06)
RET	5.92e-06	8.57e-06*	5.92e-06	8.57e-06	5.92e-06	6.48e-06	9.14e-06*	6.48e-06	9.14e-06	6.48e-06	6.35e-06	9.10e-06*	6.35e-06	9.10e-06	6.35e-06
	(5.22e-06)	(5.04e-06)	(6.97e-06)	(6.27e-06)	(6.97e-06)	(5.24e-06)	(5.06e-06)	(6.82e-06)	(6.10e-06)	(6.82e-06)	(5.21e-06)	(5.03e-06)	(6.76e-06)	(6.11e-06)	(6.76e-06)
EBIT	2.19e-05*	1.87e-05	2.19e-05*	1.87e-05	2.19e-05*	2.11e-05	1.79e-05	2.11e-05*	1.79e-05	2.11e-05*	2.26e-05*	1.93e-05	2.26e-05*	1.93e-05	2.26e-05*
	(1.31e-05)	(1.31e-05)	(1.19e-05)	(1.28e-05)	(1.19e-05)	(1.32e-05)	(1.31e-05)	(1.14e-05)	(1.25e-05)	(1.14e-05)	(1.31e-05)	(1.31e-05)	(1.16e-05)	(1.26e-05)	(1.16e-05)
MKTCAP	1.25e-05***	1.28e-05***	1.25e-05*	1.28e-05*	1.25e-05*	1.41e-05***	1.39e-05***	1.41e-05*	1.39e-05*	1.41e-05*	1.34e-05***	1.39e-05***	1.34e-05**	1.39e-05**	1.34e-05**
	(2.25e-06)	(2.24e-06)	(6.54e-06)	(6.57e-06)	(6.54e-06)	(2.64e-06)	(2.55e-06)	(8.35e-06)	(8.07e-06)	(8.35e-06)	(2.16e-06)	(2.15e-06)	(6.22e-06)	(6.28e-06)	(6.22e-06)
BVL	1.65e-05***	1.84e-05***	1.65e-05**	1.84e-05***	1.65e-05**	1.68e-05***	1.86e-05***	1.68e-05**	1.86e-05***	1.68e-05**	1.71e-05***	1.89e-05***	1.71e-05***	1.89e-05***	1.71e-05***
	(5.24e-06)	(5.06e-06)	(6.29e-06)	(6.53e-06)	(6.29e-06)	(5.27e-06)	(5.10e-06)	(6.41e-06)	(6.74e-06)	(6.41e-06)	(5.25e-06)	(5.07e-06)	(6.24e-06)	(6.44e-06)	(6.24e-06)
EAR	1.46e-06	-6.06e-07	1.46e-06	-6.06e-07	1.46e-06	2.06e-06	-3.67e-07	2.06e-06	-3.67e-07	2.06e-06	1.30e-06	-8.35e-07	1.30e-06	-8.35e-07	1.30e-06
	(3.14e-06)	(2.97e-06)	(2.87e-06)	(2.74e-06)	(2.87e-06)	(3.21e-06)	(3.02e-06)	(3.47e-06)	(3.12e-06)	(3.47e-06)	(3.14e-06)	(2.97e-06)	(2.81e-06)	(2.71e-06)	(2.81e-06)
VOLACDS	-0.000276	-0.000301*	-0.000276*	-0.000301*	-0.000276*										
	(0.000171)	(0.000172)	(0.000161)	(0.000157)	(0.000161)										
CDSPX						-0.000804	2.95e-05	-0.000804	2.95e-05	-0.000804					
						(0.00196)	(0.00183)	(0.00405)	(0.00366)	(0.00405)					
LOGCDS											-3.543*	-3.677**	-3.543**	-3.677**	-3.543**
											(1.805)	(1.821)	(1.746)	(1.818)	(1.746)
Observations	549	549	549	549	549	547	547	547	547	547	548	548	548	548	548
R-squared	0.164		0.164		0.164	0.160		0.160		0.160	0.166		0.166		0.166
Number of firms	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(1) Fixed Effects Regression *(2) Random Effects Regression* *(3) Fixed Effects Regression Robust*
(4) Random Effects Regression Robust *(5) Fixed Effects Regression VCE(Robust)*

