JÖNKÖPING INTERNATIONAL BUSINESS SCHOOL
JÖNKÖPING UNIVERSITY
SWEDBANK MARKETS/FIXED INCOME

# WHAT FACTORS ARE DRIVING FORCES FOR CREDIT SPREADS?

**-ILLUSTRATES CONNECTION WITH MARKET VOLATILITY, S&P 500 INDEX, INTEREST RATE LEVEL, THE SLOPE OF THE CURVE.**

Bacholor's thesis in Finance

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Bachelor's Thesis in Finance

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## Abstract

The purpose of this study is to examine what affects the changes in credit spreads. A regression model was performed where the explanatory variables were; volatility, SP&500 index, interest-rate level the slope of yield curve and the dependent variable was credit spread for each of CSUSDA, CSUSDBBB, and CSUSDB. We found a positive correlation between these independent variables (Volatility, S&P 500index) and a negative correlation between interest-rate level and credit spreads. These results were consistent with our hypothesis. However, the link between the slope of yield curve and credit spreads was positive and that was inconsistent with our hypothesis and some previous studies. The conclusion of this paper was a change in credit spread is related to the variables that we used in our model. And these variables explained about 50 per cent of this change.

## Acknowledgements

I would like to thank my tutors, Dr. Ghazi Shukur (Professor of Statistics) and Dr. Per-Olof Bjuggren (Professor of Economics) for their valuable advice. I am also grateful to Dr. Alireza Nasseh **(**professor of Finance at John Cook School of Business in St.Louis, USA) and Dr. Olgun Fuat Sahin (Professor-assistant of Finance at John Cook School of Business in St.Louis, USA) for their assistance. Finally, I would like to thank Swedbank for giving this opportunity to do this interesting project. Many thanks to Tomas Hedberg and Rickard Skogsfors, Swedbank Markets, for their constructive, valuable contributions.

Kandidatuppsats inom finans.

Titel: **Vilka faktorer påverkar kreditspread?**

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Handledare: Ghazi Shukur, Per-Olof Bjuggren

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## Sammanfattning

Denna kandidatuppsats behandlar ämnet om hur kreditspread kan påverkas av olika faktorer. SPSS-program användes och en regressionmodell utfördes vid analysering av kreditspread. Fyra oberoende variabler ”volatility, S&P 500 index, interest-rate level and the slope of yield curve” undersöktes for att kunna förklara förändringen i kreditspread av kreditvärdighet för varje av CSUSDA, CSUSDBBB och CSUSDB. Resultatet var att det fanns en positiv korrelation mellan kreditspread och dessa oberoende varaiblerna ” Volatility, SP&500”. Däremot fanns det en negativ korrelation mellan kreditspread och räntesaten. Dessa resultat stämde med vår hypotes. Emellertid var korrelationen positiv mellan ”slope of yield curve” och kreditspread och det var inkonsekvent med vår hypotes och några föregående studier. Den slutsats som uppsatsen resulterade i underströk att en del av förändringen i kreditspread var relaterad till de variablerna som vi undersökte i vår modell och dessa variablerna förklara cirka 50 per cent of förändringen.

## Tack

Jag tackar mina handledare, Dr. Ghazi Shukur (professor av statistik) och Dr. Per-Olof Bjuggren (professor av nationalekonomi) för deras värdefulla råd och synpunkter. Jag är också tacksam till Dr. Alireza Nasseh (professor i finans på John Cook School of Business in St. Louis, USA ) och Dr. Olgun Fuat Sahin (Professor-assistent i finans på John Cook School of Business in St. Louis, USA), för deras hjälp. Slutligen vill jag tacka Swedbank för att ha gett mig möjlighet att göra detta som ett mycket intressant projekt och även tack till Tomas Hedberg och Rickard Skogsfors, Swedbank Markets, för deras konstruktiva synpunkter och värdesakbidrag.

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# 1 Introduction

*This chapter of the thesis will give the reader an introduction to the topic of credit spreads and the background for our choices of subject. The problem discussion is followed by the purpose of the thesis. Finally we will clarify the delimitations of the thesis.*

*"Bonds are the most elegant financing that a company can achieve. By being active in the trading of the bonds, the company can affect its effective interest rate. Hallgren, 1990, cited in Sjögren, 1993, p.247"*

Corporate bonds issued by companies as an instrument that can be used to keep the company's cost of debt down on the primary market. Those bonds can be bought by anyone and then sold on the secondary market, just like stocks or any other security. The bondholder is entitled to receive a certain return from the issuing company based upon the interest rate of the bond. But as always, when there is a return, there is also a certain level of risk the investor has to bear. The bondholder has to accept the risk that if the company defaults, it will not be able to carry out promised coupon payments or maybe even not able to repay the principal (Bodie et al., 2004).

When the issuer of a bond will fail to pay interest and repayment of the amount that was borrowed is called default risk and it is a type of credit risk. One can estimate default risk by looking at the credit rating of bonds. Credit risk includes other kinds of risks that can also affect the investment of bonds. For example, the concern that market value of a bond issue will decrease or the performance of relative price of a bond issue will not be as good as other bond issues that an investor compares against. The yield of a bond issue is consisted of two parts. The yield on a similar maturity Treasury issue and a premium to compensate for the extra risks that are taken with the bond issue that do not include in a Treasury issue-this is also called a spread. The part of the risk premium or spread that is related to default risk is called *credit spread. (*Fabozzi, 2006)

The analytical framework of this paper is related to a previous paper examining credit spreads in the light of the structural framework. The paper is written by Collin-Dufresne; S.Goldstein and J. Martin. They studied the determinants of credit spread changes. They used a loglinear regression model to regress corporate bond spreads on proxies for the spot rate, slope of the yield curve, leverage, volatility, and the magnitude and probability of a downward jump in firm value and the business climate as explanatory variables. (Pieere

Collin-Dufresne; Robert S. Goldstein; J. Spencer Martin, the Journal of Finance, Vol 56, No. 6. 2001, pp. 2177-2207).