Table 8) Relation Between The Z-score' 1983 and the CDS explanatory variables

VARIABLES	(1) ZSCORE 2	(2) ZSCORE 2	(3) ZSCORE 2	(4) ZSCORE 2	(5) ZSCORE 2	(1) ZSCORE 2	(2) ZSCORE 2	(3) ZSCORE 2	(4) ZSCORE 2	(5) ZSCORE 2	(1) ZSCORE 2	(2) ZSCORE 2	(3) ZSCORE 2	(4) ZSCORE 2	(5) ZSCORE 2
WC	**1.20e-07**	**1.02e-07**	**1.20e-07**	**1.02e-07**	**1.20e-07**	**1.07e-07**	**8.81e-08**	**1.07e-07**	**8.81e-08**	**1.07e-07**	**1.65e-07**	**1.49e-07**	**1.65e-07**	**1.49e-07**	**1.65e-07**
	(2.58e-07)	**(2.56e-07)**	**(2.24e-07)**	**(2.14e-07)**	**(2.24e-07)**	**(2.59e-07)**	**(2.58e-07)**	**(2.20e-07)**	**(2.07e-07)**	**(2.20e-07)**	**(2.59e-07)**	**(2.59e-07)**	**(2.02e-07)**	**(1.85e-07)**	**(2.02e-07)**
TA	**-5.95e-07**	**-8.51e-07*** **	**-5.95e-07**	**-8.51e-07****	**-5.95e-07**	**-6.12e-07***	**-8.69e-07*****	**-6.12e-07**	**-8.69e-07****	**-6.12e-07**	**-6.43e-07***	**-9.20e-07*****	**-6.43e-07**	**-9.20e-07****	**-6.43e-07**
	(3.64e-07)	**(2.79e-07)**	**(5.71e-07)**	**(3.71e-07)**	**(5.71e-07)**	**(3.65e-07)**	**(2.80e-07)**	**(5.70e-07)**	**(3.66e-07)**	**(5.70e-07)**	**(3.66e-07)**	**(2.78e-07)**	**(5.41e-07)**	**(3.59e-07)**	**(5.41e-07)**
RET	**5.21e-06**	**6.71e-06***	**5.21e-06**	**6.71e-06**	**5.21e-06**	**5.25e-06**	**6.45e-06***	**5.25e-06**	**6.45e-06**	**5.25e-06**	**6.44e-06***	**8.03e-06****	**6.44e-06**	**8.03e-06***	**6.44e-06**
	(3.78e-06)	**(3.65e-06)**	**(4.67e-06)**	**(4.47e-06)**	**(4.67e-06)**	**(3.80e-06)**	**(3.68e-06)**	**(4.39e-06)**	**(4.22e-06)**	**(4.39e-06)**	**(3.79e-06)**	**(3.66e-06)**	**(4.43e-06)**	**(4.34e-06)**	**(4.43e-06)**
EBIT	**4.28e-05*****	**4.17e-05*****	**4.28e-05*****	**4.17e-05*****	**4.28e-05*****	**3.89e-05*****	**3.82e-05*****	**3.89e-05*****	**3.82e-05*****	**3.89e-05*****	**4.60e-05*****	**4.50e-05*****	**4.60e-05*****	**4.50e-05*****	**4.60e-05*****
	(8.94e-06)	**(8.83e-06)**	**(1.03e-05)**	**(1.01e-05)**	**(1.03e-05)**	**(9.19e-06)**	**(9.04e-06)**	**(1.08e-05)**	**(1.06e-05)**	**(1.08e-05)**	**(9.00e-06)**	**(8.90e-06)**	**(1.07e-05)**	**(1.05e-05)**	**(1.07e-05)**
TE	**-9.53e-06****	**-1.04e-05*****	**-9.53e-06****	**-1.04e-05*****	**-9.53e-06****	**-1.01e-05*****	**-1.07e-05*****	**-1.01e-05****	**-1.07e-05*****	**-1.01e-05****	**-9.19e-06****	**-1.00e-05*****	**-9.19e-06****	**-1.00e-05*****	**-9.19e-06****