## 1.1 Background

Recent financial studies have been devoted to the risk and return of different financial instruments at the various levels. Investors have always expressed interest in knowing what returns they may receive from taking different levels of risks. Therefore economists have investigated this dilemma in order to find relevant measurements to answer different kinds of questions regarding estimations and predictions of risk and return.

A few previous studies have focused on corporate bond returns or yield changes. Other researches within financial markets investigated the connection between bond and stock return at different levels. Most investigations about corporate bonds have been conducted in the United States.

This thesis is based on the theoretical aspect of the structural Models that were developed by Robert Merton (1974). He extended the model that was developed by Fischer Black and Myron Scholes in 1973 to analyze how the model can be used in order to be able to estimate credit risky issues such as corporate bonds. (Robert Merton “journal of Finance, 29 (1974), pp. 449-470)

## 1.2 Problem Discussion

The factors beyond yield changes have been widely investigated at the aggregate level and at the firm level. Various investigations have been tested to develop models to explain the factors behind bond yields. However, there remains limitation of knowledge about the drivers behind credit spread movements. The main reason is models of credit spreads are a new field of research which is why the evidence on the determinants of driving forces for credit spreads is not as strong as on bond yield driving forces.

Due to the limitations of knowledge about factors affecting credit spreads as mentioned before, Swedbank Markets (the finance Department of Swedbank) was interested in finding out how credit spreads can be affected by different macroeconomics and microeconomics factors. This was a starting point for this thesis as it sparked our interest in the subject. Therefore this thesis was based on an assignment from Swedbank Markets.

From the time we started to cooperate with Swedbank Markets we had discussions about relevant macroeconomic as well as microeconomics factors that could be included in the investigation in order to analyze credit spreads. The discussions led us to choose some factors that are volatility, S&P 500[1], interest-rate level and the slope of yield curve.

The choice of this subject was based on many reasons; there has not been much research about credit spread and also, it is a highly actual subject, availability of data and also personal interest that influenced our choice of topic.

### 1.3 Research question

Aiming to narrow down, and focusing our research, we formulate a research question that would help us create the purpose.

The research question is:
What are the driving forces for credit spreads? – This study is limited to the description and the analyses of the connection between credit spreads and the following variables that are mentioned before: *volatility, S&P 500, interest-rate level and the slope of the yield curve.*

### 1.4 Purpose

The purpose of this paper is to describe and analyze the driving forces of the following factors (volatility, S&P 500, interest-rate level and the slope of yield curve) behind credit spreads.

[1] An index consisting of 500 stocks chosen for market size, liquidity and industry grouping, among other factors. The S&P 500 is designed to be a leading indicator of U.S. equities and is meant to reflect the risk/return characteristics of the large-cap universe. (http://www.answers.com/topic/s-p-500?cat=biz-fin)

## 1.5 Delimitations

This subject would be an endless field of research if we take in account all factors that can affect credit spreads. It would be an impossible task to analyze all relevant factors and therefore, we decide to limit this study in some aspects. Thus, we decided to analyze the connection between credit spreads and only four relevant factors. We also decided to do so since Swedbank Markets is a trustworthy source and due to the availability of data that were obtained from Bloomberg through Swedbank Markets.

We have decided to focus on analyzing credit spread and how it related to *volatility, S&P 500, interest-rate level and the slope of yield curve* since we and Swedbank Markets believe that these factors might have a significant impact on the credit spread. Moreover, this thesis has its central point in Finance, focusing on credit spread and that is why we did not put any further emphasis on explaining bonds and how these financial instrument work.

## 1.6 The structure of this thesis

| Chapter | Title | Content |
|---|---|---|
| *(1)* | *Introduction* | *This chapter of the thesis will give the reader an introduction to the topic of credit spreads and the background for our choices of subject. The problem discussion is followed by the purpose of the thesis. Finally we will clarify the delimitations of the thesis* |
| *(2)* | *Theoretical Framework* | *This chapter gives a presentation of some definitions and concepts that needed for understanding credit spread. The findings of previously made studies are presented. Further, the suitable theory for this study is presented* |
| *(3)* | *Method* | *In this chapter we present a discussion about the choice of method and how the study was conducted. The chapter ends with Reliability and validity.* |
| *(4)* | *Empirical Study* | *In this chapter a hypothesis is presented and the results of the study are also presented.* |
| *(5)* | *Analysis* | *In this chapter, the theoretical framework and the empirical data are combined in order to analyze the topic according to the purpose of the thesis.* |
| *(6)* | *Conclusion* | *This chapter reviews the conclusion of the thesis. The purpose of the thesis is fulfilled through the analysis in the previous chapter. Finally, suggestions for further studies are presented.* |

# 2 Theoretical Framework

*This chapter gives a presentation of some definitions and concepts that needed for understanding credit spread. The findings of previously made studies are presented. Further, the suitable theory for this study is presented.*

## 2.1 Credit risk

An investor takes one or more of these risks when investing in bonds: credit risk, liquidity risk, volatility risk, interest rate risk, inflation risk, reinvestment risk, call risk, yield curve risk, event risk, tax risk and exchange-rate risk. Due to the focus on credit spread in this thesis, some risks that are related directly to the credit spread will be explained briefly below. (Lecture notes, Fixed Income Market class, John Cook School of Business, USA, 2006)

### 2.1.1 Risks related to investments of bonds

The price changes of a non-Treasury debt obligation and its earning over some investment period will be influenced by how the credit spread of a bond issue varies. The increase of the credit spread lead to a decrease in the market price of the bond issue, with other words “the spread has widened”. The risk that the credit spread increases and a bond issue will decline is referred to credit spread risk. An improvement of credit rating of an issuer is compensated with a better credit rating and this is called upgrade. On the other hand, deterioration in the credit rating of an issuer leads to an inferior credit rating-referred to as downgrade. An unexpected downgrading of an issuer raises the credit spread and the outcome of that is a decrease in the price of debt obligation. This risk is called downgrade risk. Thus, credit risk is based on three kinds of risk which are default risk, credit spread and downgrade risk. (Fabozzi, 2006)