	(3.73e-06)	**(3.59e-06)**	**(3.87e-06)**	**(3.68e-06)**	**(3.87e-06)**	**(3.77e-06)**	**(3.62e-06)**	**(3.86e-06)**	**(3.64e-06)**	**(3.86e-06)**	**(3.76e-06)**	**(3.62e-06)**	**(3.78e-06)**	**(3.55e-06)**	**(3.78e-06)**
TL	**-5.11e-08**	**-5.17e-08**	**-5.11e-08**	**-5.17e-08**	**-5.11e-08**	**-5.05e-08**	**-5.14e-08**	**-5.05e-08**	**-5.14e-08**	**-5.05e-08**	**-5.11e-08**	**-5.17e-08**	**-5.11e-08**	**-5.17e-08**	**-5.11e-08**
	(5.17e-08)	**(5.18e-08)**	**(4.28e-08)**	**(4.30e-08)**	**(4.28e-08)**	**(5.19e-08)**	**(5.20e-08)**	**(4.47e-08)**	**(4.47e-08)**	**(4.47e-08)**	**(5.21e-08)**	**(5.23e-08)**	**(4.33e-08)**	**(4.36e-08)**	**(4.33e-08)**
EAR	**1.78e-06**	**5.16e-07**	**1.78e-06**	**5.16e-07**	**1.78e-06**	**1.16e-06**	**-4.72e-08**	**1.16e-06**	**-4.72e-08**	**1.16e-06**	**1.76e-06**	**3.66e-07**	**1.76e-06**	**3.66e-07**	**1.76e-06**
	(2.29e-06)	**(2.17e-06)**	**(1.96e-06)**	**(1.81e-06)**	**(1.96e-06)**	**(2.32e-06)**	**(2.20e-06)**	**(2.21e-06)**	**(2.03e-06)**	**(2.21e-06)**	**(2.31e-06)**	**(2.19e-06)**	**(1.82e-06)**	**(1.68e-06)**	**(1.82e-06)**
VOLACDS	**-0.000397*****	**-0.000419*****	**-0.000397*****	**-0.000419*****	**-0.000397*****										
	(0.000120)	**(0.000120)**	**(0.000108)**	**(0.000111)**	**(0.000108)**										
CDSPX						**0.00345*****	**0.00353*****	**0.00345***	**0.00353***	**0.00345***					
						(0.00118)	**(0.00113)**	**(0.00188)**	**(0.00186)**	**(0.00188)**					
LOGCDS											**-2.704****	**-2.794****	**-2.704***	**-2.794***	**-2.704***
											(1.329)	**(1.334)**	**(1.575)**	**(1.627)**	**(1.575)**
Observations	**549**	**549**	**549**	**549**	**549**	**547**	**547**	**547**	**547**	**547**	**548**	**548**	**548**	**548**	**548**
R-squared	**0.125**		**0.125**		**0.125**	**0.121**		**0.121**		**0.121**	**0.113**		**0.113**		**0.113**
Number of firms	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(1) Fixed Effects Regression *(2) Random Effects Regression* *(3) Fixed Effects Regression Robust*
(4) Random Effects Regression Robust *(5) Fixed Effects Regression VCE(Robust)*

Table 9) Relation Between The Z-MODEL 1993 and the CDS explanatory variables

VARIABLES	(1) ZMODEL	(2) ZMODEL	(3) ZMODEL	(4) ZMODEL	(5) ZMODEL	(1) ZMODEL	(2) ZMODEL	(3) ZMODEL	(4) ZMODEL	(5) ZMODEL	(1) ZMODEL	(2) ZMODEL	(3) ZMODEL	(4) ZMODEL	(5) ZMODEL
WC	**4.69e-06*****	**4.61e-06*****	**4.69e-06*****	**4.61e-06*****	**4.69e-06*****	**4.60e-06*****	**4.51e-06*****	**4.60e-06*****	**4.51e-06*****	**4.60e-06*****	**4.79e-06*****	**4.71e-06*****	**4.79e-06*****	**4.71e-06*****	**4.79e-06*****
	(6.57e-07)	(6.52e-07)	(9.36e-07)	(9.39e-07)	(9.36e-07)	(6.61e-07)	(6.55e-07)	(9.56e-07)	(9.58e-07)	(9.56e-07)	(6.60e-07)	(6.55e-07)	(9.25e-07)	(9.27e-07)	(9.25e-07)
TA	**-2.44e-06****	**-2.36e-06*****	-2.44e-06	**-2.36e-06****	-2.44e-06	**-2.47e-06****	**-2.37e-06*****	-2.47e-06	**-2.37e-06****	-2.47e-06	**-2.54e-06*****	**-2.50e-06*****	-2.54e-06	**-2.50e-06****	-2.54e-06
	(9.66e-07)	(7.33e-07)	(1.69e-06)	(1.06e-06)	(1.69e-06)	(9.67e-07)	(7.35e-07)	(1.68e-06)	(1.06e-06)	(1.68e-06)	(9.70e-07)	(7.35e-07)	(1.63e-06)	(1.04e-06)	(1.63e-06)
RET	**2.63e-05*****	**2.97e-05*****	**2.63e-05****	**2.97e-05*****	**2.63e-05****	**2.60e-05****	**2.85e-05*****	**2.60e-05****	**2.85e-05*****	**2.60e-05****	**2.90e-05*****	**3.25e-05*****	**2.90e-05****	**3.25e-05*****	**2.90e-05****
	(1.00e-05)	(9.65e-06)	(1.20e-05)	(1.15e-05)	(1.20e-05)	(1.01e-05)	(9.70e-06)	(1.13e-05)	(1.08e-05)	(1.13e-05)	(1.00e-05)	(9.65e-06)	(1.17e-05)	(1.13e-05)	(1.17e-05)
EBIT	**5.97e-05*****	**5.25e-05****	**5.97e-05****	**5.25e-05****	**5.97e-05****	**4.75e-05****	**4.06e-05***	**4.75e-05***	**4.06e-05***	**4.75e-05***	**6.69e-05*****	**5.98e-05*****	**6.69e-05*****	**5.98e-05*****	**6.69e-05*****
	(2.23e-05)	(2.18e-05)	(2.39e-05)	(2.27e-05)	(2.39e-05)	(2.32e-05)	(2.26e-05)	(2.53e-05)	(2.42e-05)	(2.53e-05)	(2.23e-05)	(2.19e-05)	(2.41e-05)	(2.28e-05)	(2.41e-05)
TE	-1.24e-05	**-1.79e-05****	-1.24e-05	**-1.79e-05***	-1.24e-05	-1.49e-05	**-1.99e-05****	-1.49e-05	**-1.99e-05****	-1.49e-05	-1.16e-05	**-1.72e-05****	-1.16e-05	**-1.72e-05***	-1.16e-05
	(9.09e-06)	(8.59e-06)	(1.06e-05)	(9.45e-06)	(1.06e-05)	(9.23e-06)	(8.68e-06)	(1.01e-05)	(9.05e-06)	(1.01e-05)	(9.15e-06)	(8.64e-06)	(1.04e-05)	(9.28e-06)	(1.04e-05)
TL	-6.93e-08	-7.39e-08	-6.93e-08	-7.39e-08	-6.93e-08	-6.90e-08	-7.39e-08	-6.90e-08	-7.39e-08	-6.90e-08	-6.95e-08	-7.41e-08	-6.95e-08	-7.41e-08	-6.95e-08
	(1.37e-07)	(1.37e-07)	(1.02e-07)	(1.01e-07)	(1.02e-07)	(1.38e-07)	(1.37e-07)	(1.04e-07)	(1.03e-07)	(1.04e-07)	(1.38e-07)	(1.38e-07)	(1.02e-07)	(1.01e-07)	(1.02e-07)
VOLACDS	**-0.000897*****	**-0.000939*****	**-0.000897*****	**-0.000939*****	**-0.000897*****										
	(0.000319)	(0.000318)	(0.000297)	(0.000301)	(0.000297)										
CDSPX						**0.00856*****	**0.00913*****	**0.00856***	**0.00913***	**0.00856***					
						(0.00309)	(0.00297)	(0.00495)	(0.00484)	(0.00495)					
LOGCDS											**-6.180***	**-6.341***	**-6.180***	**-6.341***	**-6.180***
											(3.514)	(3.508)	(3.672)	(3.739)	(3.672)
Observations	549	549	549	549	549	547	547	547	547	547	548	548	548	548	548
R-squared	0.162		0.162		0.162	0.162		0.162		0.162	0.154		0.154		0.154
Number of firms	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