### 2.1.2 Credit market and credit spread

**Credit market;** There are two kinds of markets for Corporate Bonds. The primary market is for newly issued securities. Primary market transactions provide capital to the issuer. The

secondary market is the market in which outstanding securities are traded. In other words, it is an over-the counter, dealer market. Transactions in this market provides only liquidity to the investors and the "bid-ask" spread corresponds to dealers' profit. The classification of corporate bond is based on the type of issuer. There are four general classifications; public utilities, transportations, industrials and banks/finance. Today, corporate bonds are a part of the credit sector of the bond indexes. Corporate bonds are subdivided into utility, finance subsectors and industrial. (Fabozzi, 2006)

### 2.1.3 Credit rating

Corporate bond ratings describe the credit quality of a bond issue and taking into consideration the estimated probability of default. In addition, it helps investors to see if bond issuers will be able to fulfill their future contractual obligations. (Fabozzi, 2006) Some investment banking firms have their own credit analysis departments. But there are few institutional bond investors who rely on rating companies that make credit analysis and give out their conclusions in form of ratings. There are several bond ratings agencies as Moody's, Fitch's and Standard and Poor's. Moody's investors' service design high-grade bonds by the letters Aaa. But other agencies design high-grade bonds as AAA. Aa or AA follows as the next highest grade. Then all the three agencies use A as the third grade. Baa or BBB are designed for lower medium grade. A rating of BB or lower is assigned to be speculative. Corporate bonds market can therefore be divided into investment-grade bonds market (with an assigned rating of AAA or BBB) and non-investment-grade bonds market or popularly as high-yield bonds (with a rating of BB or lower). (Fabozzi, 2006)

A study published in 2001 by Ilia Dichev & Joseph Piotroski disclosed some interesting findings about stock investing and bond ratings. The conclusion of this study was that Stocks of companies with credit rating downgrades underperforms the broad stock market by 10-14 percentage points during the first year following the downgrade. The worst performing stocks of this group are small firms that have low credit quality to begin with! (Ilia Dichev & Joseph Piotroski: "The long-run stock returns following bond ratings changes" The Journal of Finance (Feb. 2001) Pages 173-203). The implication of this is that it apparently pays to

take a short position in the stock of a company immediately after its bond rating is lowered and this involved the time period until 2001.

### 2.1.4 Credit risk models & credit rating

According to Van Denenter of Kamakura Corporation, a vendor of credit risk models is not to simply rely on credit ratings as a forecaster of default. This is due to the following reasons which include; ratings are discrete with a limited number of rating grades. In contrast, default probability continues and ranges from 0% to 100%. While ratings are updated very infrequently, default probabilities can be estimated on real-time basis. Finally, there is no clear maturity for a credit rating. While there is a separate short-and long-term credit rating, credit risk models provide a default probability by maturity, for instance, term structure of default probabilities. (Fabozzi, 2006)

### 2.1.5 Credit risk models

Credit risk models are used in fixed income analysis. These models are categorized as either structural models or reduced-form models. Structural model is also called (BSM)[2] due to grounders of these models; Black- Scholes-Merton (1973These models are used for controlling, measuring and predicting portfolio's credit risk. Both structural models and reduced-form models assume that the information reported by the issuing corporations is accurate. However, corporate bankruptcies in recent years that have been attributable to fraud and opaque/inaccurate financial accounting data have made practitioners aware that when modeling credit risk, there must be consideration of the possibility that information is imperfect. This has led to the development of incomplete information models. One such model that combines the structural and reduced-form models but incorporates incomplete information has been proposed by Giesecke and Goldberg. (Fabozzi, 2006)

[2] Henceforth BSM.

## 2.2 Historical background of BSM

Structural models were developed by Merton (1974) and the model is based on a previous model for the pricing of options on stock by Fischer Black and Myron Scholes (1973). In the first half of the 1970s, Black, Scholes and Merton presented the fundamental theory to explain structural models (BSM). The basic idea is that a company defaults on its debt if the value of its assets falls below a certain default point and that the value of a corporate bond can be modeled as an option on these assets. Because of this, structural models are also known as "firm-value models. (Fabozzi, 2006) For further information about structural models, see (Fischer Black and Myron Scholes, "the pricing of option and Corporate Liabilities, "Journal of Political Economy, 81 (1973), pp.637-654)

According to Wesley Phoa of Capital Groups Companies, structural models have been used by bond portfolio mangers in one or more of the following ways: to forecast changes in corporate bond credit spreads, to evaluate sensitivity of corporate bond credit spreads to equity prices and to estimate a corporate bond's default risk, to predict rating changes. (Westly Phoa, "Implications of Merton Models for Corporate Bond Investors," Chapter 16 in Fabozzi, 2006)

## 2.3 Extension of (BSM) and previously made studies

Structural models were developed by Merton (1974), BSM model has been extended and modified. Studies showed that BSM model can occur not only at maturity but at any time before maturity date. The underlying legal principle here is that there are typically covenants in a typical bond indenture granting the bondholders the right to restructure the corporation should the value of corporate assets fall below a given amount, referred to as a default barrier and this explained by Black and Cox (1976). (Fabozzi, 2006) In all of these models, a company is supposed to default when the value of its assets reaches a certain threshold level.

Litterman and Scheinkman (1991) explained that most differences in the term structure of American Treasury yields could be illustrated by terms of the level of the yield curve and its slope. Here, they used a measurement of the yield curve by the three-month T-bill yield.

In 1995, Longstaff and Schwartz developed the study of Black and Coz (1976). They explained two-factor valuation illustrations for floating-rate and fixed-rate bonds. Then it was tested by taking advantage of monthly corporate bond yield data from different Moody's index. The output of this study was that the relation between credit spread and the return on a company's assets is negative and even to the risk-free interest rate. Longstaff and Schwartz showed that the interest level clarify more of the variation in credit spreads than what returns on the assets of a firm. There is another important aspect of this paper that the negatively correlation between the firm's assets and the interest rate level can have important effect on the credit spread. This correlation is different among various industry sectors. Therefore we see there is a broad different credit spreads among companies which operate in various industries but have the same credit rating and this is an significant extension of the Merton model (1974), which showed that credit spreads is only depended on default risk, with no respect to industry.