Standard errors in parentheses — *(1) Fixed Effects Regression* — *(2) Random Effects Regression* — *(3) Fixed Effects Regression Robust*

*** p<0.01, ** p<0.05, * p<0.1 — *(4) Random Effects Regression Robust* — *(5) Fixed Effects Regression VCE(Robust)*

Table 10) Relation Between The O-score 1980 and the CDS explanatory variables

VARIABLES	(1) OSCORE	(2) OSCORE	(3) OSCORE	(4) OSCORE	(5) OSCORE	(1) OSCORE	(2) OSCORE	(3) OSCORE	(4) OSCORE	(5) OSCORE	(1) OSCORE	(2) OSCORE	(3) OSCORE	(4) OSCORE	(5) OSCORE
TA	-2.75e-07	-9.37e-08	-2.75e-07	-9.37e-08	-2.75e-07	-1.87e-07	-8.35e-08	-1.87e-07	-8.35e-08	-1.87e-07	-2.69e-07	-7.44e-08	-2.69e-07	-7.44e-08	-2.69e-07
	(6.93e-07)	(1.01e-07)	(4.79e-07)	(1.15e-07)	(4.79e-07)	(6.96e-07)	(9.79e-08)	(4.71e-07)	(1.14e-07)	(4.71e-07)	(6.92e-07)	(9.74e-08)	(4.50e-07)	(1.12e-07)	(4.50e-07)
GNP	-2.89e-07	1.04e-09	-2.89e-07	1.04e-09	-2.89e-07	-1.24e-07	1.52e-08	-1.24e-07	1.52e-08	-1.24e-07	-3.06e-07	-3.25e-09	-3.06e-07	-3.25e-09	-3.06e-07
	(2.90e-07)	(5.17e-08)	(2.77e-07)	(5.05e-08)	(2.77e-07)	(3.14e-07)	(5.68e-08)	(2.67e-07)	(6.07e-08)	(2.67e-07)	(2.83e-07)	(5.17e-08)	(2.63e-07)	(5.05e-08)	(2.63e-07)
WC	-4.77e-07	-3.15e-07	-4.77e-07	-3.15e-07	-4.77e-07	-4.56e-07	-2.74e-07	-4.56e-07	-2.74e-07	-4.56e-07	-4.81e-07	-3.10e-07	-4.81e-07	-3.10e-07	-4.81e-07
	(5.11e-07)	(3.83e-07)	(4.60e-07)	(4.48e-07)	(4.60e-07)	(5.11e-07)	(3.87e-07)	(3.91e-07)	(4.47e-07)	(3.91e-07)	(5.11e-07)	(3.84e-07)	(4.36e-07)	(4.40e-07)	(4.36e-07)
CL	-1.50e-07	3.09e-08	-1.50e-07	3.09e-08	-1.50e-07	-1.69e-07	1.77e-08	-1.69e-07	1.77e-08	-1.69e-07	-1.87e-07	3.16e-09	-1.87e-07	3.16e-09	-1.87e-07
	(6.20e-07)	(5.80e-07)	(4.63e-07)	(4.32e-07)	(4.63e-07)	(6.20e-07)	(5.81e-07)	(4.62e-07)	(4.30e-07)	(4.62e-07)	(6.19e-07)	(5.80e-07)	(4.72e-07)	(4.27e-07)	(4.72e-07)
CA	-1.07e-06**	-9.98e-07**	-1.07e-06***	-9.98e-07***	-1.07e-06***	-1.11e-06**	-1.01e-06**	-1.11e-06***	-1.01e-06***	-1.11e-06***	-1.02e-06**	-9.50e-07**	-1.02e-06***	-9.50e-07***	-1.02e-06***
	(5.03e-07)	(4.79e-07)	(3.33e-07)	(3.24e-07)	(3.33e-07)	(5.04e-07)	(4.80e-07)	(3.36e-07)	(3.23e-07)	(3.36e-07)	(5.04e-07)	(4.80e-07)	(3.35e-07)	(3.23e-07)	(3.35e-07)
NI	-2.92e-05*	-2.96e-05**	-2.92e-05**	-2.96e-05**	-2.92e-05**	-2.86e-05*	-2.98e-05**	-2.86e-05**	-2.98e-05**	-2.86e-05**	-3.00e-05**	-3.01e-05**	-3.00e-05**	-3.01e-05**	-3.00e-05**
	(1.50e-05)	(1.41e-05)	(1.42e-05)	(1.34e-05)	(1.42e-05)	(1.49e-05)	(1.41e-05)	(1.41e-05)	(1.34e-05)	(1.41e-05)	(1.49e-05)	(1.41e-05)	(1.41e-05)	(1.34e-05)	(1.41e-05)
OCF	-3.90e-06	-3.83e-06	-3.90e-06*	-3.83e-06*	-3.90e-06*	-4.23e-06	-4.04e-06	-4.23e-06**	-4.04e-06*	-4.23e-06**	-3.58e-06	-3.45e-06	-3.58e-06	-3.45e-06*	-3.58e-06
	(3.73e-06)	(3.53e-06)	(2.05e-06)	(2.07e-06)	(2.05e-06)	(3.73e-06)	(3.55e-06)	(2.05e-06)	(2.08e-06)	(2.05e-06)	(3.73e-06)	(3.53e-06)	(2.13e-06)	(2.07e-06)	(2.13e-06)
TL	1.58e-06***	1.47e-06***	1.58e-06***	1.47e-06***	1.58e-06***	1.60e-06***	1.48e-06***	1.60e-06***	1.48e-06***	1.60e-06***	1.57e-06***	1.46e-06***	1.57e-06***	1.46e-06***	1.57e-06***
	(3.47e-07)	(3.29e-07)	(2.14e-07)	(1.95e-07)	(2.14e-07)	(3.48e-07)	(3.30e-07)	(2.13e-07)	(1.98e-07)	(2.13e-07)	(3.47e-07)	(3.29e-07)	(2.14e-07)	(1.91e-07)	(2.14e-07)
VOLACDS	-2.78e-05	0.000133	-2.78e-05	0.000133	-2.78e-05										
	(0.000247)	(0.000219)	(0.000203)	(0.000162)	(0.000203)										
CDSPX						-0.00294	-0.000856	-0.00294*	-0.000856	-0.00294*					
						(0.00232)	(0.00111)	(0.00171)	(0.000973)	(0.00171)					
LOGCDS											-3.581	-3.445	-3.581	-3.445	-3.581
											(2.645)	(2.580)	(2.869)	(2.838)	(2.869)
Observations	542	542	542	542	542	540	540	540	540	540	541	541	541	541	541
R-squared	0.171		0.171		0.171	0.175		0.175		0.175	0.175		0.175		0.175
Number of firms	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