Collin-Dufresne et al. (2001) investigated changes in credit spreads on individual bond yields. The output was that aggregate factors seem to be more important than firm specific factors in verifying credit spread changes. And most of the variation in credit spreads of individual bonds is showed by an aggregate factor general to all corporate bonds.

Leake (2002) investigated if changes in the slope of the UK risk-free yield curve affect the yield spread of data on investment-grade UK corporate bonds. But he did not find any connection and drew the conclusion that credit spreads are driven by aspects like liquidity and risk aversion, instead of default risk.

Various software companies have also developed credit risk models build on structural models, for instance, Moody's KMV model and RiskMetric Group's Credit Grades. The default is modeled in these approaches by using large databases of historical data.

## 2.4 BSM and theoretical elements of Credit spreads changes

Structural models give information about how to hedge the default risk that was not acquired from traditional approaches. It also illustrates the credit risk of a corporate bond as a function of the volatility of the issuer's assets and the issuer's leverage. Furthermore, it shows whether the theoretical determinants of credit spreads should be positively or negatively correlated with movements in credit spreads. (Pieere Collin-Dufresne; Robert S. Goldstein; J. Spencer Martin, the Journal of Finance, Vol 56, No. 6. 2001, pp. 2177-2207). The output of these models also provides information about how to hedge the default risk, which was not obtainable from traditional methods. (Fabozzi, 2006)

As the credit spread CS(t) is uniquely defined through: (1) the price of a debt claim, (2) this debt claim's structural cash flows, and (3) the (appropriate) risk-free rate, we can write CS(t) = CS ($V_t$, $r_t$, $\{X_t\}$), where V is firm value, r is the spot rate, and $\{X_t\}$ represents all of the other "state variables" that are needed to specify the model. Since credit spreads are uniquely determined given the current values of the state variables, it follows that credit spread changes are determined by changes in these state variables. (Pieere Collin-Dufresne; Robert S. Goldstein; J. Spencer Martin, the Journal of Finance, Vol 56, No. 6. 2001, pp. 2177-2207)

# 3 Method

*In this chapter we present a discussion about the choice of method and how the study was conducted. The chapter ends with Reliability and validity.*

When we had determined the subject and purpose for this thesis, we decided a proper manner of how to address the dilemma. According to (Sekaran, 2000) research can be described as a systematic and organised effort to describe and analyse a problem and find a solution to it.

In order to fulfil the purpose of this thesis we needed to analyze data. Therefore, a quantitative approach is preferable.

## 3.1 Quantitative and qualitative methods

There are quantitative and qualitative methods that can be used when collecting data. According to (Riley, Wood, and Clark 2000, Bell, 2000) the main point of method is to achieve an insight of the interrelations between events and perceptions in contrast to debatably more objective statistical quantitative methods and the quantitative perspective emphasizes statistical methods of collecting measurable data and the connection between them. A statistical method can be used in order to recognise measure and analyse the interrelations between variables and events. (Ejvegård, 1996)
The purposes of this study it to draw a general conclusion concerning the connection between credit spread and some market factors. Therefore a quantitative approach is suitable since it allows statistical models analysis which can be implied on the entire data.

We chose to use a quantitative statistical method due to the purpose of this study which is to examine whether there is a connection between credit spread and each of these variables (Volatility, S&P 500 INDEX, interest rate level, the slope of the yield curve).

In order to fulfil the purpose of this thesis, the data was accessible from Swedbank Markets through Bloomberg. We used secondary data in this study because it is easily accessible from Swedbank Markets as mentioned before and this allowed us to analyse a larger amount of data within the limited time schedule.

### 3.2 Linear Regression Analysis

As mentioned before in 3.4, we had a number of observations between the time periods April 1997 until February 2007. Totally, we had 513 observations for each of the variables. A linear regression function on SPSS program was used in order to test our hypothesis with the given signs that is presented in the next chapter. We chose this model based on which models have been used successfully in previous studies.

## 3.3 Statistical Method

### 3.3.1 Regression

**Regression** is used to determine how many specific factors such as the price of interest rates, particular industries or sectors influence the price movement of an asset. (Retrieved 2007-04-13 from: //www.investopedia.com /terms/r/regression) Thus, we used regression in order to analyze our data because we found that regression is the most suitable approach for analyzing the data.

A regression is a statistical measure that attempts to determine the strength of the relationship between one dependent variable (usually denoted by Y) and a series of other changing variables (known as independent variables). The two basic types of regression are linear regression and multiple regression. Linear regression uses one independent variable to explain and/or predict the outcome of Y, while multiple regression uses two or more independent variables to predict the outcome. The general form of each type of regression is (Retrieved 2007-04-13 from: //www.investopedia.com /terms/r/regression):

Linear Regression: $Y = a + bX + u$

Multiple Regression: $Y = a + b_1X_1 + b_2X_2 + B_3X_3 + ... + B_tX_t + u$

Where Y is the variable that we are trying to predict, X is the variable that we are using to predict Y, a is the intercept, b is the slope, and u is the regression residual. In multiple regression the separate variables are differentiated by using subscripted numbers.

There are three major regression models, namely, standard or simultaneous, hierarchical and stepwise regression. The choice of technique largely depends on the researcher's goals. (Sheridan J Coakes, 2006)

### 3.3.2 R-square

It is a statistical measure that represents the percentage of a security's movements that are explained by movements in a benchmark index. For fixed-income securities the benchmark is the T-bill, and for equities the benchmark is the S&P 500. R-squared values range from 0 to 100. An R-squared of 100 means that all movements of a security are completely explained by movements in the index. (Retrieved 2007-04-13 from http://www.investopedia.com/terms/r/r-squared.asp)

### 3.3.3 P-Value

Statistical hypothesis testing is traditionally employed to determine if a result is statistically significant or not. This provides a "p-value" representing the probability that random chance could explain the result. In general, a 5% or lower p-value is considered to be statistically significant. P-value, Retrieved 2007-04-13 from http://www.investopedia.com/terms/s/statistically_significant.asp

## 3.4 Overview of Data used in the study

Here, we describe the data arrangement for this study to estimate changes in credit spreads. We also describe the theoretical explanation of data with predicted coefficient signs. The presented data concerning all variables was obtained from Bloomberg through Swedbank Markets for the period April 1997 to February 2007. The data was consisted of weekly observations, giving 513 observations for each of the variables. After a discussion with Swedbank Markets we decided to use weekly data because it might give a long number of observations for the observation period (April 1997 until February 2007). (Swedbank Markets, 2007)

In order to be able to run a regression analysis we needed to define the dependent variables and independent variable.

## 3.5 Dependent and Independent variables

### 3.5.1 The dependent variable

The dependent variable in this study is credit spread. Credit spread can be obtained through different approaches. In this paper, credit spreads ($CS_t^i$) for bond *i* at week *t* were determined by taking the yield for each credit rating (10-year yields for USD A, USD BBB and USD B) and reduce it with the swap yield (USD 10y swap yield) at the same maturity. (Swedbank Markets, 2007) We chose the following approach due to availability of data of USD 10y swap yield and 10-year yields for (USD A, USD BBB and USD B).

### 3.5.2 The independent variables

We chose four independent variables that we believe are suitable to use in a regression analysis. Then, the independent variables were presented by:

1) Volatility of stock market

There is a positive relationship between volatility and credit spreads. With other words, if volatility increases the probability of default also increases. This relationship is supported by previous studies. Collin-Dufresne, Goldstein and Martin (2001) confirmed this theoretical relationship. Ericsson Jacobs and Oviedo (2004) found also a positive relationship between CDS and volatility.

2) S&P500 index values

The relationship between S&P 500 and credit spreads is expected to be positive. (Pieere Collin-Dufresne; Robert S. Goldstein; J. Spencer Martin, the Journal of Finance, Vol 56, No. 6. 2001, pp. 2177-2207) We use weekly S&P 500 values, as proxy and this represents the changes in the situation of the economy.

3) Risk-free rate level (10y government bond yield- rolling 10y yield)

The relation between risk-free rate and credit spread is negative. This is supported by Longstaff and Schwartz (1995). They concluded that a company's assets are expected to grow when interest rate increases and this decreases the probability of default. Therefore this should lower credit spreads. Weekly 10-year Treasury rates data ($r_t^{10}$) was used here.

4) Slope of yield curve

The slope of yield curve is defined as the difference between 10-year government bond yields and 2-year Treasury yields ($r_t^{10} - r_t^2$). This proxy is determined to indicate the condition of the economy and the prediction for the future short rates. (Pieere Collin-Dufresne; Robert S. Goldstein; J. Spencer Martin, the Journal of Finance, Vol 56, No. 6. 2001, pp. 2177-2207) The result of this should indicate a decrease in credit spreads. Thus, there is a negative correlation between the slope of the yield curve and credit spreads. Collin-Dufresne, Goldstein and Martin (2001) corroborate this negative relation in their study.

Volatility of stock market, SP&500 index values, risk-free rate level are significant and there is a correlation between credit spreads and each of these explanatory variables based on the given signs. (Pieere Collin-Dufresne; Robert S. Goldstein; J. Spencer Martin, the Journal of Finance, Vol 56, No. 6. 2001, pp. 2177-2207). This has also been the outcomes in all other research paper we have studied. However, evidence is mixed regarding the slope of yield curve. This variable has been confirmed to be statistically significant in some studies, while other it was not significant in other investigations.

In theory, the independent variables should be able to explain some part of the variation in credit spreads. If one or a few of these variables do not give a reasonable or a weak explanation concerning credit spread, the interpretation should not directly be as imperfection in theories but it might be linked to the data and how variables are used as proxies.

## 3.6 Reliability and Validity

### 3.6.1 Reliability

Reliability is the ability of a test or other selection technique to produce similar results or scores for an individual on separate occasions. (Stone, 2004) The using of data obtained from Bloomberg through Swedbank Markets strengthens the reliability since Bloomberg and Swedbank Markets are arguably respected source of financial information. The information could easily be gathered again from our contact person in Swedbank Markets and compared it with the information presented in the thesis appendices.

### 3.6.2 Validity

Validity is the ability of a test or other selection technique to measure what is set out to measure. (Stone, 2004) Since a quantitative method is used in this thesis the risk of misinterpretation is reduced. A linear regression analysis was used in the thesis. Then, the use of SPSS in order to analyse the data strengthens the validity.

In order to minimize the errors and reduce the risk of excluding or including data that is not related to the selection criteria, a double-checking of data through processing it in the program was performed several times.

# 4 Empirical study

*In this chapter a hypothesis is presented and the results of the study are also presented.*

After deciding the appropriate statistical method we developed a hypothesis to face the dilemma of the thesis and meet the purpose of the thesis.

## 4.1 Hypothesis

As mentioned before in section 2.4, the structural models show whether the theoretical determinants of credit spreads should be positively or negatively correlated with movements in credit spreads. Our assumption is that structural models of credit spreads can explain the spreads observed in our sample. The table below shows the null hypothesis and what kind of the relationship between credit spreads of (CS USDA, CS USDB, CS USDBBB) and the market factors that are chosen in this thesis is presented by the predicted signs. The plus sign implies that there is a positive relationship between credit spreads of (CS USDA, CS USDB, CS USDBBB) and the market factors. On the other hand, the negative sign means that there is a negative relationship between credit spreads of (CS USDA, CS USDB, CS USDBBB) and the market factors.