Standard errors in parentheses — *(1) Fixed Effects Regression* — *(2) Random Effects Regression* — *(3) Fixed Effects Regression Robust*

*** p<0.01, ** p<0.05, * p<0.1 — *(4) Random Effects Regression Robust* — *(5) Fixed Effects Regression VCE(Robust)*

Estimates of coefficients of the annual time-series regression of the Grade Score model of ZSCORE1 where:

$$GSZ1_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 BVL_{i,t} + \beta_6 EAR_{i,t} + \beta_7 ZSCORE1_{i,t} + \varepsilon_{i,t} \quad (16)$$

Where ZSCORE1 is calculated as follows Z-Score=1.2*Tt1+1.4*T2+3.3*T3+0.6*T4+0.999T5 (1968), and were WC is the working capital , TA is the total Assets , RET is the retained earnings , MKTCAP is the market capitalization, BVL is Book Value of the Liabilities, EAR is the Earnings the former variables are used as control variables
As explanatory variables we use the ZSCORE1 as previously described above.

Table 13 Relation Between the Grade Score and Z-Score model (1968)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
VARIABLES	**GSZ1**	**GSZ1**	**GSZ1**	**GSZ1**	**GSZ1**
WC	3,22e-07	1,90e-07	3,22e-07	1,90e-07	3,22e-07
	(3,25e-07)	(3,20e-07)	(3,76e-07)	(3,47e-07)	(3,76e-07)
TA	-1,69e-05***	-1,85e-05***	-1,69e-05**	-1,85e-05***	-1,69e-05**
	(4,70e-06)	(4,40e-06)	(7,87e-06)	(7,05e-06)	(7,87e-06)
RET	2,59e-05***	2,68e-05***	2,59e-05***	2,68e-05***	2,59e-05***
	(4,78e-06)	(4,40e-06)	(9,59e-06)	(8,60e-06)	(9,59e-06)
EBIT	6,61e-05***	6,20e-05***	6,61e-05***	6,20e-05***	6,61e-05***
	(1,20e-05)	(1,18e-05)	(1,38e-05)	(1,36e-05)	(1,38e-05)
MKTCAP	2,52e-06	2,46e-06	2,52e-06	2,46e-06	2,52e-06
	(2,05e-06)	(2,01e-06)	(3,25e-06)	(3,20e-06)	(3,25e-06)
BVL	1,56e-05***	1,69e-05***	1,56e-05*	1,69e-05**	1,56e-05*
	(4,85e-06)	(4,50e-06)	(7,99e-06)	(7,04e-06)	(7,99e-06)
EAR	-3,35e-06	-4,11e-06	-3,35e-06	-4,11e-06	-3,35e-06
	(2,87e-06)	(2,55e-06)	(4,00e-06)	(3,10e-06)	(4,00e-06)
ZSCORE1	0,426***	0,477***	0,426**	0,477***	0,426**
Observations	549	549	549	549	549
R-squared	0.404		0.404		0.404
Number of firms	50	50	50	50	50

Standard errors in parentheses

****** p<0.01, ** p<0.05, * p<0.1***

(1) Fixed Effects
(2) Random Effects
(3) FE Robust
(4) RE Robust
(5) FE VCE (Robust)

Estimates of coefficients of the annual time-series regression of the Grade Score model of ZSCORE2 where:

$$GSZ2_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 EAR_{i,t} + \beta_8 ZSCORE2_{i,t} + \varepsilon_{i,t} \quad (17)$$

Where ZSCORE2 is calculated as follows Z-Score"=0.717*T1+0.847*T2+3.107*T3+0.420*T4+0.998*T5 (1983) and were WC is the working capital , TA is the total Assets , RET is the retained earnings , EBIT is the Earnings before Interest and Taxes, TE is Total equity , TL is the Total Liabilities, EAR is the Earnings. The former variables are used as control variables.

As explanatory variables we use the ZSCORE2 as previously described.

Table 14) Relation Between the Grade Score and Z-Score' model (1983)

VARIABLES	*(1)* GSZ2	*(2)* GSZ2	*(3)* GSZ2	*(4)* GSZ2	*(5)* GSZ2
WC	9,44e-08	-5,22e-09	9,44e-08	-5,22e-09	9,44e-08
	(2,76e-07)	(2,73e-07)	(2,74e-07)	(2,53e-07)	(2,74e-07)
TA	-7,70e-07**	-9,54e-07***	-7,70e-07	-9,54e-07***	-7,70e-07
	(3,90e-07)	(2,33e-07)	(7,12e-07)	(3,61e-07)	(7,12e-07)
RET	1,70e-05***	1,76e-05***	1,70e-05**	1,76e-05**	1,70e-05**
	(4,03e-06)	(3,71e-06)	(7,43e-06)	(6,95e-06)	(7,43e-06)
EBIT	6,03e-05***	5,56e-05***	6,03e-05***	5,56e-05***	6,03e-05***
	(9,78e-06)	(9,44e-06)	(1,47e-05)	(1,33e-05)	(1,47e-05)
TE	-1,60e-05***	-1,64e-05***	-1,60e-05**	-1,64e-05***	-1,60e-05**
	(4,01e-06)	(3,68e-06)	(6,43e-06)	(5,69e-06)	(6,43e-06)
TL	9,03e-08	9,54e-08*	9,03e-08	9,54e-08*	9,03e-08
	(5,54e-08)	(5,58e-08)	(5,74e-08)	(5,37e-08)	(5,74e-08)
EAR	3,00e-07	-1,26e-06	3,00e-07	-1,26e-06	3,00e-07
	(2,45e-06)	(2,16e-06)	(3,42e-06)	(2,69e-06)	(3,42e-06)
ZSCORE2	0,679***	0,767***	0,679***	0,767***	0,679***
	(0,0478)	(0,0426)	(0,252)	(0,226)	(0,252)
Observations	549	549	549	549	549
R-squared	0,467		0,467		0,467
Number of firms	50	50	50	50	50