$H_{0:}$

| Variable | Predicted sign |
|---|---|
| Volatility of stock market ($VIX_t^i$) | + |
| S&P 500 index values ($SP_t^i$) | + |
| Risk-free rate level ($r_t^{10}$) | - |
| Slope of yield curve ($Slope_t^i$) | - |

Table1. Variables and their predicted signs

## 4.2 Model

Our linear regression model was estimated for each sample bond *i* at date *t* with credit spread ($CS_t^i$).

$$(CS_t^i) = B_{0\,t}^{\ i} + B_1^i \, VIX_t^i + B_2^i \, SP_t^i + B_{3t}^{\ i} \, r_t^{10} + B_4^i \, Slope_t^i + e_t$$

## 4.3 Credit spread change

The collection of data was processed by the linear regression model on weekly time series in order to present the relation between credit spreads and the explanatory variables. Table 2 illustrates the output of the model. Complete results in details are found in Appendix 1,2,3 for each credit spread with credit rating A, BBB and B. We have also performed linear regression using other approaches in order to obtain credit spreads but the result of this is not presented here due to simplicity.

| **Credit spreads** | **Volatility of stock market** | **S&P 500 index value** | **Risk-free interest rate** | **Slope of yield curve** | ***R*-square $R^2$ (0,000)** |
|---|---|---|---|---|---|
| **Significant levels, p-value** | **(0,000)** | **(0,000)** | **(0,000)** | **(0,000)** | |
| **CS(USDA)** | **0,012 % = 1,2 bp** | **0,000%** | **-0,096%= -9,6bp** | **0,067 %= 6,7bp** | **0,369= 36,9%** |
| **CS(USDBBB)** | **0,020 %= 2,0bp** | **0,001%** | **-0,175%= -17,5bp** | **0,154%= 15,4bp** | **0,583= 58,3%** |
| **CS(USDB)** | **0,132%= 13,2bp** | **0,002 %** | **-0,319 %= -31,9bp** | **0,394 %= 39,4bp** | **0,605= 60,5%** |

Table 2 shows the outcome of regression model concerning credit spreads, in brackets (significant levels) and the value of R-square.

# 5 Analysis

*In this chapter, the theoretical framework and the empirical data are combined in order to analyze the topic according to the purpose of the thesis.*

We built up our assumption which is presented in 4.1 based on the theory that structural models of credit spreads can explain the spreads observed in our sample. After performing a regression analysis using our data we found that the positive correlations represent the next explanatory variables. For each per cent that the explanatory variables (Volatility of stock market, SP&500) the credit spreads (USDA, USDBBB, and USDB) rise. For each per cent that a risk-free rate level increase, the credit spreads (USDA, USDBBB, and USDB) decrease and this was consistent with our hypothesis in previous chapter, 4.1. On the other hand, for each per cent that slope of yield curve rises, the credit spreads (USDA, USDBBB, and USDB) increase. The latter result was not contrary to our hypothesis.

## 5.1 Credit spread change

According to structural model that is discussed in 2.4, the theoretical determinants of credit spreads should be positively or negatively correlated with movements in credit spreads. This is illustrated in the previous chapter (Table.2). Table.2 shows how the independent variables affect credit spreads and the amount of this affect of each variable.

As one could see in the table above, the first result that the model showed was the significant levels of the explanatory variables were similar; (0.000). A variable is significant if the p-value is less than 5 per cent (0,000 < 0, 05) according to P-value that is presented in 2.5.3 and that was in the case of the independent variables. This implied that there was a kind of correlation between the explanatory variables and credit spreads.

R-Square ($R^2$) is a statistical measure that illustrates the percentage of a security's movements that are explained by change in a benchmark index according to R-square that is presented in 2.5.2. Table 2 in the previous chapter also shows R-square for each variable.

## 5.2 Result of the study

### 5.2.1 Credit spread with credit rating A (CS USDA)

R-square shows how much variation of y-variable in the model could be explained through other variables. In table 2, R-square for (CS USDA) is 36, 9%. This means that 36, 9% of (CS USDA) is explained by using the market factors that we used in our model in 4.2.

P-value shows whether the factors we used are significant or not. It is (0,000) concerning all factors that used to explain (CS USDA) and this means that all these factors are significant.

In table 2 the reader can see that (CS USDA) increases with 1,2 bps (0,012 %) if volatility rises with 100 basic points (1 per cent). (CS USDA) increases with 0.000 bps (0,000%) If S&P 500 rises with 100 basic points (1 per cent). (CSUSDA) decreases with -9,6bp (-0,096%) if interest-free rate increases with 100 basic points (1 per cent). Therefore, the null hypthesis should be accepted, meaning that there is a positive relationship between credit spread of credit rating A and volatility of stock market, S&P500. And a negative relationship between credit spread A and risk-free rate level. The sample size in the test is large enough for making general conclusion with statistical accuracy. These results consistent with the Collin-Dufresne et al. (2001) and was confirmed by Swedbank Markets and (Dr. Olgun Fuat Sahin , Professor-assistant of Finance at John Cook School of Business in St.Louis, USA).

In contrast, as shown in table2, (CS USDA) increases with 6,7bps (0,067 %) if slope of yield curve rises with 100 basic points. Therefore the null hypothesis should be rejected. This result does not consistent with the result of Collin-Dufresne et al. (2001). After a discussion Tomas Hedberg and Rickard Skogsfors (personal meeting, Swedbank Markets, 2007), we assume that the rational explanation is the slope of yield curve is affected by factors such as

macroeconomic that are not mentioned in this paper. There is more complexity in explaining the influence of other factors that affect directly the slope of yield curve and not credit spreads.
The complete results for credit spread related to credit rating A, are found in appendix 1.

### 5.2.2 Credit spread with credit rating BBB (CS USDBBB)

In Table 2 in the previous chapter, the level of significance is (0,000) concerning all factors that used to explain (CS USDBBB) and this means that all these factors are significant. R-square for (CS USDBBB) is 58, 3%. This means that 58, 3% of (CS USDBBB) is explained by using the market factors that we used in our model. ….

In table 2 shows that (CS USDBBB) increases with 2,0bp (0,020 %), if volatility rises with 100 basic points (1 per cent). (CS USDBBB) increases with 0.001 bps (0,001%), if SP&500 rises with 100 basic points (1 per cent). (CS USDBBB) decreases with -17,5bp (-0,175%), if interest-free rate increases with 100 basic points (1 per cent). Hence, the null hypothesis for (CS USDBBB) should be accepted, meaning that there is a positive relationship between credit spread of credit rating BBB and volatility of stock market, S&P500. And a negative relationship between credit spread A and risk-free rate level. These results consistent with the Collin-Dufresne et al. (2001) and was confirmed by Swedbank Markets and (Dr. Olgun Fuat Sahin, Professor-assistant of Finance at John Cook School of Business in St.Louis, USA).
In contrast, as shown in table2, (CS USDBBB) increases with 15,4 bp (0,154 %), if slope of yield curve rises with 100 basic points. Thus, the null hypothesis should not be accepted. This result does not consistent with the result of Collin-Dufresne et al. (2001). After a discussion Tomas Hedberg and Rickard Skogsfors (personal meeting, Swedbank Markets, 2007), we assume that the rational explanation is the slope of yield curve is affected by factors such as macroeconomic that are not mentioned in this paper. There is more complexity in explaining the influence of other factors that affect directly the slope of yield curve and not credit spreads
The complete results for credit spread related to credit rating BBB, are found in appendix 2.

### 5.2.3 Credit spread with credit rating (B CS USB)

The level of significance is (0,000) as shown in table 2, concerning all factors that used to explain (CS USB) and this means that all these factors are significant. R-square for (CS USDB) is 60,5%. This means that 60,5%.of (CS USDB) is explained by using the market factors that we used in our model in 4.2.

In table 2 shows that (CS USDB) increases with 13,2bp (0,132%) if volatility rises with 100 basic points (1 per cent). (CS USDB) increases with 0.002bps (0,002%) if SP&500 rises with 100 basic points (1 per cent). (CS USDB) decreases with -31,9bp (-31,9%) if interest-free rate increases with 100 basic points (1 per cent). Hence, the null hypothesis for (CSUSDB) should be accepted, meaning that there is a positive relationship between credit spread of credit rating BBB and volatility of stock market, S&P500. And a negative relationship between credit spread A and risk-free rate level. These results consistent with the Collin-Dufresne et al. (2001) and was confirmed by Swedbank Markets and (Dr. Olgun Fuat Sahin, Professor-assistant of Finance at John Cook School of Business in St.Louis, USA).

In contrast, as shown in table2, (CS USDB) increases with 39,4bp (0,394%), if slope of yield curve rises with 100 basic points. Thus, the null hypothesis should not be accepted. This result does not consistent with the result of Collin-Dufresne et al. (2001). After a discussion Tomas Hedberg and Rickard Skogsfors (personal meeting, Swedbank Markets, 2007), we assume that the rational explanation is the slope of yield curve is affected by factors such as macroeconomic that are not mentioned in this paper. There is more complexity in explaining the influence of other factors that affect directly the slope of yield curve and not credit spreads

The complete results for credit spread related to credit rating B are found in appendix 3.

# 6 Conclusions

*This chapter reviews the conclusion of the thesis. The purpose of the thesis is fulfilled through the analysis in the previous chapter. Finally, suggestions for further studies are presented.*

In this study, the purpose was to describe and analyze the driving forces of the following factors (volatility, S&P 500, interest-rate level and the slope of yield curve) behind credit spreads and the main reasons beyond the choice of this subject were there has not been much research about credit spread and also, it is a highly actual subject, availability of data and also personal interest that influenced our choice of topic.

In this paper, we studied some factors that might affect changes in credit spreads on individual bonds with different ratings (A, BBB, B). We found that the factors we processed in the linear regression model were significant and could explain the changes in credit spreads. This led us to conclude that we used significant variables to fulfil the purpose of this thesis.

The correlation between the explanatory variables and credit spreads in this study were consistent to our hypothesis and previous studies. However, the relationship between the slope of yield curve and credit spreads were positive. Therefore, the null hypthesis regarding this relationship was rejected. One of the main reasons that this was not consistent to our hypothesis is due to the affect of the factors such as macroeconomics as mentioned in the previous chapter.

We concluded that aggregate factors included in risk-free interest rate and slope of the yield curve appeared much more significant than firm-specific factors as SP&500. This implies that aggregate factors have more impact on changes of credit spreads.

We also found that relation between volatility, SP&500, risk-free interest rate and slope of yield curve increased in strength as we move down the ratings. The increase of the correlation between SP&500 and credit spreads was not clear despite the model showed that SP&500 was a significant variable.

We assume that the statistical model used in this paper is valid since the results obtained of it are confirmed by Dr. Ghazi Shukur (Professor of Statistics in Jonkoping International Business School).

We believe that the result of the study is truthful based on the statistical method that we used and since the results were confirmed by Tomas Hedberg and Rickard Skogsfors in Swedbank Markets. (Personal meeting, Swedbank Markets, 2007)

## 6.1 Fulfilment of the purpose

The purpose was fulfilled since the research question of the thesis was answered. The question was answered by using a suitable statistical model (linear regression) and statistically proving that there are a relationship between the market factors and credit spread for three different credit rating (A, BBB, B) in this study.

## 6.2 Further Research

Due to the limited time, we could not analyse all factors that can be assumed to affect credit spreads for different credit ratings and analyze it from different perspectives. Therefore we believe with this in mind, it would be interesting to scrutinize the factors affecting credit spreads further. An especially interesting topic could be to study different regression models and process different market factors in those models and see if the statistical results of this kind of studies differ from our result in this thesis. It could also be interesting to analyse credit spread with respect to different market factors in the U.S. bond market and the Swedish bond market in terms of change, size and different credit ratings.