Standard errors in parentheses

****** p<0.01, ** p<0.05, * p<0.1***

(1) Fixed Effects
(2) Random Effects
(3) FE Robust
(4) RE Robust
(5) FE VCE (Robust)

Estimates of coefficients of the annual time-series regression of the Grade Score model of ZMODEL where:

$$GSZ3_{i,t} = \beta_0 + \beta_1 WC_{i,t} + \beta_2 TA_{i,t} + \beta_3 RET_{i,t} + \beta_4 EBIT_{i,t} + \beta_5 TE_{i,t} + \beta_6 TL_{i,t} + \beta_7 ZMODEL_{i,t} + \varepsilon_{i,t} \quad (18)$$

Where ZMODEL is calculated as follows Z-MODEL= 6.56*T1+3.26*T2+6.72*T3+1.05*T4 (1993) and were WC is the working capital, TA is the total Assets, RET is the retained earnings, EBIT is the Earnings before Interest and Taxes, TE is Total equity, TL is the Total Liabilities, the former variables are used as control variables.
As explanatory variables we use the ZMODEL as previously described

Table 15) Relation Between The Grade Score and Z-Model (1993)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
VARIABLES	**GSZ3**	**GSZ3**	**GSZ3**	**GSZ3**	**GSZ3**
WC	3,92e-06***	3,85e-06***	3,92e-06***	3,85e-06***	3,92e-06***
	(4,23e-07)	(4,14e-07)	(1,12e-06)	(1,13e-06)	(1,12e-06)
TA	-2,22e-06***	-1,93e-06***	-2,22e-06	-1,93e-06**	-2,22e-06
	(5,94e-07)	(3,92e-07)	(1,68e-06)	(8,19e-07)	(1,68e-06)
RET	3,11e-05***	3,25e-05***	3,11e-05**	3,25e-05**	3,11e-05**
	(6,17e-06)	(5,78e-06)	(1,38e-05)	(1,27e-05)	(1,38e-05)
EBIT	5,15e-05***	4,78e-05***	5,15e-05**	4,78e-05**	5,15e-05**
	(1,37e-05)	(1,32e-05)	(2,29e-05)	(2,19e-05)	(2,29e-05)
TE	-1,11e-05**	-1,40e-05***	-1,11e-05	-1,40e-05	-1,11e-05
	(5,56e-06)	(5,09e-06)	(1,22e-05)	(1,10e-05)	(1,22e-05)
TL	2,07e-07**	2,09e-07**	2,07e-07***	2,09e-07***	2,07e-07***
	(8,42e-08)	(8,40e-08)	(7,27e-08)	(7,13e-08)	(7,27e-08)
ZMODEL	0,255***	0,274***	0,255***	0,274***	0,255***
	(0,0274)	(0,0253)	(0,0875)	(0,0841)	(0,0875)
Observations	549	549	549	549	549
R-squared	0,435		0,435		0,435
Number of firms	50	50	50	50	50

Standard errors in parentheses

****** p<0.01, ** p<0.05, * p<0.1***

(1) Fixed Effects
(2) Random Effects
(3) FE Robust
(4) RE Robust
(5) FE VCE (Robust)