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# Appendix 1

## Credit spread with credit rating A

**Variables Entered/Removed(b)**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500(a) | . | Enter |

a All requested variables entered.
b Dependent Variable: **CSA**

**Model Summary(b)**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,607(a) | **,369** | ,364 | ,15217 |

a Predictors: (Constant), SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500
b Dependent Variable: **CSA**

**ANOVA(b)**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 6,888 | 4 | 1,722 | 74,366 | ,000(a) |
| | Residual | 11,786 | 509 | ,023 | | |
| | Total | 18,674 | 513 | | | |

a Predictors: (Constant), SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500
b Dependent Variable: **CSA**

**Coefficients(a)**

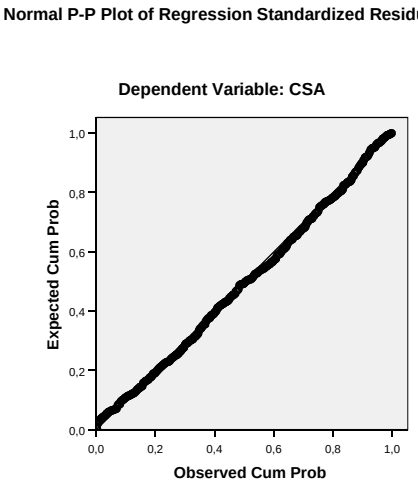
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | ,112 | ,090 | | 1,246 | ,213 |
| | **VOLATILITY** | ,012 | ,001 | ,422 | 10,498 | **,000** |
| | **SP500** | ,000 | ,000 | ,325 | 6,843 | **,000** |
| | **GOGOV10** | -,096 | ,011 | -,397 | -8,825 | **,000** |
| | **SLOPEYILEDCURVE** | ,067 | ,010 | ,339 | 6,728 | **,000** |

a Dependent Variable: **CSA**

**Residuals Statistics(a)**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | -,0222 | ,6259 | ,3517 | ,11588 | 514 |
| Residual | -,44671 | ,51077 | ,00000 | ,15158 | 514 |
| Std. Predicted Value | -3,226 | 2,366 | ,000 | 1,000 | 514 |
| Std. Residual | -2,936 | 3,357 | ,000 | ,996 | 514 |

a Dependent Variable: **CSA**



# Appendix 2
# Credit spread with credit rating BBB

**Variables Entered/Removed(b)**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500(a) | . | Enter |

a All requested variables entered.
b Dependent Variable: **CSBBB**

**Model Summary(b)**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,764(a) | **,583** | ,580 | ,18913 |

a Predictors: (Constant), SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500
b Dependent Variable: **CSBBB**

**ANOVA(b)**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 25,492 | 4 | 6,373 | 178,162 | ,000(a) |
| | Residual | 18,207 | 509 | ,036 | | |
| | Total | 43,699 | 513 | | | |

a Predictors: (Constant), SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500
b Dependent Variable: **CSBBB**

**Coefficients(a)**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | ,139 | ,112 | | 1,242 | ,215 |
| | **VOLATILITY** | ,020 | ,001 | ,482 | 14,772 | **,000** |
| | **SP500** | ,001 | ,000 | ,501 | 12,968 | **,000** |
| | **GOGOV10** | -,175 | ,014 | -,473 | -12,926 | **,000** |
| | **SLOPEYILEDCURVE** | ,154 | ,012 | ,509 | 12,434 | **,000** |

a Dependent Variable: **CSBBB**

**Casewise Diagnostics(a)**

| Case Number | Std. Residual | CSBBB | Predicted Value | Residual |
|---|---|---|---|---|
| 191 | 3,021 | 1,31 | ,7387 | ,57133 |
| 264 | 3,004 | 1,41 | ,8418 | ,56819 |

a Dependent Variable: **CSBBB**

**Residuals Statistics(a)**

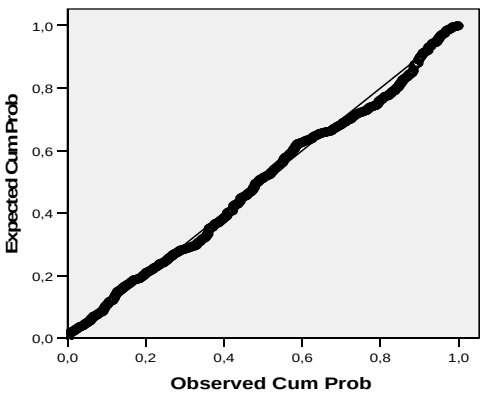
| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | ,0382 | 1,2561 | ,8070 | ,22292 | 514 |
| Residual | -,53831 | ,57133 | ,00000 | ,18839 | 514 |
| Std. Predicted Value | -3,449 | 2,015 | ,000 | 1,000 | 514 |
| Std. Residual | -2,846 | 3,021 | ,000 | ,996 | 514 |

a Dependent Variable: **CSBBB**

**Variables Entered/Removed(b)**

**Normal P-P Plot of Regression Standardized Residual**

**Dependent Variable: CSBBB**



# Appendix 3

# Credit spread with credit rating B

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500(a) | . | Enter |

a All requested variables entered.
b Dependent Variable: **CSB**

**Model Summary(b)**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | ,778(a) | **,605** | ,602 | ,71842 |

a Predictors: (Constant), SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500
b Dependent Variable: **CSB**

**ANOVA(b)**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 403,063 | 4 | 100,766 | 195,234 | ,000(a) |
| | Residual | 262,709 | 509 | ,516 | | |
| | Total | 665,772 | 513 | | | |

a Predictors: (Constant), SLOPEYILEDCURVE, VOLATILITY, GOGOV10, SP500
b Dependent Variable: **CSB**

**Coefficients(a)**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -,439 | ,425 | | -1,034 | ,302 |
| | VOLATILITY | ,132 | ,005 | ,798 | 25,132 | ,000 |
| | SP500 | ,002 | ,000 | ,329 | 8,758 | ,000 |
| | GOGOV10 | -,319 | ,051 | -,221 | -6,220 | ,000 |
| | SLOPEYILEDCURVE | ,394 | ,047 | ,332 | 8,338 | ,000 |

a Dependent Variable: CSB

**Casewise Diagnostics(a)**

| Case Number | Std. Residual | CSB | Predicted Value | Residual |
|---|---|---|---|---|
| 191 | **3,351** | 5,98 | 3,5723 | 2,40773 |

a Dependent Variable: **CSB**

**Residuals Statistics(a)**

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | 1,6205 | 6,2621 | 3,5711 | ,88640 | 514 |
| Residual | -1,84382 | 2,40773 | ,00000 | ,71561 | 514 |
| Std. Predicted Value | -2,201 | 3,036 | ,000 | 1,000 | 514 |
| Std. Residual | -2,566 | 3,351 | ,000 | ,996 | 514 |

a Dependent Variable: **CSB**

**Normal P-P Plot of Regression Standardized Residual**